RADIOACTIVE WASTE MANAGEMENT

Presented to Parliament by the Secretary of State for the Environment, the Secretary of State for Scotland and the Secretary of State for Wales by Command of Her Majesty
July 1982

LONDON
HER MAJESTY'S STATIONERY OFFICE
£2.70 net

Cmnd. 8607

RADIOACTIVE WASTE MANAGEMENT

INTRODUCTION

1. The responsibilities for civil radioactive waste management policy, whether in the context of nuclear power or from other waste sources, lie with the Secretary of State for the Environment, together with the Secretaries of State for Scotland and Wales. This responsibility is exercised in close consultation with the Secretary of State for Energy and other Ministers who have responsibilities for radioactivity. The Secretary of State for Northern Ireland controls the use and disposal of radioactive substances in Northern Ireland.

2. In response to the Sixth Report of the Royal Commission on Environmental Pollution[1], a White Paper, Nuclear Power and the Environment, was published in 1977[2]. It announced a number of steps to deal with the problems presented by wastes from the nuclear industry and set out the position of the then government. It was contemplated that a further White Paper would be published when action under some of these headings was further advanced. This White Paper sets out the present situation, explains what has been done, and describes the next steps that need to be taken by the government and the industry.

3. It is in four sections:

i. paras 4-12 give a brief description of the nature of radioactive wastes, their significance in relation to natural radioactivity, and the general objectives of waste management;

ii. paras 13-26 describe what has been achieved, the role of the Radioactive Waste Management Advisory Committee (RWMAC), the expansion of research, and the conclusions from the review of existing controls;

iii. paras 27-50 describe the present position for each major category of waste, including relevant current action and research, and also deal with transport and decommissioning;

iv. paras 51-69 identify what the next steps are. Research and development must continue; shallow land burial and the carefully controlled disposal of certain wastes to the sea will continue to play a role; and, for some wastes, new disposal facilities are needed at an early date. For others, the appropriate course of action at the moment is properly controlled storage. New developments are also required in organisation. Throughout, the public must be kept fully informed about what is being done, and there must be proper scope for public discussion.

Hear, hear.

THE NATURE AND MANAGEMENT OF RADIOACTIVE WASTES

4. Many natural materials, including our own bodies, are slightly radioactive. In addition, almost any material can be made radioactive by a nuclear reactor or a particle accelerator. Radioactive materials can be used beneficially in

1. Royal Commission on Environmental Pollution (Chairman Sir Brian Flowers). Sixth Report, Nuclear Power and the Environment. Cmnd 6618.

2. Nuclear Power and the Environment. The Government's response to the Sixth Report of the Royal Commission on Environmental Pollution. Cmnd 6820.

The main aim

medicine, industry, research and domestic products. They are also a by-product of the generation of nuclear power. All these uses of radioactive substances give rise to residues which cannot be processed for reuse and therefore have to be disposed of. These residues are *radioactive wastes.*

5. It should be emphasised that the term "radioactive wastes" covers materials with a very wide range of levels of radioactivity and toxicity, from those that are quite insignificant to those which require stringent and elaborate precautions. The following table shows the radioactivity levels of a number of typical waste types arising from the operations of Magnox power stations and from reprocessing:

Waste type	*Specific activity, Ci/m³*	
	α	$\beta\gamma$
Fuel element debris	0	2
Graphite debris	0	6
Ion exchange material (power station)	0.02	140
Sludges (power station)	2	50
Ion exchange materials (reprocessing)	2	5000
Plutonium contaminated materials	10	360β
Pond sludges (reprocessing)	20	600
Fuel cladding wastes	25	3000
Heat-generating wastes	500	700000

In framing policy, it is convenient to use the following categories:

i. *low-level*: those wastes with a low level of radioactivity (many of them from sources other than the nuclear industry or the generating boards) which can be safely disposed of by existing routes, the arrangements depending on the particular level and type of radioactivity;

ii. *intermediate-level*: the term often used for those wastes which at present can be safely stored but for which disposal facilities are not at present available and which do not fall within iii.

iii. *heat-generating*: wastes in which the temperature may rise significantly as a result of rapid radioactive decay, so that this factor has to be taken into account in designing disposal facilities. In the UK these are the highly active liquid residues arising from the first stage of the reprocessing of spent reactor fuel. While they have a much higher level of radioactivity, the total volume involved is considerably smaller than for either i or ii.

6. A general description of the different types of radioactive waste, and the scale on which they arise, was given in the report of an Expert Group[1] appointed by the Department of the Environment (DOE) with a membership drawn mainly from the regulatory bodies, the nuclear industry and the generating boards. In the case of wastes from nuclear power, DOE has compiled a more detailed inventory covering both existing wastes and those expected to be produced up to 2000. This inventory will be extended beyond that date where appropriate, and is now being expanded to include wastes resulting from the

1. Department of the Environment, Scottish Office, Welsh Office. A Review of Cmnd 884: The Control of Radioactive Wastes. DOE, September 1979. Available from Department of the Environment.

decommissioning of plant. Detailed surveys of current discharges of waste and their impact have been published by the Environment Departments[1] and the Ministry of Agriculture, Fisheries and Food (MAFF)[2], and data will continue to be published annually.

7. One basic characteristic of radioactivity, which actually assists in waste management, is that it decays over time. The rate of decay (which is expressed in terms of "half-life") varies from one chemical element to another, and from isotope to isotope of any given element. For many isotopes this is a rapid process. However, there are some isotopes with half-lives measured in thousands of years and, although that also means their activity is less concentrated, their relatively long lives must be taken into account in the management of wastes containing such isotopes. There are also considerable variations in intrinsic toxicity between one radioactive substance and another. Figure 1 shows how two measures of the hazard represented by spent reactor fuel, the external radiation dose rate and the consequences if the materials were consumed or inhaled, decrease over time.

8. Techniques have been developed to detect and measure extremely low levels of radioactivity and a great deal is known about the pathways of radioactive substances in the environment, which are what would determine the likely consequences of disposal. An estimated 78 per cent of the radiation received by the population of the United Kingdom is from natural sources, and a further 21 per cent from medical uses. The amount received from all other uses is very small, about 1 per cent, and the amount caused by the discharge of radioactive wastes to the environment is only 0.1 per cent of the total. Proposals to bury radioactive wastes have to be viewed in the perspective of the very large amounts of radioactivity already present in the ground in the form of naturally-occurring radioactive substances.

9. The use of radioactive substances and the generation of nuclear power have for a number of years been subject to comprehensive statutory controls in order to protect the public. All disposals of radioactive wastes require the authorisation of the appropriate government departments under the Radioactive Substances Act 1960. The aim of government policy is that the total contribution to radiation exposure from radioactive wastes should remain very small, even though the use of nuclear power increases. The aim is also that the radiation doses received by individuals, which of course vary, must be kept well within acceptable limits.

10. The recommendations of the International Commission on Radiological Protection (ICRP), an independent scientific body, are the internationally accepted standard for the protection of radiation workers and members of the population who are exposed to man-made radiation sources. In 1977 ICRP published a major review of its recommendations and these provide the basis for a European Community Directive made in 1980 under the Euratom Treaty which lays down basic safety standards for the health and protection of workers

1. Annual Survey of Radioactive Discharges in Britain. Available from Department of the Environment, Room A502, Romney House, 43 Marsham Street, London SW1P 3PY.
2. Annual Survey of Radioactivity in Surface and Coastal Waters. Available from MAFF Directorate of Fisheries Research, Pakefield, Lowestoft, Suffolk.

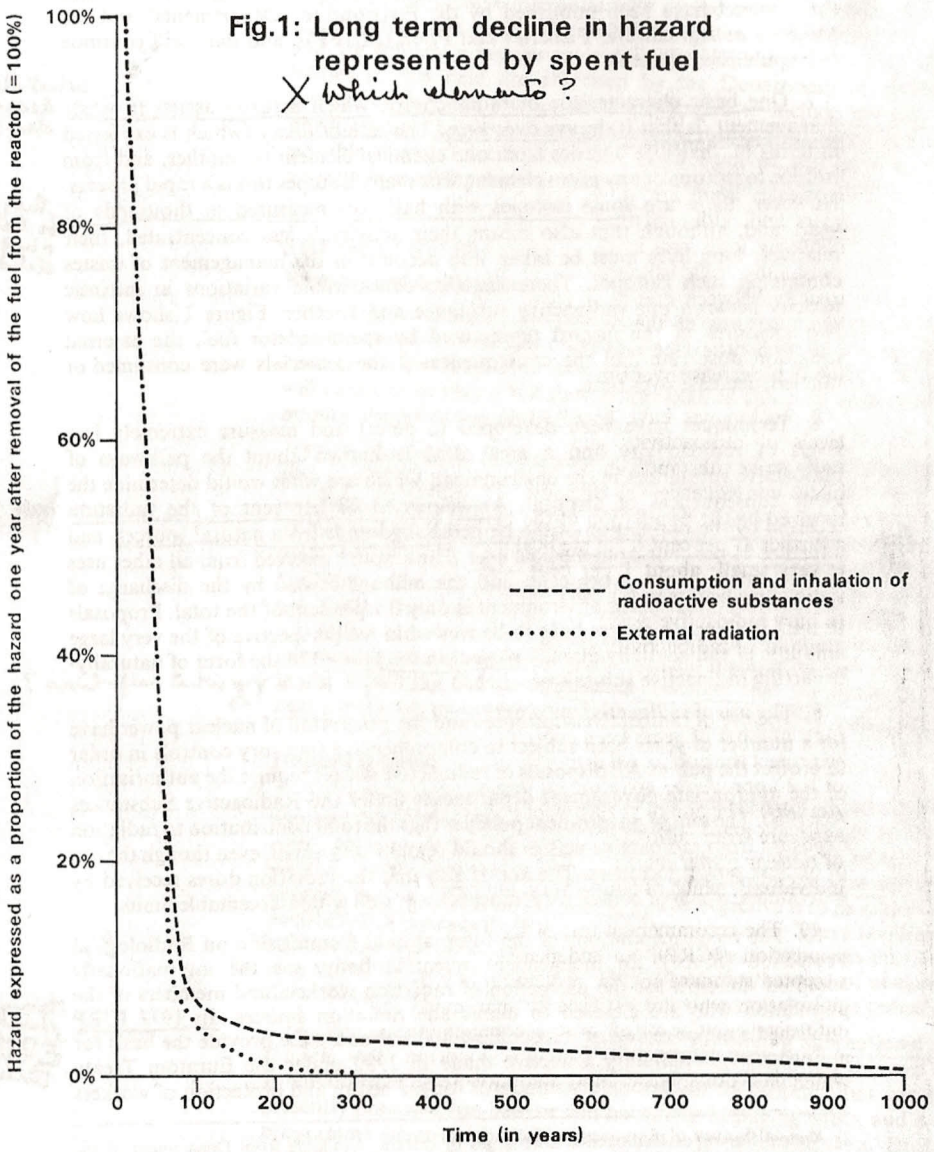

Fig.1: Long term decline in hazard represented by spent fuel

X Which elements ?

and the general public against the dangers of ionizing radiation. The requirements of the Directive are already largely met in the UK by existing legislation. Implementation of the remaining Directive provisions will be achieved by means of revised Ionising Radiations Regulations which are being prepared by the Health and Safety Commission under the Health and Safety at Work etc Act 1974 and other legislative or administrative measures taken by the Departments of Trade, Health and Social Security, and the Environment.

11. The Expert Group mentioned in paragraph 6 recommended in 1979 that the objectives of radioactive waste management in the UK should be based on the ICRP system of dose limitation, as expanded and interpreted by the National Radiological Protection Board (NRPB), who have the duty of providing the government with advice on ICRP's recommendations and proposed European legislation. The government accepts the objectives as formulated by the Expert Group, which are set out in full in the Annex to this White Paper. Two essential features of these objectives are that any practice giving rise to radiation exposure must be justified in terms of its overall net benefit to society; and that all exposures should be reduced to levels which are as low as reasonably achievable, economic and social factors being taken into account. The objectives will be kept under review in the light of advice from RWMAC and NRPB.

Not the same as acting on them.

There are both deleterious.

12. The government attaches great importance to the safe and effective management of radioactive wastes, As a result of research undertaken in this and other countries over the last five years, there is no evidence of any major scientific problems and the government has concluded that it is feasible to manage and dispose of all the wastes currently envisaged in the UK, in acceptable ways. There is an extensive body of existing knowledge about the technology involved. In some respects this will have to be further refined and developed, and the necessary work is in hand. The main task, however, is to identify the most appropriate of the methods available to us for each category of waste, and then ensure that this method is implemented according to an agreed programme and in a way that meets the objectives for radiological protection.

??? X

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Why wasn't all this done before a single reactor was built?

ACTION SO FAR

X

13. As set out in the 1977 White Paper, the main elements in the responsibility of the Environment Secretaries of State for the management of wastes from nuclear power are to:

i. ensure that the creation of wastes from nuclear activity is minimised;

ii. ensure that waste management problems are dealt with before any large nuclear programme is undertaken;

|| Hear hear

iii. ensure that the handling and treatment of wastes is carried out with due regard to environmental considerations;

iv. secure the programmed disposal of waste accumulated at nuclear sites;

v. ensure that there is adequate research and development on methods of disposal;

Hear hear

vi. secure the disposal of wastes in appropriate ways at appropriate times and in appropriate places.

Can't be done. Nothing is "appropriate" for HLW except that creating it.

R.C. says in perpetuity.

It was considered important that this responsibility should be given to government departments which have the primary function of safeguarding the environment and that it should be independent of the responsibilities for promoting nuclear power.

14. As noted in the 1977 White Paper, the Secretary of State for Defence remains responsible for the management of radioactive wastes from the defence programme, and the publication of information about these has to be restricted for security reasons. However, there is close liaison between the Ministry of Defence (MOD) and the relevant civil Departments in order to ensure that the standards applied within MOD are at least as rigorous as those observed by civil organisations and that the disposal of both kinds of wastes, taken together, is environmentally acceptable. The amounts of radioactive wastes from the defence programme are in fact relatively small, and the problems they pose are broadly similar to those posed by civil wastes. Information about discharges to the environment from MOD establishments is included in the published data.

15. In research and other related matters DOE acts on behalf of the three Secretaries of State, in close liaison with the Scottish and Welsh Offices and the Department of the Environment for Northern Ireland, and in collaboration with MAFF. It has recruited the necessary technical staff for that purpose, and the Radiochemical Inspectorate (RCI) has been significantly strengthened. There are equivalent inspection duties undertaken in Scotland, by HM Industrial Pollution Inspectorate (HMIPI), and in Northern Ireland, by the Alkali and Radiochemical Inspectorate (ARCI).

16. The Radioactive Waste Management Advisory Committee, which was set up in accordance with a recommendation of the Royal Commission, provides advice on major issues relating to the development and implementation of overall policy, and the environmental aspects of the handling and treatment of wastes. The Committee is made up predominantly of independent members with relevant backgrounds or expertise, and also includes members from the nuclear industry, CEGB and the relevant trade unions. It publishes annual reports.[1]

17. Waste management is one of the factors to be taken into account in the design of nuclear systems, and it is important that this should be done at a sufficiently early stage. For this purpose, in England and Wales the RCI (in consultation with MAFF) and in Scotland the HMIPI maintain close links with the Nuclear Installations Inspectorate (NII) of the Health and Safety Executive (HSE) in order to be in a position to assess, and give a view on, the waste management aspects of proposals for new plant or processes submitted to NII by nuclear site operators under the Nuclear Installations Act 1965. These close links also extend to the waste management implications of proposed modifications to nuclear plant or its method of operation, and to continuing work on the safety of the treatment and storage of wastes. Liaison on these subjects includes MAFF as the Department jointly responsible with DOE for authorising discharges of wastes from nuclear sites in England. There is also

1. Radioactive Waste Management Advisory Committee. First Annual Report, HMSO 1980; Second Annual Report, HMSO 1981; Third Annual Report, HMSO 1982.

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direct contact, as appropriate, between RWMAC and the Advisory Committee on the Safety of Nuclear Installations (ACSNI), which gives independent advice to the Health and Safety Commission and when appropriate to Ministers.

18. The government has reviewed the adequacy of the research effort on waste management and disposal, and the methods used for the control of this research programme. Adjusted to today's prices, the size of the DOE-funded programme has increased from £5.0 million in 1978/79 to £9.8 million in 1982/83 and it has become the largest subject area in the DOE programme. At a time when economies have been necessary in expenditure on a number of other research programmes, this increase indicates clearly the importance the government attaches to its responsibilities in this field. The major topics for research are mentioned below. The report of the initial review was published, and has recently been followed by a detailed progress report,[1] as part of the general policy of making the results from the programme publicly available. The structure of the programme has also been changed in order to relate it more closely to the policy objectives set out in paragraph 13 above. The MAFF-funded programme has similarly increased from £1.5 million in 1978/79 to £2.3 million in 1982/83.

19. RWMAC is consulted each year about the proposals for the following year's research programme, and also from time to time in more depth about particular areas of the programme, although it is not practicable or appropriate to give it executive functions. Consultation also takes place with the nuclear industry and the generating boards in order to ensure that there is a proper relationship between the various research programmes, avoiding unnecessary duplication or any gaps. Broadly speaking, the DOE programme consists of research necessary for the Department's functions and a certain amount of basic and generic research. Control of basic and generic research carried out by the United Kingdom Atomic Energy Authority (UKAEA) has been transferred to DOE and in these areas UKAEA now works under contract to DOE. DOE is also responsible, with MAFF, for initiating and co-ordinating research on radioactivity in the environment and its pathways to man.

20. Although much of the relevant expertise and facilities has traditionally lain in the public sector, the government has sought to increase the proportion of research undertaken by the private sector, in the belief that this will bring about long term benefits both for the continuing quality of the research and for British industry. In 1981/82 nearly a third of the DOE programme (by value) was carried out in the private sector.

21. The arrangements for monitoring radioactivity in the environment have been reviewed. The report of this review[2] concluded that there were no important gaps in the arrangements and that the main objectives of environmental moni-

1. Department of the Environment. Review of Research on Radioactive Waste Management and Radioactivity in the Environment. Departments of the Environment and Transport Research Report 32, 1979; Department of the Environment. DOE-Sponsored Research on Radioactive Waste: a Progress Report. Pollution Report 12, 1981.
2. State-of-the-Art Review of Radioactivity Monitoring Programmes in the United Kingdom. A Report by the Radioactivity Monitoring Management Group.

toring were being met. Some areas for improvement were identified and the necessary work is in hand.

22. The Environment Departments have set in hand, in consultation with the nuclear industry, the generating boards and other organisations, the preparation of an overall long-term strategy for the management of wastes, including those at present stored at nuclear sites. Information for this purpose has been derived from the waste inventory, which will be kept under review, The research programme includes studies designed to bring out relevant management options, and also studies which will assist in formulating the criteria by which these options will have to be assessed. A systems engineering study which is being carried out by DOE will make it possible to take into account the implications of different approaches to managing wastes, and to evaluate the radiological and financial costs of alternative storage and/or disposal options for particular streams of waste. The study will be continuously updated, as further information becomes available. The conclusions from the initial work are taken into account in this White Paper.

23. As criteria for waste management are formulated they will be set out in a new series of notes to be produced by DOE, after consultation with RWMAC. The first of these sets out interim guidelines for packaging radioactive wastes.[1]

24. One element in the responsibility placed on the Environment Secretaries of State by the 1977 White Paper was to ensure that waste management problems are dealt with before any large nuclear programme is undertaken. The government believes that appropriate solutions to the wastes problem are available with the use of present science and technology, and work is directed towards refining and assessing them. The expectation now is that nuclear capacity will grow at a much more moderate rate than was envisaged in 1977. The types of facility which will be needed for wastes already accumulated will also, broadly speaking, serve for future wastes. Waste management is not therefore a barrier to the further development of nuclear power as now foreseen.

25. In the long term the fast breeder reactor has the potential to provide a means of obtaining power from the plutonium recovered from reprocessed spent fuel. The government's policy objective is to ensure that the UK has the ability to build fast reactors when needed, although this is likely to be some years away. Any decision to proceed with a commercial demonstration fast reactor would be subject to a wide-ranging public inquiry.

26. A review of the arrangements for the control of all types of radioactive wastes, by the Expert Group mentioned in paragraph 6 above, was already in hand at the time of the 1977 White Paper. The general conclusion, which has been endorsed by RWMAC, was that those disposal routes which already exist for radioactive wastes are acceptable and should continue to be used, if necessary on an increasing scale. The report pointed to the need to avoid over-elaborate arrangements not required for radiological protection. At the same time, it

1. Radioactive Waste Management Information Note No 1—Packaging Radioactive Wastes. Department of the Environment, 1982.

identified a number of points where the existing arrangements need to be extended or elaborated, and this work is in hand. The relevant conclusions of the review have been reflected in a new guide to the administration of the 1960 Act[1], which has replaced the previous Explanatory Memorandum published in 1963.

THE PRESENT POSITION

Heat-generating wastes

27. By far the largest part of the radioactivity with which we are concerned for waste management purposes is contained in the heat-generating wastes and public attention has focused on these. As already explained (paragraph 5(iii)), these wastes are separated out in the course of reprocessing spent nuclear fuel. For magnox fuel (for which there is the additional factor that the fuel casing corrodes when stored in water), the reprocessing programme has been operating since the early 1950's, and has dealt with over 20,000 tonnes of fuel. Oxide fuel from the AGR stations is being stored in ponds at Sellafield until the Thermal Oxide Reprocessing Plant (THORP) of British Nuclear Fuels Limited (BNFL) is commissioned. The construction of this plant was approved by the government following the Windscale Public Inquiry in 1977 and it is expected that it will be completed in 1990.

28. Heat-generating wastes have been safely stored in cooled stainless steel tanks at Sellafield for more than 25 years. The volumes involved are small: 1,000m^3, plus a rather smaller volume at lower concentration at Dounreay which results from research and development on fast reactors. However storage in a solid form is more cost-effective in respect of the protection required, and such a form is also more suitable for eventual transport and disposal. Work is going ahead on the design of a vitrification plant at Sellafield, which will convert the wastes from the liquid form to glass blocks within metal containers, and which is expected to come into operation in 1987. They will then be placed in a store of the kind already in use at Marcoule in France.

29. In the case of these wastes, there are important advantages in being able to delay operations to allow for radioactive decay. Thus for present power stations the transport of spent fuel to Sellafield for reprocessing is not undertaken until at least 90 days after it is removed from the reactor, and there is a further delay before it is reprocessed. Vitrification, however, should take place as soon as practicable after reprocessing in order to minimise the volumes of wastes held in liquid form. In the light of further work carried out since the 1977 White Paper, it is now envisaged that vitrified wastes will be stored at the surface for a period of at least 50 years. By the end of that period, heat generation and radiation will be much reduced because the shorter-lived radionuclides will have decayed. This would greatly simplify disposal, although some heat will continue to be generated as a result of the remaining radionuclides. But (as RWMAC

1. Department of the Environment, Scottish Development Department, Department of the Environment for Northern Ireland, Welsh Office: Radioactive Substances Act 1960. Guide to the Administration of the Act. HMSO 1982.

have emphasised) to say that there are technical advantages in deferring disposal is not to say that storage is a substitute for disposal.

30. In leaving the decision on disposal to a future generation, we in the present generation have a clear moral duty to formulate the options as we see them at present, and to develop the supporting scientific and technical knowledge, so that they will be better placed than we are to make the eventual choice. Moreover, it is desirable to ensure as far as possible that the vitrified blocks produced are compatible with the eventual management systems. This is to avoid the need for repackaging and other operations at a later stage, which, as well as being expensive, would involve contamination and exposure to radiation. Financial provision is being made in advance for the future costs of waste management, but it is important to gain sufficient knowledge to ensure that the scale of this has been correctly assessed.

31. The practicable options for disposal are already clear in outline, and were identified by the Royal Commission: burial deep underground, or emplacement on or under the ocean bed. There has been extensive research in a number of countries into geological disposal, and its feasibility has been established in principle. DOE will be publishing a comprehensive review of the relevant studies. The UK programme is now concentrating on checking the applicability of findings from other countries to UK conditions. Research is continuing into the other disposal options in order to bring knowledge about them to the same level. At the same time studies are also taking place in order to determine what would be the maximum safe lifetime (without major reconstruction) for various possible forms of store. Why not come out in the open about Christ keeping?

32. Another approach which has been advocated is to convert the liquid wastes into a solid material other than a glass. The work done on solidification processes and products in other countries, and findings on the properties of the various types of materials, are kept under review, but alternative processes are not yet available on a commercial scale. Meanwhile criticisms of the durability of the glasses produced by vitrification have not been substantiated and RWMAC have advised that it is right to proceed with the vitrification plant at Sellafield. Why has HARVEST been abandoned then?

33. Another alternative would be the separation of the long-lived actinides (the constituents of the waste that remain hazardous for longest) from the relatively short-lived fission products, and destruction of those actinides by fission as a result of irradiation in a reactor. Although technically possible, present indications are that this would involve additional exposure of the workforce and be very costly. It is not therefore a topic included in the UK research and development programme. However, the UK has participated in a programme by the International Atomic Energy Agency (IAEA) to assess this technique: we have available the results of research funded by the European Community; and the UKAEA is providing irradiation facilities for US research.

34. As reprocessing is currently undertaken on a commercial scale only by the UK and France, BNFL have been able to acquire valuable additional business by reprocessing spent fuel from other countries. All overseas contracts made since 1976 have included an option for BNFL to return the wastes from these operations to the country of origin. Unenforceable.

Only Magnox at present.

Intermediate-level wastes

35. The term "intermediate-level wastes" is used for convenience to cover a wide variety of wastes produced by the nuclear industry and the generating boards, in the form of sludges, fuel element cladding, ion exchange resins and various sorts of debris. While they generally have a much lower level of radioactivity than heat-generating wastes, some of it may be long-lived and the total volume involved is much greater. At present there are 35,000m³ of such wastes and by the year 2000 the cumulative total will be about 70,000m³, excluding any such wastes that may arise from decommissioning of plant.

36. The lack of suitable disposal facilities for intermediate-level wastes is the major current gap in waste management, and it is important that it should be remedied. The types of wastes that can be accepted at any given facility will depend upon the details of the eventual design, and the packaging of the wastes, and it is not therefore possible to say with certainty at this stage how many facilities will be required. Work is now proceeding on the basis of bringing into operation by the end of the decade facilities which should be able to accept a high proportion of the wastes suitable for disposal. The probable forms are an engineered trench at a depth of about 20-30 metres, and a modified mine or purpose-built cavity at greater depth.

37. In addition to the work now proceeding, field studies will be required before detailed proposals for specific facilities can be drawn up. Before any development requiring planning permission takes place the normal procedures, which include provision for public inquiries, will apply, The construction and operation of a storage and disposal facility will require a licence from NII as a nuclear site for the purposes of the 1965 Act. Its use for disposals will require appropriate authorisations under the 1960 Act. The question of who should be responsible for promoting, constructing and operating such facilities is dealt with later in this White Paper.

Low-level wastes

Solid

38. Disposals of low-level wastes take place in solid, liquid or gaseous form. Solid wastes in this category come not only as miscellaneous rubbish from the nuclear industry and the generating boards but also from a variety of medical, research and industrial sources. Satisfactory disposal routes have already been established for them, involving (according to the level and type of radioactivity, and the origin) disposal with ordinary refuse, disposal at a landfill site subject to certain specified precautions, burial on the site at which the wastes originate, burial in a trench at a specially designed site, or disposal at sea. The activity limits appropriate to each method are set out in the Guide to the Administration of the 1960 Act.

39. The use of the sea for the disposal of solid wastes is controlled by an international convention (the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter), and takes place under a consultation and surveillance mechanism operated by the Nuclear Energy Agency (NEA) of the Organisation for Economic Co-operation and Development (OECD). The

present site used for the purpose is about 500 miles south-west of Lands End: its use was last reviewed in 1979 by the NEA, which concluded that it could safely continue to be used until at least the next review in 1984.

40. There is at present only one site generally available to waste producers for trench burial: the site at Drigg in Cumbria owned and operated by BNFL. Following the report of the Expert Group, discussions have taken place with BNFL and CEGB about methods of making more economical use of Drigg by processing waste to reduce its volume. Incineration has proved technically and economically unsatisfactory in this particular case, and the implications of compaction are now being examined. The government does not consider that there is any need at present to revise the authorised limits for disposal at Drigg but the position will be kept under review.

41. The government has accepted the recommendation of the Expert Group that, in view of the remote location of Drigg and the extent to which it will be required for BNFL's own wastes, additional sites suitable for burial of this type of waste should be identified.

42. Where wastes are of lower activity, so that they can safely be buried on an ordinary landfill site, subject only to certain specified precautions, there is a statutory duty on local authorities to accept such wastes on sites which they provide. There are also a number of disposals of such wastes to privately owned sites. In the latter cases the relevant government department consults local authorities and other relevant public authorities before issuing an authorisation under the 1960 Act, although there is no statutory requirement to do so. The government believes that the private sector will continue to play a major role in this aspect of radioactive waste management, but does not propose at present to follow the Expert Group's recommendation to extend the statutory obligation to accept such wastes to private operators of licensed landfill sites.

Liquid

43. The discharges into the sea from the Sellafield site of BNFL are monitored and the pathways by which they may return to man are the subject of a continuing research programme. Several authoritative and independent studies have confirmed that exposures, to even the most highly exposed group, are well within the limits recommended by the International Commission on Radiological Protection. In the past, corrosion of spent magnox fuel elements awaiting reprocessing at Sellafield has raised the concentration of caesium in the cooling ponds, and this increased the amount discharged to sea. This problem is being successfully tackled: there has already been a substantial reduction in caesium discharges and further improvements will follow the commissioning next year of an ion exchange plant (SIXEP).

44. After SIXEP comes into full operation, a new authorisation will be issued setting new quantitative limits. Steps are meanwhile being taken to formalise present practice by inserting in the existing authorisation the requirement that discharges should not only be within the present limits but should also be as low as is reasonably achievable (ALARA), where lower figures can be attained. Both the quantitative limits and the application of the ALARA principle follow internationally recognised practice.

present site used for the purpose is about 500 miles south-west of Lands End: its use was last reviewed in 1979 by the NEA, which concluded that it could safely continue to be used until at least the next review in 1984.

40. There is at present only one site generally available to waste producers for trench burial: the site at Drigg in Cumbria owned and operated by BNFL. Following the report of the Expert Group, discussions have taken place with BNFL and CEGB about methods of making more economical use of Drigg by processing waste to reduce its volume. Incineration has proved technically and economically unsatisfactory in this particular case, and the implications of compaction are now being examined. The government does not consider that there is any need at present to revise the authorised limits for disposal at Drigg but the position will be kept under review.

41. The government has accepted the recommendation of the Expert Group that, in view of the remote location of Drigg and the extent to which it will be required for BNFL's own wastes, additional sites suitable for burial of this type of waste should be identified.

42. Where wastes are of lower activity, so that they can safely be buried on an ordinary landfill site, subject only to certain specified precautions, there is a statutory duty on local authorities to accept such wastes on sites which they provide. There are also a number of disposals of such wastes to privately owned sites. In the latter cases the relevant government department consults local authorities and other relevant public authorities before issuing an authorisation under the 1960 Act, although there is no statutory requirement to do so. The government believes that the private sector will continue to play a major role in this aspect of radioactive waste management, but does not propose at present to follow the Expert Group's recommendation to extend the statutory obligation to accept such wastes to private operators of licensed landfill sites.

Liquid

43. The discharges into the sea from the Sellafield site of BNFL are monitored and the pathways by which they may return to man are the subject of a continuing research programme. Several authoritative and independent studies have confirmed that exposures, to even the most highly exposed group, are well within the limits recommended by the International Commission on Radiological Protection. In the past, corrosion of spent magnox fuel elements awaiting reprocessing at Sellafield has raised the concentration of caesium in the cooling ponds, and this increased the amount discharged to sea. This problem is being successfully tackled: there has already been a substantial reduction in caesium discharges and further improvements will follow the commissioning next year of an ion exchange plant (SIXEP).

44. After SIXEP comes into full operation, a new authorisation will be issued setting new quantitative limits. Steps are meanwhile being taken to formalise present practice by inserting in the existing authorisation the requirement that discharges should not only be within the present limits but should also be as low as is reasonably achievable (ALARA), where lower figures can be attained. Both the quantitative limits and the application of the ALARA principle follow internationally recognised practice.

45. Very much smaller quantities of radioactivity are discharged to the sea, rivers and sewers from other nuclear sites, and also by other users of radioisotopes, including hospitals, industrial premises and research organisations. Details of the discharges from nuclear sites and their environmental impact are given in regular government publications; all discharges are within the authorised limits.

Gaseous

46. Regular discharges to the atmosphere are of relatively minor importance. The existing authorisations for nuclear sites, which have in the past relied on a general requirement on the operator to use the best practicable means to limit discharges, are at present being amended to contain in addition numerical limits for the more radiologically significant nuclides; new authorisations will automatically contain such limits.

47. The conclusions of the Expert Group do not point to any present need for further national or international controls to limit the build-up in the atmosphere of long-lived radionuclides, but the subject will be kept under review.

Krypton ?

Decommissioning ! ! !

48. One major source of wastes will eventually be the decommissioning of nuclear plant. While some relatively small amounts of waste have already arisen from decommissioning, it is expected to be at least ten years before the first nuclear power stations operated by the generating boards start to go out of use. Significant amounts of waste will not arise until decontamination or dismantling takes place. The various options are being examined by the government, the nuclear industry and the generating boards. ACSNI is considering the safety issues involved, and the waste management issues are discussed in RWMAC's Third Annual Report. Decisions about the timing of the various stages of decommissioning will be affected by the estimated radiation exposures to the workforce, the relative economic costs and benefits, the availability of resources, the radioactive inventory and its decay pattern, the availability of disposal routes, the need to reuse buildings or space, and the space required for the wastes arising compared with the space taken up by the shut-down plant. These factors will have to be weighed carefully in order to determine the right course of action in any particular case. Meanwhile the nuclear industry and the generating boards are making financial provision for the costs of decommissioning existing plant. Quite inadequate. !

49. As already noted, the DOE inventory of wastes is being expanded to cover the wastes expected to arise from decommissioning. The studies so far carried out in this and other countries indicate that, apart from the bulk of some items, the problems these wastes present will not be qualitatively different to those presented by other forms of waste, although they strengthen the case for the provision of additional disposal facilities. As and when information becomes available, the wastes from decommissioning will be taken fully into account in DOE's systems engineering studies and in the waste management strategy.

All beautifully vague.

Transport of wastes

50. Comprehensive internationally agreed safety standards for the transport of all radioactive materials, including wastes, have existed for over 20 years and are subject to regular review. In the UK the primary regulatory responsibilities in this field are exercised by the Department of Transport. DOE's systems engineering studies will be extended to include the logistics of transporting wastes between the sites at which they are produced and/or treated and possible disposal facilities, as the costs involved will have to be taken into account in reaching decisions about disposal and storage facilities.

THE NEXT STEPS

Research and development

51. The government will continue to ensure that the necessary research and development is carried out on methods of radioactive waste management. Close contact will be maintained with what is being done in other countries. The UK will continue to play a full part in the work in this field of the European Community, the NEA and the IAEA.

52. In the case of *heat-generating wastes*, work in other countries has shown that geological disposal is, in principle, feasible and safe and we are still a long way from the time when it would be sensible to take decisions about the provision of disposal facilities. Research will continue in order to help determine eventually which is the best option in terms of safety, environmental acceptability, flexibility and costs, plus the requirements placed on future generations. This will not, for the time being, require further fieldwork in the UK, but the government will follow closely work in other countries and, where appropriate, will join in international collaborative projects on land disposal as well as ocean disposal. In the meantime, the government is confident that the methods of storage for heat-generating wastes envisaged are safe and acceptable. Which methods?

Disposal facilities

53. There is no technical obstacle to the development of the disposal facilities required for *intermediate-level solid wastes*. There are already accumulations of such wastes at nuclear sites, and it is desirable to dispose of these as soon as possible, and to avoid the creation of additional accumulations and the provision of costly and extensive storage capacity. The objective is to have the new facilities mentioned in paragraph 36 above in operation soon. These facilities should be able to cope with most types of intermediate-level solid wastes that already exist, plus those that will be created by the further development of nuclear power on the scale envisaged for the UK over the remaining years of this century.

54. For *low-level solid wastes*, subject to continuing international agreement, the UK will continue to use sea disposal to the extent that this can be justified in environmental terms. There is no reason to suppose that sea disposal as presently practised has had, or will have, any damaging effect, and a continuing programme of research and assessment is being undertaken. Because of the absence of measurable effects assessment of the environmental impact has to be by means of modelling techniques as a basis for estimating radiation dose. The

Not forthcoming
2-year moratorium agreed—

NEA is co-ordinating an international reserach programme to add to existing scientific knowledge about the Atlantic disposal site and the UK is participating fully in this programme. In order to make possible the optimum use of sea disposal, new packaging and transport facilities will be required, and the necessary action is in hand. Other existing disposal methods have proved satisfactory and will continue to be used. As already noted, additional sites for trench burial will be identified in order to supplement the existing site at Drigg.

55. *Liquid discharges and discharges to the atmosphere* will continue to be subject to authorisation and monitoring by the Environment Departments (in the case of nuclear sites in England jointly with MAFF).

Organisation and finance

56. The provision of further disposal facilities will require developments in the present organisation. As with other industries, and in accordance with the polluter pays principle, the cost of waste management measures must be met by the industry and reflected in its accounting practices. This is accepted by the industry.

57. The Royal Commission recommended that a Nuclear Waste Disposal Corporation should be set up as an independent statutory body to develop and manage disposal facilities. They had in mind primarily facilities for heat-generating waste, which are not an immediate issue. Having taken the advice of RWMAC, the government does not consider that the creation of a new and separate body would represent the most effective way of carrying out the tasks that lie immediately ahead. Instead, the government has agreed that the component parts of the industry should, in co-operation, set up a Nuclear Industry Radioactive Waste Executive (NIREX) in order to provide a mechanism by which they can successfully fulfil their own responsibilities in this field and work within a comprehensive plan for waste management. The Executive will have a Directorate consisting of senior representatives of BNFL, CEGB, UKAEA and the South of Scotland Electricity Board (SSEB); and the UKAEA have agreed to provide, on a repayment basis, a small staff based at Harwell.

58. The overall organisation for waste management will therefore have three elements: government, the nuclear industry and the generating boards, and the private sector. At the *government* level, the regulatory bodies (the authorising departments under the Radioactive Substances Act 1960 for the disposal of waste, the NII under the Nuclear Installations Act 1965 for the licensing of nuclear sites and the safety of on-site operations), will ensure, by general oversight and the use of their statutory powers that high standards of waste management are maintained; that potential hazards are reduced to levels that are not only acceptable, but as low as reasonably achievable; and that the public are fully safeguarded, both now and for future generations. The regulatory bodies will also continue to commission basic and generic research, and the research required for the purposes of their policy objectives and regulatory functions. The Secretary of State for the Environment, together with the Secretaries of State for Scotland and Wales, will remain responsible for the overall strategy of waste management.

not possible.
Pu 239.

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59. The implementation of the strategy, in particular by the provision of treatment and disposal facilities will fall to *the nuclear industry and the generating boards*, acting through the new Executive. The costs for disposal are expected to be roughly £65 million over the next ten years, and will be borne by the producers of the wastes. These new arrangements will not derogate from the responsibilities of the existing bodies in the industry: they will retain their existing plant and facilities, and in some cases may also provide new plant and facilities. But the creation of the Executive will enable the bodies in the industry to arrive at a common view and take common action, in particular through the promotion of schemes which will benefit more than one body. In this way it will provide a means of achieving at the practical level the objectives of the regulatory bodies in ensuring on a continuing basis safety and the protection of the environment.

60. There is scope for a substantially increased role for the *private sector* in the implementation of the strategy, as well as in research. The Executive will be expected to use the private sector, wherever feasible, for the design of facilities and plant and for the actual disposal operations, subject of course to the full range of regulatory safeguards referred to above, and whatever corresponding financial conditions may be appropriate. The construction of new facilities and plant will in any case be largely contracted out to the private sector.

61. The government has discussed with the industry how the Executive will approach its task. The Environment Departments will continue to develop a broad strategy for the effective and environmentally acceptable management of wastes, against which the industry's performance can be assessed. The Executive will develop comprehensive plans for dealing with the various waste types, on the basis of a study of the realistic options, and in consultation with the Environment Departments and MAFF; and will put forward specific proposals, which will be assessed against the strategy. In order to keep Parliament and the public informed, the Executive will submit periodic reports to the Environment Secretaries of State on work in hand by the industry and future plans, and those will be published. They will also be considered by RWMAC, and its views on them will be summarised in its own annual reports.

62. The government has reviewed the effectiveness of the existing statutory safeguards, mentioned above, in order to confirm their adequacy in the new situation. Proposals for new facilities will also be subject to the normal planning legislation, including the provision for a public inquiry. To the extent that the safeguards rely on the requirements of the 1965 Act, which do not extend to sites under the control of the UKAEA, the UKAEA have given an undertaking that they would conform to similar procedures. If however future investigation shows that there is a need to extend statutory controls in order to give a more complete assurance that wastes will be managed in a planned, safe and environmentally acceptable way, then that will be done.

63. At present section 10 of the 1960 Act empowers the Environment Departments to provide facilities for the disposal or accumulation of radioactive waste, or to arrange for the provision of such facilities by other persons. In practice, to the extent that specialised facilities have been necessary for waste producers outside the nuclear industry and the generating boards, these have been provided (by informal arrangement with DOE) by BNFL (at Drigg) and UKAEA (at

Harwell, for sea disposal). Facilities of this nature must continue to be available, but the legal arrangements are being reviewed to place them on a more satisfactory basis for the future.

Storage of wastes

64. Where wastes have to be stored for strategic or other reasons, the Expert Group recommend that the following basic principles should apply:

(a) the storage facilities must adequately contain the radioactivity associated with the wastes;

(b) all stores wastes must be retrievable;

(c) the conditioning of wastes will generate other wastes, but these should be minimised.

These principles are applied by the regulatory bodies, in particular by NII in licensing waste stores: (a) and (b) are overriding principles, but the desirability of minimising wastes (c) must be weighed against other factors such as cost and the limitation of workforce exposure. NII have made it clear that they will not authorise the construction and use of waste stores if the storage of the wastes in question would be contrary to the national waste management strategy. Storage prior to disposal should be undertaken only where there is a specific technical or radiological justification for it, as in the case of vitrified heat-generating wastes (see paragraph 29 above).

65. The Expert Group also noted that there are at present several different procedures for controlling the storage of radioactive wastes, involving different Acts and different bodies. They concluded that this had not led to any significant gaps or overlaps in the system of control and that the overall responsibilities of the Environment Secretaries of State should resolve any inconsistencies in practice which might have arisen in the past. That is also the government's view, subject to what is said above about the possibility of amending legislation at a later date.

Involving the public

66. Radioactive waste is the source of much public concern. It is sometimes seen as dangerous and intractable material which poses almost insuperable management problems. This view is, in the government's considered judgment, an exaggerated one. Closer study of the question shows that, although problems and dangers are certainly present, the problems are being resolved, and the dangers can be eliminated, by the systematic application of known technology and sound common sense. Policies to this end will not, however, be successful unless there is public support based on a full and accurate assessment of the situation.

67. The government proposes to take the appropriate measures to provide the necessary basis for public support. It will continue to make available full information about the amounts of waste stored at civil nuclear sites. It will continue to publish full accounts of monitoring, research and discharges to the environment. It will make readily available information about its policies and the reasoning behind them. It will ensure that its strategy, as it develops, is publicly available. The machinery for achieving this will be published reports

by the departments concerned, by RWMAC and by NIREX. These will provide ample material for informed public debate about the general issues of policy involved.

68. In addition, specific proposals to develop the land disposal facilities needed for intermediate level wastes will require planning permission. There will thus be provision for a public local inquiry at which such a proposal can be fully explained and evaluated.

69. For more than 30 years, the UK has been engaged in the development of nuclear power for peaceful purposes and, over that time, has had an excellent record of ensuring the safe management of the wastes that arise from its use. The government is convinced that we can continue to manage those wastes safely and successfully in the future and that solutions to the problems of radioactive waste management are available to us, as and when they are required. What is now needed is effective action to develop these solutions and put them into practice at the appropriate time in ways that will be publicly acceptable.

ANNEX

OBJECTIVES FOR RADIOACTIVE WASTE MANAGEMENT

The objectives for radioactive waste management in the UK are as follows:

(a) all practices giving rise to radioactive wastes must be justified, ie the need for the practice must be established in terms of its overall benefit;

(b) radiation exposure of individuals and the collective dose to the population arising from radioactive wastes shall be reduced to levels which are as low as reasonably achievable, economic and social factors being taken into account;

(c) the average effective dose equivalent from all sources, excluding natural background radiation and medical procedures, to representative members of a critical group shall not exceed 5mSv (0.5 rem) in any one year.

The advice of NRPB is that the use of a limit of 5mSv in a year, combined with the use of optimisation techniques to meet the second objective above, will in most cases result in an average dose rate equivalent to a critical group of less than 1mSv a year of life-long whole body exposure from all sources of radiation. Hence the lifetime whole body dose equivalent to an individual will not normally exceed 70mSv (7 rem). In some cases it may be necessary to pay particular attention to the lifetime dose equivalent likely to be accumulated by representative individuals in the critical group taking account of all the age-related factors affecting their exposure.

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Dd 201607 C25 7/82

ISBN 0 11 186070 6

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