Nuclear Power
and the Environment

THE GOVERNMENT'S RESPONSE TO THE SIXTH REPORT OF THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION (Cmnd. 6618)

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NUCLEAR POWER AND THE ENVIRONMENT:
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THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION

Finding the right solutions to questions about the place of nuclear power in society is of vital significance to our long-term energy strategy, to our own future well-being and that of the world as a whole. The Sixth Report of the Royal Commission on Environmental Pollution* has made an important contribution to the wide-ranging debate on this subject which is increasingly coming to be conducted at the international as well as the national level. The most recent manifestation of this international interest was at the Downing Street Summit on 7–8 May.

2. The United Kingdom has been engaged in the development of nuclear power for peaceful purposes for more than 25 years, and over that time has had an excellent record in ensuring the safety of nuclear plants, their fuel and the wastes that arise from their use. At present nuclear power makes an important contribution to our energy supplies. In 1976 it accounted for more than one-tenth of the electricity produced by the generating boards. By the end of this decade the proportion should rise to one-fifth, as stations ordered in the 1960s are completed.

3. No nuclear power station has been ordered since 1970. Decisions will be needed in the near future on the thermal reactor programme, and thereafter on policy towards the further development of the fast reactor. It must be strongly emphasised that these decisions would not involve any commitment to a large additional nuclear power programme. But they are concerned with the extent to which we should keep the options open of having such programmes in the future.

4. In taking these decisions, and the much more significant decisions which will be needed in a few years’ time on the place of nuclear power in our energy supplies, the Government recognise that a great many factors will have to be taken into account. Some are technical or economic in character. For example, the relative costs of different strategies, their implications for other energy sources and their consequences for industry will continue to be important. The Royal Commission have drawn particular attention however to other aspects of nuclear power, notably its social, environmental and security effects, which will have to be understood and resolved before there is any large-scale commitment to this form of energy.

5. The Royal Commission concluded that the abandonment of nuclear fission power would be neither wise nor justified. They expressed concern however about certain risks they believed would be involved in a large-scale commitment to nuclear power several decades from now. In fact, the relatively favourable prospects for the United Kingdom energy economy in the medium term give us time to develop, with the help of public debate, our policies for this period. Power stations built under earlier programmes will ensure a nuclear contribution to our energy supplies for the remaining

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years of this century although, if there were no further stations, this contribu-
tion would reach a peak in the 1980s and decline in the 1990s as stations
are decommissioned. The extent of our eventual commitment can only be
resolved in decisions taken progressively over the years in the light of
national need, and of the acceptability to the country at large of the possible
economic, social and environmental impact of an extended nuclear
programme. For the present, it is important that the Government should
continue to review the adequacy of the arrangements for supervising and
controlling the use of nuclear power, to undertake whatever research or
other work is necessary to clarify uncertainties and remedy weaknesses, and
to provide the context within which the debate on future developments can
proceed.

6. In particular two central issues raised by the Royal Commission’s
report are the subject of current debate both within the United Kingdom
and internationally:

i. the management of radioactive wastes;

ii. the security problems involved both in the possible proliferation of
nuclear weapons in the hands of other national governments and
in the possible diversion of plutonium into the hands of terrorist
groups, and the implications of these problems.

In his speech on April 7, President Carter proposed that, as one element
in continuing discussions between supplier and recipient countries, an Inter-
national Fuel Cycle Evaluation Programme should be established. The
Government have indicated that they welcome it, and are prepared to
participate. In these discussions at the international level the Government
will take full account of the Royal Commission’s views. By the same token
however they are not yet in a position to give a final response in this White
Paper to certain of the Commission’s conclusions and recommendations in
these specific fields.

7. The Government also particularly welcome the Royal Commission’s
examination of the adequacy of the existing arrangements in the United
Kingdom for the supervision and control of nuclear power, both in present
conditions and for the future. In many respects the report endorses existing
practice or activities. Overall the Commission were broadly satisfied with
the present radiological safety standards, with the arrangements for enforc-
ing them, and with the system for controlling releases of radioactivity to the
environment. They make a number of specific recommendations for the
future, and the Government have decided to accept the bulk of these. The
most important points are:

i. the Secretary of State for the Environment, together with the
Secretaries of State for Scotland and Wales, has been given a
responsibility for policy on the management of civil nuclear wastes.
These Ministers have already taken steps to review the present
policy; they will review the adequacy of the research effort on
waste disposal and on radioactivity in the environment, and they
will in future co-ordinate environmental monitoring;
the Government are taking steps to ensure that they have a wide range of advice available, including advice from outside Government and the nuclear industry, on all aspects of nuclear power;

iii. further measures will be taken to make more information available about nuclear matters in order to extend open government and facilitate full public discussion of the issues.

The remainder of this White Paper contains the Government's response to the main matters raised in the Royal Commission's report. Where a more detailed reply is required to a particular conclusion or recommendation, it is given in Annex A. The checklist in Annex B gives, for each conclusion or recommendation, a reference to the paragraph containing the Government's response.

ENERGY POLICY

8. The Commission accepted the need to maintain a nuclear option. They were however concerned about possible large-scale future reliance on fast reactors, which they thought would be open to substantial environmental objections (42). They did not oppose on environmental grounds the building of a first commercial scale fast reactor (CFR1). Their preferred strategy on purely environmental grounds would be to delay the development of CFR1 in order to provide time for the socio-political aspects of a large scale reliance on plutonium to be examined fully, in order to free resources for increased effort on alternative energy sources and in order to provide time for the problems of waste management and disposal to be resolved. The Commission recognised however that a delay could well create very serious problems, including the loss of expert technologists (which might seriously damage the prospects for success of the project) and the loss of opportunities for collaboration with other countries, which they considered might free resources for other purposes. They also recognised that there was a risk that the fast reactor would prove to be essential for vital energy supplies, and that it would not be available in time.

9. Because of the potential dangers associated with plutonium, the Commission concluded (44) that we should not rely for energy supply on a technology involving plutonium unless there is no reasonable alternative. They therefore recommended that a major commitment to fission power and the large-scale use of plutonium should be postponed for as long as possible (45), and that there should be increased support for energy conservation and combined heat and power schemes and for the development of other energy sources including fusion power (46). Their own tentative view (43) was that an alternative energy strategy could be devised which would avoid the future need for a large nuclear programme based on fast reactors or for reliance on imported oil.

*Numbers in parentheses refer to the summary of principal conclusions and recommendations in Chapter XI of the Commission's report.
10. The Government accept the Commission’s view that the development of alternative energy sources should be pursued with greater vigour (46). Expenditure on these sources has been increased and is expected to increase further in the future. Research and development programmes are now under way or are being established for the most promising renewable sources, and also for fusion power; and the scope for widespread use of combined heat and power in this country is being studied (see Annex A, paragraph 15). The Government are also actively pursuing further possibilities for energy conservation as a contribution to the efficient overall use of resources. But there is growing world interest in renewable resources and the Government will be extending their work in these areas.

11. The Commission’s alternative strategy includes a substantial nuclear component (50 gigawatts (GW) in 2010, 80 GW in 2025) but also places heavy reliance on coal, on renewable resources such as solar and tidal energy and on combined heat and power. The Commission did not present this alternative strategy as a seriously studied option and accepted that it was based on a number of speculative assumptions. The Government will continue to study this alternative strategy. There are risks and uncertainties about all energy options. The Commission contrasted their own alternative strategy with what they described as “official energy strategy for the UK”. The Government believe that the Commission may have misinterpreted the illustrative projections of demand they received in evidence, which were not as firm as they believed, and are being re-examined in the context of the energy review. The Government’s objective is to work towards that pattern of supply and demand in which our energy needs are met long-term at lowest cost, with adequate security, and in a way that is environmentally and socially acceptable. Because of the uncertainties, especially about future demand, we cannot now define precisely what this pattern will be in the long term, and we therefore need to assess and have available a wide range of energy options.

12. As already noted, decisions will be needed in the near future on the thermal reactor programme, and thereafter on policy towards the further development of the fast reactor. In reaching decisions on the fast reactor, the Government will give careful consideration to the views expressed by the Commission’s (49). In this context the Government also accept the Commission’s recommendation (50) that “there should be no commitment to a large nuclear programme including fast reactors until the issues have been fully appreciated and weighed in the light of wide public understanding”. The procedures required for public consultation are discussed below (paragraphs 39-43).

MANAGEMENT OF RADIOACTIVE WASTES

13. The Royal Commission gave particular consideration to the management of radioactive wastes. They took the view that, although the primary responsibility for these matters is properly one for Government, it should be independent of the responsibilities of Government Departments for promoting nuclear power (5, 40). This is already the accepted position in the case of discharges of radioactivity to the environment (see Annex A, paragraph 1).
14. The management of civil radioactive wastes however is at present divided between a number of Departments and other organisations. The Government accept that an overall long-term strategy is needed, and that waste disposal considerations need to be taken fully into account in the design of nuclear systems. In accordance with the Royal Commission’s recommendation (40) therefore the Secretary of State for the Environment will in future be responsible, together with the Secretaries of State for Scotland and Wales, for nuclear waste management policy. The main elements in this new responsibility will be 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;

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;

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

The new responsibility will be exercised in close consultation with the Secretary of State for Energy and the other Ministers who have responsibilities in this field.

15. The Government are considering whether the Secretaries of State for the Environment, Scotland and Wales will need further statutory powers to help them in carrying out this responsibility.

16. The Commission recommended (40) that a Nuclear Waste Management Advisory Committee should be set up to advise the responsible Ministers on broad policy issues affecting radioactive waste management. They pointed to the major decisions which will fall to be taken in the years to come; and they clearly felt that, as with other aspects of nuclear power, arrangements were needed to muster all available advice for Ministers. They felt that since the Committee would need to see the results of appropriate development work before it proffered informed advice, the Committee itself should sponsor and direct long-term research (for up to 10 or 20 years) and have funds guaranteed to it for that length of time. The Commission also considered that the Committee should be a statutory body.

17. The Government accept the recommendation for such a Committee in principle. They do not however think it need, initially at least, be a statutory body, as some flexibility will be an advantage in the early stages of its life. And giving it executive functions might divert it from its major duty of advising on radioactive waste management policy. They will therefore consider further with the Committee, when it is established, whether it should have executive functions with regard to the management of research, and whether
the scale and balance of the research programme are right. Meanwhile the Secretaries of State for the Environment, Scotland and Wales will assume control of the waste management element in the total expenditure on nuclear research and development which the United Kingdom Atomic Energy Authority (UKAEA) is authorised to incur. The Committee will be asked to submit an annual report, which will be laid before Parliament.

18. The Government are already carrying out, as a priority task, a review of the existing arrangements for the control of radioactive waste, which date from the White Paper on the Control of Radioactive Wastes (Cmnd. 884) published in 1959. The adequacy of the present research effort in this field will also be reviewed. The findings will be announced in due course in a further White Paper, and the Nuclear Waste Management Advisory Committee will be consulted about them. Meanwhile the Commission’s views on particular methods of waste disposal are discussed in Annex A.

19. In accordance with the polluter pays principle, the costs incurred in achieving effective and environmentally acceptable methods of waste disposal will need to be taken into account in calculating the cost of power generated by nuclear reactors. The Government note the Commission’s view (39) that waste management on the lines they envisage would be unlikely to produce an appreciable increase in the cost of such electricity.

20. The Commission recommended (41) that a Nuclear Waste Disposal Corporation should be set up. They saw a need, not currently fulfilled, for an executive body to develop and manage radioactive waste disposal facilities, and they had in mind the desirability of continuity in managing the disposal and containment of long-lived wastes. The Government see the force of this proposal, but do not think they need to come to a decision at this stage. They propose to reconsider it in due course in the light of the results of the current review of existing policy for waste disposal; and they will also seek the advice of the Nuclear Waste Management Advisory Committee.

21. The Commission recommended (27) that there should be no commitment to a large-scale nuclear programme until it has been demonstrated beyond reasonable doubt that a method exists to ensure the safe containment of long-lived, highly radioactive waste for the indefinite future. The Government note the Commission’s confidence that a solution to this problem will in fact be found. And the Commission’s proposition is bound to be the dominant factor in any process preceding decisions about further large-scale programmes (including any programme of fast reactors).

22. The Commission’s report does not attempt to deal with the environmental implications of the radioactive wastes which arise in the defence nuclear programme. For security reasons, information about the processes giving rise to these wastes and about their size and composition must be restricted and therefore the Secretary of State for Defence will retain full responsibility for their management. The existing liaison between the Ministry of Defence (MOD) and the responsible civil Departments will continue however 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 categories of waste, taken together, is environmentally acceptable.

RADIATION EXPOSURE AND ENVIRONMENTAL PATHWAYS

23. The Government welcome the Commission's endorsement in their conclusions (3) of the present practice under which basic standards for permissible exposure to radiation are recommended by an independent scientific body, the International Commission on Radiological Protection. The recommended standards form the basis of a Euratom Directive to the member states of the European Communities laying down the basic standards for the health protection of workers and the general public against the dangers of ionizing radiations. Although advice on the adequacy of these standards has been available to the Government from the National Radiological Protection Board (NRPB), the Secretary of State for Social Services will now, in view of the Commission's recommendation (4) that it should have a statutory responsibility in this field, place on the NRPB a formal duty to provide such advice by giving a direction under the Radiological Protection Act 1970. The Department of Health and Social Security is reviewing with the NRPB and the other bodies principally concerned, as the Commission recommended, the membership of the board and its sources of finance, and will subsequently review its own need for additional expertise. The Medical Research Council will continue to provide advice about the biological bases on which radiological protection standards rest.

24. The Government also note the Commission's conclusions, which accord with their own expert advice, that, at the levels likely to be permitted in relation to possible somatic effects, the genetic effects of radiation should not be significant (1); and that, on present evidence, the derived standards for plutonium exposure and uptake are not seriously in error (2).

25. The Government agree with the Commission (10) that there should be a clear location of responsibility for initiating and co-ordinating research into the effects of radioactivity on man and the environment, and for identifying gaps and overlaps. This function however can be more appropriately performed by a Minister than (as the Commission suggested) by the NRPB and, in view of their new responsibility for nuclear waste management policy, it is right that it should be exercised by the Secretaries of State for the Environment, Scotland and Wales, acting jointly. The Departments concerned will collaborate closely with the Ministry of Agriculture, Fisheries and Food (MAFF). Research contracts already incorporate freedom to publish results subject only to patent and security considerations, as the Commission wished.

26. Similar considerations apply to the Commission's recommendation (13) about the overall strategic responsibility for initiating and co-ordinating monitoring in connection with environmental pathways, which will also more appropriately lie with the Secretaries of State for the Environment, Scotland
and Wales, acting jointly, than with the NRPB. The Departments concerned will collaborate closely with MAFF and the NRPB.

27. In accordance with the Commission's recommendation (12), the Department of the Environment (DOE), the Scottish Development Department and the Welsh Office will in future publish an annual survey of discharges of radioactivity to air, water and land from all civil nuclear installations. For security reasons, it will not be possible to include an account of similar discharges from all defence installations but this information will be available within DOE so that the survey can certify that the general level of such discharges is acceptable and thus present a comprehensive picture. The Commission also recommended that the NRPB should periodically publish a comprehensive report on the total radiation exposure of the public: the NRPB have already published one report for the purpose and have confirmed that they will publish updated versions, with extended coverage, from time to time.

28. The Government agree with the Commission's conclusion (17) that the risk of serious accident in any single reactor is extremely small, and note their view that the hazards posed by reactor accidents are not unique in scale, nor of such a kind as to suggest that nuclear power should be abandoned for this reason alone.

29. The Nuclear Installations Inspectorate, which now forms part of the Health and Safety Executive (HSE), provides advice to Government on nuclear safety (for example, through the study it is at present carrying out for the Secretary of State for Energy on the safety of Pressurised Water Reactors). The Commission recommended (19) that HSE should also ensure that there is a supplementary source of independent expert advice, and this role will be filled by the Advisory Committee on the Safety of Nuclear Installations, which is being set up to advise the Health and Safety Commission (and through them, if necessary, the relevant Ministers) in place of the former Nuclear Safety Advisory Committee.

30. In accordance with the Commission's recommendation (15), the Secretary of State for Social Services will give the NRPB a direction making them formally responsible for the specification of emergency reference levels (which are used in the event of an accident).

31. The Government accept in principle, for all civil nuclear installations, the Commission's recommendation (16) that emergency plans should be made available to the public, and the Department of Energy (DEn) will work out the necessary arrangements for implementing this decision in consultation with the other bodies concerned.

NON-PROLIFERATION AND SECURITY

32. The Commission considered (22) that plutonium (which is a by-product in thermal reactors and is used as a fuel in fast reactors) "appears to offer unique potential for threat and blackmail against society because of its great
radiotoxicity and its fissile properties”. They also considered (23) that the construction of a crude nuclear weapon by an illicit group is a credible possibility. They discussed both the possibility that plutonium derived from the peaceful uses of nuclear energy might pass into the hands of terrorist groups and the possibility that it might lead to the proliferation of nuclear weapons in the hands of other national governments.

33. The Commission recommended (25) that, when foreign fuel is reprocessed in this country, plutonium extracted from it should, if returned, be incorporated in new mixed oxide fuel elements. The Government agree that decisions on the form in which plutonium is to be returned must be based on non-proliferation and security considerations. They will be pursuing this question in further international discussions on non-proliferation, including the proposed international fuel cycle evaluation.

34. In relation to terrorist groups, the Commission concluded (24) that, given the adequacy of existing or planned security measures, the risks at the present level of nuclear development are small. They accepted that security measures will be periodically reviewed and if necessary strengthened. They expressed considerable concern however about the security situation that would exist in what they term a “plutonium economy”: in other words a society, which could conceivably exist in the early part of the next century, in which there were much larger stocks, and much more frequent movements, of plutonium than at present. Their anxiety was that under these circumstances the risks might be such that either adequate security could no longer be assured or the security measures introduced would do serious damage to civil liberties.

35. So far as the present situation is concerned, the Commission were not convinced (23) that the Government had fully appreciated the implications of the possible illicit construction of a crude nuclear weapon. In fact, security measures in connection with the transport and storage of plutonium have been greatly strengthened over the last two years, and will be reviewed at regular intervals.

36. The Commission are right to draw attention (26) to the need to consider carefully, in making future decisions about large-scale nuclear development, the effect of possible security measures. In the context of trying to find an appropriate balance between any possible effects of nuclear power on civil liberties and its possible benefits for economic growth, the Government advance the following considerations which seem to be of significance.

37. However the hazards of plutonium are rated in relation to those posed by other dangerous substances, it is certainly a possible target for terrorists. But by giving careful attention to security considerations at the design stage of nuclear installations, we could ensure that its availability in an accessible form remained severely restricted, even in a society which made extensive use of plutonium-fuelled power stations. Designing security into nuclear systems in this way would not only reduce the risk of successful terrorist action but should also reduce the need for the types of measures (such as any large-scale
increase in checks on personnel) which could be regarded as a threat to civil liberties. The Government will ensure that full attention is given to this aspect at the planning and design stages of nuclear systems. Cost comparisons between nuclear and other systems will have to take into account the additional cost imposed by security measures.

38. The degree of surveillance needed to detect and watch terrorists at any given time depends more on the prevalence of terrorism than on the availability of plutonium. Moreover, terrorism is in large measure an international phenomenon. On the one hand, this means that the United Kingdom could not necessarily avoid the potential problems of nuclear terrorism by a unilateral decision not to use plutonium. On the other hand, this fact clearly makes it important for the governments concerned to co-operate fully in adequate security arrangements in all countries in which stocks of plutonium exist now or may exist in the future. This aspect is therefore being taken fully into account in current international discussions. In the nuclear field as in other fields, the Government will continue to preserve civil liberties and to relate any security measures strictly to the nature and scope of the specific threat at any given time.

THE NEED FOR PUBLIC DEBATE

39. Because of the importance they attached to energy strategy, the Commission favoured the idea of an independent, high level advisory body in this field, which would take account of economic, social, technical and environmental considerations (48). The proposed Energy Commission; the existence of the Royal Commission and the NRPB; the creation of the Advisory Committee on the Safety of Nuclear Installations and the Nuclear Wastes Management Advisory Committee will mean, taken together, that the Government will have a wide range of outside advice available to them on nuclear power in addition to the views of their own expert advisers. Nevertheless the Government consider that there is a need for a high-level independent body to advise specifically on the interaction between energy policy and the environment and will give further consideration to the form this body should take.

40. A Green Paper on energy policy will be published later this year. The Government's hope is that, together with this White Paper, it will promote and assist a wide-ranging debate on all aspects of energy policy, in which the debate on the role that nuclear power should play in meeting our energy needs will be one element. The proposed Energy Commission will also have a part to play in promoting such a debate. This will permit the fulfilment of the Commission's recommendation (50) that the issues should be fully appreciated and weighed in the light of wide public understanding before there is any commitment to a large additional nuclear programme including fast reactors.

41. In order to help public understanding, arrangements will be made for the periodic publication, in DOE's Pollution Paper series, of summaries, in a form comprehensible to layman, of the results of research and development on radioactive waste management, research into the effects of radioactivity
and monitoring of radioactivity, DEn will continue to publish information on a regular basis, and the results of studies by HSE into reactor safety and into the safety of other energy sources will also be published.

42. The Commission recommended (50) that a special procedure for public consultation should be established in respect of major questions of nuclear development to enable decisions to “take place by explicit political process”. In the case of specific projects there are provisions for public inquiries to be held, as in the case of the proposal to build an oxide reprocessing plant at Windscale. The Government fully accept however the need for a proper framework for wider public debate, and will consider the most suitable kind of special procedure to achieve this, bearing in mind the Commission’s suggestions in this respect. They also accept that, before any decision is taken on CFR1, this procedure should be settled and announced.

43. The particular environmental and social problems of nuclear power are unique. At the same time the debate about nuclear power now in progress in this country and in other developed countries is one element in the wider debate about future energy needs, supplies and conservation. And that wider debate itself contributes to still more general concerns relating to the use and conservation of resources; the need for economic growth; and the goals and objectives of society at large. The Government will give further thought to the complex problems of energy policy, in the light of the Royal Commission’s report, in preparing the forthcoming Green Paper on this subject.
OTHER CONCLUSIONS AND RECOMMENDATIONS

Role of a unified pollution inspectorate

1. In England discharges of radioactivity from nuclear sites* are at present authorised by DOE and MAFF as the Departments concerned with the receiving environment, and discharges from other sites by DOE. In Wales, the Welsh Office exercises functions corresponding to those of DOE. In Scotland authorisations are given solely by the Scottish Office. Dumping of solid wastes at sea is authorised by MAFF or the Department of Agriculture and Fisheries for Scotland (DAFS), as the case may be.

2. No decision has yet been reached on the Commission's recommendation in their Fifth report that a unified pollution inspectorate for England and Wales should be set up within DOE in order to ensure that there is an integrated approach at source to difficult industrial pollution problems which may affect all sectors of the environment. The Government are not yet therefore in a position to express a view on the Commission's further recommendation (6) in their present report that the responsibility for controlling discharges of radioactivity to the environment should in future lie with such an inspectorate. In Scotland Her Majesty's Industrial Pollution Inspectorate is already responsible for controlling discharges of radioactivity to the environment in consultation with DAFS, as the Commission noted.

Radioactive emissions to the atmosphere

3. The Government accept the Commission's view (28) that, although there are no significant problems at present, a rather more systematic approach to control of radioactive emissions to the atmosphere may be needed in future. At present the controlling authorities require specific measures to be taken (including the installation of appropriate equipment) to reduce emissions to the lowest practicable level in the light of the effect on the quality of the local environment, but the authorisations do not set a quantitative limit. The Government agree in principle however that each nuclear site should have clear standards to which to work and that the possible additive effects of discharges should be taken into account in setting such standards.

Disposal of high-level wastes

4. Irradiated fuel from nuclear reactors contains a proportion of long-lived actinides (a generic term for the heavy radioactive elements such as plutonium) and fission products. The effect of reprocessing is to separate out the plutonium and the unused uranium and produce a somewhat smaller volume of highly active waste in liquid form, in which practically all the

*The term "nuclear sites" is used in order to cover both licensed sites (those operated by the Central Electricity Generating Board, the South of Scotland Electricity Board, British Nuclear Fuels Limited (BNFL) and the Radiochemical Centre Limited) and the sites operated by the United Kingdom Atomic Energy Authority (UKAEA).
fission products and all the rest of the actinides are contained. This waste is stored in high integrity tanks while research proceeds on methods of disposal*. In the case of irradiated fuel from Magnox reactors in particular, corrosion problems prevent storage for any length of time unless reprocessing is carried out; and planning permission has recently been given for the refurbishing of the plant used for this purpose at Windscale, Cumbria. A planning application by BNFL for the construction of a separate plant at Windscale for the reprocessing of fuel from United Kingdom Advanced Gas-Cooled Reactors (AGRs) and from foreign customers is the subject of a public local inquiry which will open on June 14. The general desirability of reprocessing is also the subject of current discussion internationally. The research which has been carried out or is under way on methods of disposal of high level wastes after reprocessing is described below: some of it would also be relevant to a greater or lesser extent to alternative approaches to nuclear waste problems, if these were adopted.

5. A method for converting the liquid high-level wastes obtained from the reprocessing into a vitreous solid has been developed and proved on a pilot scale. A commercial scale demonstration plant should be in operation in the mid-1980s and parallel development is going on in other countries. There would eventually (disregarding certain far-fetched suggestions which the Commission dismissed) be three possible ways of disposing of the vitrified wastes:

   i. disposal on the bed of the deep ocean;
   ii. disposal into stable geological formations on land;
   iii. disposal under the bed of the ocean.

The Government note the doubts expressed by the Commission (33) about the eventual international acceptability of course i., but they believe that it is not an option to be dismissed at this stage. The Government accept the Commission's conclusion (34) that neither course ii. nor course iii. has yet been sufficiently studied or demonstrated as a feasible option and that there should be a continuing research programme (35 and 36) into methods of disposal to geological formations.

6. The main contractors for this research are likely to be the UKAEA; the Directorate of Fisheries Research of MAFF, and the Institutes of Geological and Oceanographic Sciences of the Natural Environment Research Council (NERC) (which the Commission specifically mentioned) will have an important part to play. Research on this subject is already proceeding in the United Kingdom and a number of other countries under the auspices of the European Economic Community (EEC) and the Nuclear Energy Agency

*Disposal is defined as dispersal of radioactive waste into an environmental medium or emplacement in a facility, either engineered or natural, with the intention of taking no further action apart from necessary monitoring.

Storage is defined as emplacement in a facility, either engineered or natural, with the intention of taking further action at a later time, and in such a way and location that such action is expected to be feasible. The action may involve retrieval, treatment in situ or a declaration that further action is no longer needed, and that storage has thus become disposal.
(NEA) of the Organisation for Economic Co-operation and Development (OECD); and will be relevant both to disposal under the sea and to disposal under land surface. At the same time the UKAEA isconcerting a programme of studies to investigate the behaviour of radioactive substances released in the deep sea. Within the United Kingdom it is expected that expert assessments of the results of all these studies can be available by the late 1980s, when the vitrification process should be available on a commercial scale. It will then be possible for a view to be taken about the overall acceptability and comparative merits of the different options. If the view taken is favourable it would then be for decision whether pilot facilities should be constructed for one or more of the methods. The aim would be to have a pilot facility or facilities in operation by the early 1990s. For the purpose of this programme a number of test borings will be required, and it is important that, subject to normal planning procedures, these should now go ahead.

7. Another technique which could be important in waste disposal is the separation of the actinides from reprocessed high-level wastes and their partial conversion into shorter-life fission products by the device of placing them in a fast reactor. The Government agree with the Commission’s conclusion (32) that this does not provide a reason for delaying the vitrification programme, especially as it might also be desirable to vitrify the shorter-life fission products. A programme of research into actinide separation will continue both in this country and in other EEC countries. It will be kept under review and, in addition, the Government will, as the Commission suggest, seek the advice of the Nuclear Waste Management Advisory Committee when it is established.

Disposal of other wastes

8. At present low-level solid waste is in the main buried; intermediate level solid waste is mostly stored, though some is disposed of at sea. The Government have noted the Commission’s conclusions that:

i. the burial of very low-level solid wastes at local authority sites (with special precautions) is perfectly satisfactory (paragraph 356);

ii. the burial of low-level solid wastes at the Drigg site is satisfactory for the present (30);

iii. in the longer term wastes of the kind now buried at Drigg should preferably be taken to a national disposal facility (30);

iv. there is a lack of clearly formulated policy for the disposal of intermediate level solid waste at nuclear power stations (31);

v. the policy of accumulating more highly active solid wastes at UKAEA and BNFL sites with a view to eventual ocean disposal would prove inadequate if such disposal turned out to be unacceptable: the possible future requirements again point to the need for a national disposal facility (31).

Their views on these points will be taken into account in the review mentioned in paragraph 18 of this White Paper.
Epidemiological studies of radiation workers

9. In order to obtain epidemiological data about occupational exposure to radiation, the NRPB has set up a Register of Radiation Workers covering those currently engaged in radiation work at nuclear sites, and is considering extending its coverage to former radiation workers who are still employed at such sites. The Commission recommended (14) that the register should also include those former radiation workers who left the relevant establishment before the register was set up. The NRPB are considering the possibility of bringing onto the register selected groups of ex-BNFL employees, and the methodology for doing the same with other selected groups. Any attempt to follow up all former radiation workers however would be very costly and would have little epidemiological value. The NRPB are also considering the case for bringing onto the register other types of worker who may encounter relatively high levels of radiation, such as those in metal mines.

Investigation of accidental over-exposure

10. Cases of accidental over-exposure which occur on licensed sites and in places covered by regulations under the Factories Act have to be reported to HSE, who inform the NRPB of significant cases; and the new Euratom directive 76/579 will lead to regulations extending this reporting requirement to all employers. The procedure by which information is passed on to the NRPB meets the substance of the Commission's recommendation (14) that there should be arrangements to monitor accidental exposure to radiation and, in view of the satisfactory arrangements which also exist for giving treatment in such cases and making available for this purpose the advice of medical officers at the major nuclear establishments and of the NRPB's own staff, there appears to be no need to set up an additional co-ordinating panel of experts as suggested in paragraph 253 of the Commission's report.

Research on radiobiology

11. In the field of basic radiobiology the Government join with the Commission in welcoming (7) the setting up by the Medical Research Council (MRC) and the NRPB of a Joint Committee on Radiological Protection.

Research on radioactivity in the environment

12. The Government accept the Commission's conclusion (11) that there should be continuing research into the effects of radiation on the natural world as well as into those mechanisms for dispersion and concentration within the environment which are relevant in assessing the effect of radiation on man. In practice there is a considerable overlap between the two fields of study. Extensive work on the marine environment has been carried out at the Fisheries Radiobiological Laboratory of MAFF and the Commission have recognised its quality. In 1976/7 expenditure was £423,000 and MAFF seek advice from NERC, from universities and from other independent bodies when these can make a contribution. Discharges of
radioactive material to the atmosphere have been relatively small but an extensive research programme on the atmospheric and terrestrial environments has been carried out over a number of years by the Environmental and Medical Sciences Division of the UKAEA's Harwell establishment; and total expenditure in this field in 1976/7 by the UKAEA, the NRPB and the Research Councils was £227,000. In addition close contact is maintained with the large volume of similar, and often complementary, work in other countries, especially other EEC countries. MAFF, NRPB and UKAEA have identified some areas in which further work may be needed, with particular reference to the possible future pollution of food and crops by radionuclides. The Government have noted the Commission's view that independent research into all sectors of the environment should be encouraged through the Research Councils (8 and 9), and that there has been insufficient research into the atmospheric and terrestrial environments (9). These views will be taken into account in a review by DOE, in collaboration with the other bodies concerned, of the adequacy of the present research programme.

Low-level discharges from Windscale
13. The Government agree with the Commission (29) that research is required into the possible future effects of plutonium-contaminated low-level discharges from Windscale. Research will continue to be carried out by the Fisheries Radiobiological Laboratory of MAFF into all aspects of such discharges, and this topic will be covered in the general review mentioned above.

Reactor siting policy
14. The criteria and methods of working of the NII are being reviewed as the Commission recommended (18), and the Government accept in principle that there should be regular reviews of reactor siting policy (21) but the Commission's suggestion that there are anomalies in current siting policy is unjustified. Although they thought it inconsistent for siting policy to take into account the possibility of incidents more disastrous than what is termed "the maximum credible accident" the decision to do so has been a deliberate one with the objective of introducing additional safety margins. The other point to which the Commission drew attention, the difference in the range of risk factors calculated by the NII and by the Safety and Reliability Directorate of the UKAEA, arises because the NII have calculated risk factors for a wider range of population densities within the area surrounding a nuclear power station.

Combined heat and power from nuclear reactors
15. The Government note the Commission's desire (20) to see commercial reactors developed to sufficiently high safety standards to allow near-urban siting. This objective has already been achieved with the Advanced Gas-Cooled Reactors at Hartlepool and Heysham. The possibility of using power station heat for district heating, as the Commission wished to see done with
such nuclear stations, is being examined by a DEn group on combined heat and power schemes, which published a first report in March of this year.*

Transport of radioactive materials
16. Most of the issues concerned with the transport of radioactive materials to which the Commission drew attention are already being studied by the Department of Transport, as they recommended (37). The vessels in which fuel is transported however are subject to stringent criteria specifically laid down by the International Atomic Energy Agency, and there would be no advantage from a safety point of view in treating them as though they were fixed nuclear installations.

Future role of the UKAEA
17. The Government are giving further consideration to the Commission’s view (47) about the desirability of extending the UKAEA’s functions to cover work on renewable energy sources.

Return of reprocessing wastes to foreign customers
18. If foreign fuel is sent to the United Kingdom for reprocessing the Commission took the view (38) that (because of factors such as the need for an additional journey and the risk of earthquakes in certain other countries) the interests of the global environment would not be served either by returning the resulting wastes to the country of origin or by returning the irradiated fuel if it had not in the event been reprocessed. In giving permission for BNFL to take on foreign business the Secretary of State for Energy made it a condition that the contracts negotiated should contain certain options for the return of wastes or irradiated fuel to the country of origin. The Commission’s views will be taken into account if and when the question of exercising such an option actually arises.

### Checklist of the Royal Commission's Conclusions and Recommendations

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