The Environment Council

BNFL NATIONAL STAKEHOLDER DIALOGUE

WASTE WORKING GROUP

A combined report comprising:	
Interim report:	28 February 2000
First update:	31 October 2000
Second update:	23 November 2001
Date of this combined report:	November 2002

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Produced by The Environment Council

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Preface

This document is a compilation of three previously published reports. The reports are divided by the blue pages and are presented in chronological order:

Waste Working Group Interim Report - An initial report from the Working Group to the Main Group on 25/26 November 1999 subsequently published on 28/02/00.

First Update – a meeting report from the reconvened Waste Working Group that met on 31/10/00 to review their interim report in the light of BNFLs announcement on 23 May 2000 concerning closure of Magnox reactors.

Second Update – a meeting report from the reconvened Waste Working Group that met on 23/11/01 to review their work in the light of developments over the past year, and to assess any evidence of the Dialogue's impact on BNFL.

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INTERIM REPORT

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Foreword to Interim Report of the
Waste Working Group in the BNFL National Dialogue

Background to the Interim Reports

Two sub-groups were set up within the BNFL National Dialogue: the Waste Working Group (WWG) and the Discharges Working Group (DWG). The working groups included members from community and environment interests, regulators, government departments, BNFL and its UK customers. The terms of reference for the working groups were derived from the outputs of workshops involving a much wider range of interested parties or “stakeholders” in BNFL’s activities - the “Main Group”.

Participation (by organisation or individuals) in either the overall dialogue or the working groups must not be taken as an indication of support or disagreement with the dialogue itself , its outputs or BNFL’s activities.

The reports from both the WWG and the DWG must be read carefully. The working groups have been very careful to outline where they agree and disagree and they have tried to be as explicit as possible.

These are interim reports, with both WWG and DWG indicating areas needing further work. Their principle purpose is to inform the deliberations of the Main Group of stakeholders in the dialogue and any related decisions or activities they might undertake. It is important to note that these are, therefore, interim reports to the Main Group of stakeholders in the dialogue.

Nothing can or should be inferred from the reports about the views of Main Group stakeholders on their contents, except where these views have been made explicit and appended to the reports.

Aim of the BNFL National Dialogue

The BNFL National Dialogue involves a wide range of organisations and individuals interested in or concerned about nuclear issues. Its aim is to inform BNFL's decision-making process about the improvement of their environmental performance in the context of their overall development. The dialogue is open to national organisations and regional groups as well as well as expert and specialist concerns. If you believe you are affected by the issues, think you can contribute or wish to participate then please contact The Environment Council on 020 7632 0117.

History of the BNFL National Dialogue to date

After a preparatory period, a large meeting of stakeholders in the activities of BNFL was held on 9th September 1998. This group identified and prioritised a list of issues and concerns that could be addressed in further meetings. “Reprocessing” and “Trust” headed the list of issues.

In December 1998 a smaller Task Group drawn from a range of organisations (listed below[1]) met to consider how the dialogue might move forwards. Early on it was decided that Trust could not be addressed as a separate issue; rather participants would have to see if it began to build through attempting to work together.

The Task Group recommended that the dialogue first address Waste and Discharges. It was thought these areas offered the best potential for finding some areas of agreement, however limited. These might in turn have an influence on related external developments like the implementation of OSPAR and the government's response to the House of Lords recommendations on the management of nuclear waste. Also it was thought that, as such a nuclear dialogue was unprecedented in the UK, Waste and Discharges offered the best opportunity for learning about the strengths and pitfalls of working together before attempting to address even more contentious issues like Reprocessing.

The Main Group of stakeholders met again in March 1999 to revise the proposed talks programme put forward by the Task Group. The Waste and Discharges working groups were formed and issued with draft terms of reference by the Main Group. Both WWG and DWG revised their terms of reference slightly in the light of the practicalities of the task in the timescale granted (March to November 1999). The amended terms of reference were forwarded to Main Group members in August 1999 and are given in each report.

The role of the convenor

The convenor of the dialogue is The Environment Council, an independent UK charity. The Environment Council is responsible for designing and facilitating each stage in the dialogue. The Council also provides or organises the relevant support, like issuing invitations and booking venues.

The Environment Council is not responsible for any issue discussed in the dialogue. The Environment Council holds no formal position on any of the substantive issues that are or might be considered. It is for the participants to decide what issues are raised, how they might be addressed and how any observations, conclusions and recommendations might be recorded and communicated.

The Environment Council, 28 February 2000

[1]The Task Group met on 14 December 1998. Note that participation in the Task Group in itself did not imply support for or disagreement with BNFL's activities or the National Dialogue. The Task Group consisted of a total of 14 people, as follows:

Mr Mark Fryer	Allerdale Borough Council
Mr Colin Duncan	BNFL
Ms Grace McGlynn	BNFL
Mr Tony Free	British Energy
Mr Robin Simpson	Copeland Borough Council
Cllr Anne Glendinning	Cumbria County Council
Mr Martin Forwood	Cumbrians Opposed to Radioactive Environment (CORE)
Mr Robert Gunn	DTI
Dr Alan Duncan	Environment Agency
Dr Patrick Green	Friends of the Earth
Mr John Kane	GMB
Mr Pete Roche	Greenpeace
Mr Steve Napier	IPMS
Mr David Mason	Nuclear Installations Inspectorate (NII)

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Executive Summary

This report summarises the progress made by a sub-group of 15 stakeholders from the overall group of 80, in providing guidance for BNFL's waste management strategy. It aims to provide a framework on which future work can build, and should be viewed as a 'work in progress' status report of one aspect of the overall Stakeholder Dialogue. The report also reflects some responses to the working group made by members of the main group following circulation of an earlier version of this report.

The initial group activities were aimed at understanding where the various waste streams originated and how they were dealt with. This led to a consensus that the early recovery and treatment of historic waste arisings into adequately long-lived forms for above ground passively safe, retrievable, monitorable storage and the prompt treatment of current waste arisings were priorities. Such a policy is acceptable in the interim in the absence of a final disposal or other long-term management solution.

There was further agreement that waste volumes should be minimised and that the policy and practice of interim storage may have implications for other operational issues. In particular, the timing and justification of decommissioning programmes must proceed against this "passively safe" policy background, though these were not examined by the group. BNFL's current waste management policy for its interim treatment programme aims to deal with historic waste arisings meets these priorities. Such an interim approach provides adequate containment and conditioning while longer-term strategies are developed. There is NGO concern that the current vitrification programme could not be described as prompt and might slip further. However, BNFL contends that the current programme optimises the vitrified waste volume, and must be met to comply with BNFL's business commitments, which are monitored by the regulator**.**

It was also agreed that at the outset of this interim phase it is essential that a comprehensive review of the safety and feasibility of disposal is carried out. The NGO participants of the WWG argued that it should not be presumed that this scientific review would indicate that disposal could go ahead. It is the opinion of the NGOs, based on their experience of the various Nirex proposals, that the scientific problems with disposal are intractable and that the interim above ground passively safe retrievable monitorable storage policy needs to allow for this outcome. In this view, the interim above ground passively safe retrievable monitorable storage phase is adopted with the explicit recognition that currently available science does not offer a long-term solution.

The opposing view is that the science and safety of disposal will be generally accepted as satisfactory, but that a successful programme to develop and implement deep geological disposal will only be possible after the development of sufficient stakeholder group, public and political consensus on this.

Much of the further work of the WWG was focused on the examination of scenarios covering the range of possible lifetimes of the Magnox reactors, and of Magnox and THORP reprocessing. These addressed both stopping and continued reprocessing and whether or not plutonium and reprocessed uranium were considered as a waste. After iterative questioning there was consensus about the outcomes of the scenarios in terms of the wastes which would be generated, though there was disagreement as to which should be adopted. A problem was raised by the failure to mention the possibility of Magrox fuel at an early stage, and the implications of this for future work have been taken on board. Nonetheless, the WWG believes that the nine scenarios developed by the WWG provide a framework within which strategic options can be considered objectively. The scenarios could provide a framework for all research and analysis conducted in connection with the BNFL Stakeholder Dialogue.

The Magnox cases, ranging from 'stop reprocessing now' to 'reactor life extension' gave a maximum variation from the current business plan of + 3% to - 5% on the total UK inventory, rising to + 6% to - 8% if decommissioning wastes are excluded.

The HLW picture (and the implications for the continued reprocessing of Magnox fuel through B205) is more contentious. The 'Stop Now' variant refers to the immediate cessation of Magnox reprocessing, which would result in the cessation of Magnox electricity generation. This would leave around 6,600 te Magnox fuel in core and in pond to be managed as HLW. The WWG acknowledged that the choices available in terms of the immediate cessation of Magnox reprocessing are very limited - with an operational regime in which reprocessing is the only short-to-medium-term viable option given a wet handling route at most magnox stations, the absence of alternative dry storage, and the uncertainties involving the achievement of long term passively safe storage for this highly reactive fuel. This fuel must be maintained under quiescent or inert conditions. Its wet or dry storage in its current form would involve commitment to maintaining safety systems and procedures which would impede the achievement of passive safety criteria. It was also noted that the planning, procedural requirements and construction of dry stores would take at least 6 years, and that during the construction phase, 'in pond' and possibly 'in core' Magnox fuel would have to be reprocessed. The small difference in waste arisings between 'Stop Now' and the Reference Case led to a reluctant acceptance by the NGOs that the latter could be supported, although the WWG recognises that the choice of future reprocessing and Magnox generation strategy would not be made on the basis of waste volumes alone (see para 2.2).

The WWG considers that dry storage of magnox fuel in its current form, although technically feasible, does not meet the objective of long term passively safe storage. To do so would require research and development of dry handling routes and/or drying facilities, as well as the definition, construction and operation of a facility to condition the fuel into a form suitable for passive storage which did not preclude eventual disposal, followed by suitable interim storage.

Even so, some parties in the main Stakeholder Dialogue group maintain the view that these practical difficulties could be overcome. While accepting the possible need to reprocess some Magnox spent fuel which is already wet and corroded, they would advocate maximising the amount of Magnox fuel, currently in stores or ponds, going into dry storage.

This will clearly be a matter for discussion at future working groups.

The agreement on scenarios did not, however, extend to the 'Blue Sky' case, where the amount of extra fuel reprocessed, at nearly 11,000te (with its attendant separation of plutonium) over the 'Reprocess Existing Fuel' case, would be considered by the NGO's to justify a further overall review by the Spent Fuel Management Options Group.

THORP ILW volumes from five scenarios covering the range from 'stop now' to 'full three decades of operation' gave a maximum variation from the current business plan of + 4% to -4% on the total UK inventory, rising to +8% and -7% if decommissioning wastes are excluded.

There is no significant difference between vitrified HLW arisings in the current business plan and the maximum case as additional THORP business is assumed to come from overseas. Even without substitution, HLW will be returned to overseas customers. The only difference between the scenarios is thus that the extra HLW that is generated is stored at Sellafield prior to vitrification and export. Reductions below the current business plan see increases in HLW volumes as more AGR spent fuel (which has a greater HLW volume) is considered to be directly disposed or stored.

The WWG noted, however, that in the case of AGR fuel the impediments to direct disposal were not as compelling as those associated with Magnox fuel. The industry representatives did, however, point out that some conditioning would be necessary before disposal, and there were still some technical questions on the ease and longevity of long term storage.

Substitution would give increases in the ILW volumes remaining in the UK (assuming the Magnox current business plan) ranging from 7% in the maximum THORP case to 1% for the Stop Now scenario. This increases to 13% and 2% if decommissioning wastes are excluded. HLW volumes requiring disposal in the UK would decrease by 7% in the Current business plan, increasing to - 22% in the maximum THORP case. These figures make no allowance for the spent fuel which may require management. This is 3300 m^3 of fuel -from Sizewell B and the AGR programme. With this included in the total the -7% becomes -2% and the -22% becomes -6%.

The WWG agreed that waste volumes alone would not provide a definitive judgement on either reprocessing or substitution, and that other factors such as transport, the precautionary principle, inter-generational equity, sustainability and socio-economic factors would need to be evaluated. Similarly the group could not agree on a favoured THORP scenario, but recognised that the waste volumes provided an input to the succeeding group on reprocessing, which would need to consider other factors such as discharges, Pu use, and socio-economic factors.

Waste storage was examined across the range of scenarios, and the planned storage was found to be adequate for all but the maximum scenarios, where extra stores may be needed. The storage of AGR fuel which would be required under the 'baseload' or 'stop THORP now' scenarios would have other implications beyond those relating directly to the fuel and volumes, such as planning, worker dose and the impact on discharges etc.

Longer term, in the absence of a positive consensus on disposal, the conversion from interim to potentially permanent storage would have regulatory, planning and public acceptance implications. An immediate implication is that the length of the planning approval, 30 years, is considerably less than the assumed lifetime of the buildings.

Apart from Sizewell B, all the planning and socio-economic implications of potentially permanent storage are at Sellafield unless AGR fuel is stored at reactor site of origin. This could also be an implication of the re-examination sought if the maximum Magnox case is adopted.

The work of the WWG has been limited to evaluation and comparisons which could be performed within the waste area. Real decision making on future scenarios requires the evaluation of factors in other areas, for example safety, discharges, stored products, generation, costs, and practicalities of the management of raw waste, hazards, social factors, transport and the like. These comparisons will be central to the work of future groups, and the methodology by which this is achieved will be the major challenge of this work.

The different scenarios:

- will have different discharge implications which need to be taken into account.
- produce different amounts types and forms of stored waste which may give differing risks and hazards.
- will affect Company income streams and therefore the ability to fund action.
- will produce differing amounts of potentially reusable Pu and U which would have implications if waste policies change or these materials were to be managed in an equivalent regime.

- will give different occupational doses which needs to be factored into decision making
- could give differing or continuing needs for transport
- will give differing socio-economic effects which must be evaluated
- will have differing public and political acceptability aspects over the range of stakeholders
- will give differing regulatory considerations
- will have safeguards, proliferation implications and institutional control aspects that need to be taken into consideration

With time the weight attached to each of the factors will change and this must be acknowledged by the Company and future Working Groups.

Socio-economic effects are accepted as crucial to the development of nuclear waste management. However there is a paucity of empirical data upon which to base evaluation. Research must be commissioned by the Company in partnership with stakeholders to model socio-economic effects. The study should look primarily but not solely at West Cumbria and should be conducted through a mutually acceptable process.

There is a fundamental divergence of views within the group on the role and appropriateness of reprocessing. This led to summaries of BNFL and NGO views being attached as appendices to the report. Nevertheless, while there will doubtless be challenging discussions, the WWG sincerely hope that after the full and exhaustive conclusion of the work of future working groups, the stakeholders will be in a position to make a set of balanced, realistic and self-evident recommendations to the company which will significantly enhance its stated desire to improve its environmental performance.

1. Introduction, Terms of Reference and Methodology

1.1. This report aims to summarise the progress achieved by the waste working group (WWG) which was convened as a sub-group of the BNFL stakeholder dialogue process. This process has the overall objective of making recommendations to the company in respect of ways it can improve its environmental performance. At the May meeting of the WWG this objective was refined as 'to review and recommend a strategy or strategies to guide BNFL's management of radioactive waste.' The full Terms of Reference of the group, developed through successive meetings, are attached as Appendix 5.

1.2. The dialogue process involves circa 80 stakeholders from whose ranks were drawn two working groups of approximately 15 people to examine the issues of waste and discharges. The other issues of reprocessing and plutonium/mixed oxide fuel will subsequently be considered by working groups whose composition will be the subject for debate at the November meeting of all stakeholders engaged in the process. Our task in the WWG and the information contained in this report is to support and underpin the work of those working groups and thereby to inform the dialogue process to help it achieve its objective. The membership of the WWG is given in Appendix 2.

1.3. In a series of four meetings from May to October, the WWG examined the issues surrounding the generation of nuclear waste and its management at Sellafield. A major part of the work was to agree on illustrative waste profiles for various operational scenarios. This interim report summarises the findings, which we hope will help the deliberations of other working groups and of those engaged in the wider dialogue process.

1.4. It was decided by the WWG that to append every document produced in the course of deliberations would be impractical. Two key papers ’BNFL Response to Waste Working Group Request for Waste Scenario Analysis’ and ‘NGO Views on Reprocessing following BNFL Documentation’ have been included as Appendices 3 and 4. All other documents either considered or generated by the Working Group are listed in Appendix 1. These documents are available from The Environment Council and interested parties may request them via Schia Mitchell.

2. Outline of the Process of the Working Group

2.1. The WWG initially had a brief visit to Sellafield waste treatment facilities to increase mutual awareness of the issues and current practices. This was followed by a presentation by BNFL on the waste arisings, flowsheets and treatments currently anticipated for the site. This led to an extensive activity of deciding what issues the WWG thought important. In particular, there was a pressing need to understand, and agree on, the waste arisings from different scenarios, and to be able to relate these to the publicly available documentation – principally the National Waste Inventory published by UK Nirex.

2.2. There was however early agreement that under any scenario there was waste which needed to be treated and safely stored. There was also agreement that the process, and in particular the science, of disposal needed to be reviewed in the light of the Nirex failure. It was also agreed that the waste results, whatever they were, could not stand alone, but must be viewed against other factors such as discharges, costs, financial factors, licensing issues (OSPAR, planning permissions etc.) and socio-economic factors.

2.3. During and between subsequent meetings the necessary work was done to reach a consensus on waste arisings from different scenarios. Suitable scenarios were then selected for study – allowing the key differences between scenarios to be understood.

2.4. This also led to a clarification of the relative technical difficulties posed by the various waste forms, and hence by the results of the various scenarios. In turn, an informed discussion on these results led to a measure of consensus on which scenarios are untenable, and a clear view of the points of disagreement on the others.

2.5. The WWG feels that both agreements and disagreements are now clear and based on a shared knowledge platform, and can be passed on to the succeeding activities as a firm basis for further work.

2.6. It is hoped that the waste profiles produced by the WWG for various scenarios and the discharge implications of these as considered by the DWG can then be evaluated against the issues of reprocessing, MOX, and the socio-economic consequences which different scenarios entail. While recognising that some potentially serious differences may need to be overcome, it is hoped that from this matrix of information a critical path would emerge to suggest a proposed programme of actions which would best achieve the stated goal of 'improving the company's environmental performance

3. Group Discussion

3.1. The WWG spent some time discussing waste management policy and practice following the Nirex Inquiry decision. The House of Lords have recommended that the disposal programme be immediately relaunched. This view was not shared by members of the WWG.

3.2. The group considered that consensus on the current science of disposal was not sufficiently robust to be able to say with any confidence that disposal could be undertaken now or at some time in the future. Disposal was defined as an operation after which the need for human intervention is removed and the subsequent environmental consequences are deemed to be acceptable.. Simply relaunching the disposal programme would be likely to lead to a repeat of the mistakes of the past and would not result in a scientifically, publicly and politically acceptable programme for the treatment of waste.

3.3. The WWG agreed that whatever the views of the different participants about future operating scenarios for the company, or the nuclear industry generally, as a result of past operations a historic legacy of wastes exists – much of which is still in a raw untreated form – and that this waste has to be managed

3.4. There was a consensus that the priority for the company, and in relation to radioactive wastes generally, was for the prompt treatment of current and the early recovery and treatment of historical waste arisings into adequately long-lived forms for above ground passively safe retrievable monitorable storage. Such a policy is acceptable in the interim in the absence of a final disposal or other long term management solution.

3.5 WWG participants agreed that BNFL's current treatment policy for its historical waste arisings aims to meet this criterion. Such an interim approach allows time for further development work on a longer term approach to be carried out. There is NGO concern that the current vitrification programme could not be described as prompt and might slip further. However, BNFL contends that the current programme optimises the vitrified waste volume, and must be met to comply with BNFL's business commitments, which are monitored by the regulator.

3.6. Future issues relating to Plutonium management and the potential role of High Active Waste in its deposition are subjects for future working groups.

3.7. A further consensus was that in any future scenario, the waste volume should be minimised.

3.8. The WWG also agreed that, at the outset of this interim phase it is essential that a comprehensive review of the safety and feasibility of disposal is carried out. The NGO participants of the WWG argued that it should not be presumed that this scientific review would indicate that disposal could go ahead. It is the opinion of the NGOs, based on their experience of the Nirex various proposals, that the scientific problems with disposal are intractable and that the interim above ground passively safe retrievable monitorable storage policy needs to allow for this outcome. In this view, the interim above ground passively safe retrievable monitorable storage phase is adopted with the explicit recognition that currently available science does not offer a long term solution.

3.9. The opposing view is that the science and safety of disposal will be generally accepted as satisfactory, but that a successful programme to develop and implement deep geological disposal will only be possible after the development of sufficient stakeholder group, public and political consensus on this.

3.10. The WWG agreed that the policy and practice of interim storage may have implications for other operational issues. In particular, the timing and justification of decommissioning programmes must proceed against this policy background. Safeguards, proliferation implications and institutional control are also matters that need to be taken into consideration.

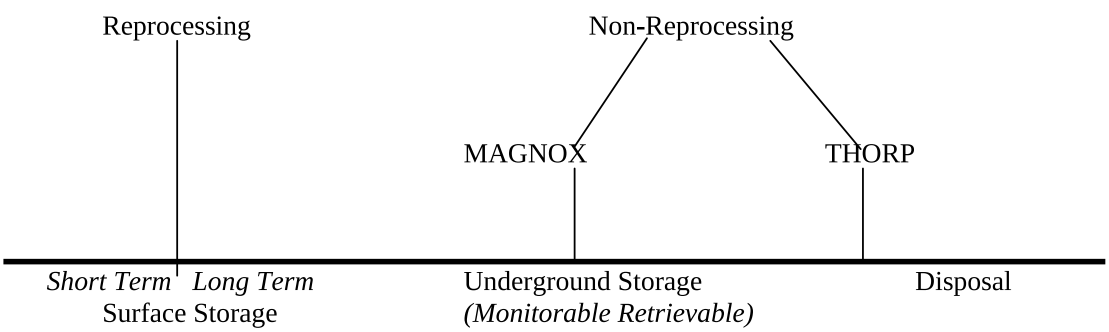
3.11. The WWG agreed that the absence of a demonstrably scientifically safe long-term final solution meant that practices which exacerbate waste management problems must be constrained to actively minimise the creation of further wastes.

3.12. This means that the company's adoption of interim above ground passively safe retrievable monitorable storage needs to be accompanied by an active science and engineering programme which examines the viability of future options post the 50-100 year life of the stores. Such options could include further periods of surface storage (both short and long term), or monitorable and retrievable underground storage or disposal if this could be demonstrated as inherently safe. These options are illustrated below:

Current Programmes

Current Waste from reprocessing	Legacy Waste (Stored unconditioned)	Decommissioning Waste
Direct Conditioning and Storage	*Early Retrieval Conditioning and Storage*	*Decommission as soon as reasonably achievable*
		Early conditioning and storage

Future Developments



3.13. This process could be linked to the planning timetable for the company's stores - it was noted that planning permission expires before the life the stores

3.14. The adoption of an interim above ground passively safe retrievable monitorable policy needs to be accompanied by a policy and practice of actively seeking to minimise the waste volume and radioactive content of the waste form.

3.15. There was disagreement about the interpretation of this agreement. The NGO participants of the WWG considered that this meant that no more waste should be produced, whereas the Company participants argued that a few percent extra from future operations would make little overall difference to scale of the overall waste management problem.

3.16. The WWG agreed that choice between these views would depend on a number of factors including the characteristics and toxicity of the waste form, the available storage capacity and also economic, political and social considerations.

3.17. However, the WWG agreed that wastes should not be produced in a form which cannot be stored in a passively safe form and which are deemed incompatible with potential future storage or disposal options. The WWG also agree that the priority for existing wastes is to achieve a passively safe form.

3.18. Within this framework, the WWG examined a number of scenarios for the future operational practice of the company - though there was disagreement as to which should be adopted. These addressed both stopping and continued reprocessing and whether or not plutonium and reprocessed uranium were considered as a waste.

4. Choice and Consideration of Different Scenarios

4.1. The WWG chose a number of scenarios which covered the likely range of possibilities. This section presents these basic programme scenarios and the associated waste information which was used by the WWG in its evaluation. Discussion of the data is undertaken in Section 5.

4.2. The overall examination of all waste volumes was carried out against the background of an understanding of the figures for the whole life of the current UK programme given, under defined assumptions, in the 1998 Inventory.

4.3. The main assumptions in this inventory are:

Waste Categories

- The inventory does not include materials which are not currently classified as waste. Subsequent table therefore do not include plutonium or reprocessed uranium.

Reactor Lifetimes

- The assumption for Magnox stations is that Calder Hall and Chapelcross operate for 45 years and that other Magnox reactors operate for an average of 37 years.
- The assumption for British Energy stations is that the AGRs will have an average lifetime of 30 years and Sizewell B will operate for 40 years

Reprocessing

- Based on the assumed reactor lifetimes Magnox reprocessing is scheduled to continue until 2008/9. The total amount of fuel reprocessed after April 1998 (the reference date for the Inventory) is 11,500 te.
- The THORP reprocessing scenario is that reprocessing will continue until 2013/14 by which time a total of 12,400 te of fuel will have been reprocessed. This 12,400 comprises 5,600 te of AGR fuel (for which contracts have been signed) and 6,800 te of LWR fuel (of which 5,200 te is currently subject to contracts).

4.4. Note that all fuel remaining unreprocessed is considered, in the following tables, to be directly disposed. In the event that a long-term storage scenario is ultimately adopted (after the review of disposal science envisaged in, for example, paras 3.7, 6.3), the tonnage quantities will remain unchanged but the volume may vary with the regime adopted.

Using the above assumptions, the overall inventory figures are summarised in Tables 1 and 2.

Table1. Total UK ILW Arisings - 1998 UK Inventory

	ILW Volume / m^3	
	Operations	Decommissioning
BNFL (Sellafield, Calder & Chapelcross)	79,806	31,591
BNFL (Reactor sites)	13,490	28,507
BNFL (Other)	334	78
British Energy	7,297	24,088
UKAEA	12,621	8,332
Ministry of Defence	3,275	4,789
Urenco	4	
Nycomed Amersham	665	
Others	68	
	117,560	97,385

Table 2. Total UK HLW Arisings - 1998 UK Inventory

	Volume / m^3
	HLW
BNFL (Sellafield, Calder & Chapelcross)	1,864
UKAEA	22
	1,886

4.5. A number of future scenarios were defined for the Magnox and THORP programmes which spanned the range from a prompt end to reprocessing (taken as end 1999) to the company's 'Blue Sky' maximum projections. The following summary and commentary is largely taken from 'BNFL Response to Waste Working Group Request for Waste Scenario Analysis' which is available to all main group members and is referenced in Appendix 3. The National Inventory was used as the basis for the analyses as it is the most authoritative and comprehensive data set, and is publicly available. It is recognised that using the national inventory as the basis for the scenarios, give slightly smaller percentage differences than would be obtained by referring changes to the BNFL waste alone, as BNFL wastes account for the large majority of the inventory.

4.6. The conversion from these scenarios to operational waste volumes is underpinned by the relationships shown in Table 3.

Table 3. Unit Rates of ILW and HLW Arising From Reprocessing - 1998 UK Inventory

	Waste volume / m^3/te	
	ILW	HLW
Magnox	1.2	0.02
AGR	0.8	0.08
LWR (reduction in reprocessing*)	0.8	0.08
LWR (increase in reprocessing*)	0.8	0.12

***** when compared to existing contracts

4.7. Magnox

The four Magnox scenarios are shown in Table 4, and their resulting waste volumes in Tables 5-7.

M1. The 'Stop Now' case terminates Magnox reprocessing at the end of 1999.
M2. The 'Reprocess Existing Fuel' case shuts down the reactors at end 1999, and reprocesses the fuel then in ponds and in the reactors. This leads to a cessation of Magnox reprocessing in about 2005/6 .
M3. The 'Current business plan' case is based on BNFL's current business plan with an average reactor lifetime of 37 years. This gives an end to Magnox reprocessing in about 2008/9.
M4. The 'Blue Sky' case assumes a life extension to 50 years.

Table 4. Magnox scenarios (te fuel reprocessed from 1/4/98)

	te reprocessed post 1/4/98	Variance from current business plan /te
M4. Blue Sky	19,000	+7,500
M3. Current business plan	11,500	0
M2. Reprocess existing fuel	8,100	-3,400
M1. Stop now	1,500	-10,000

NB above figures rounded to the nearest 100 te. More than 40,000 te fuel reprocessed prior to 1/4/98

Table 5. Impact of Magnox reprocessing scenarios on waste volumes

	Variance of waste volumes / m^3	
	ILW	HLW
M4. Blue Sky	+10,000	+150
M3. Current business plan	0	0
M2. Reprocess existing fuel	-5,000	-70
M1. Stop now	-13,000	-200

Table 6. Impact of Magnox reprocessing scenarios on ILW volumes. Note: this includes variations in reactor operating wastes due to differing reactor lifetimes.

	Conditioned waste volumes / m^3		
	Operations	Decommissioning	Total
M4. Blue Sky	128,000	97,000	225,000
M3. Current business plan	118,000	97,000	215,000
M2. Reprocess existing fuel	113,000	97,000	210,000
M1. Stop now	105,000	97,000	202,000

Note All scenarios assume that THORP operates as per THORP current business plan scenario. All figures rounded to the nearest 1,000 m^3. Note: this includes variations in reactor operating wastes due to differing reactor lifetimes.

Table 7. Variation in Magnox vitrified HLW volumes

	HLW Volume / m^3	Spent Fuel requiring management - te
M4. Blue Sky	970	0
M3. Current business plan *	820	0
M2. Reprocess existing fuel	750	0
M1. Stop now	620	6,600

* Note All scenarios assume that THORP operates as per THORP current business plan scenario. All figures rounded to the nearest 1,000 m^3

4.8. THORP

Five THORP scenarios were examined – each with and without substitution.

T1: Reprocessing is terminated now (end 1999) - with and without substitution
T2: THORP Baseload Contracts - with and without substitution
T3: THORP Fulfil existing contracts - with and without substitution
T4: BNFL current business plan with and without substitution
T5: Blue sky - defined as 3 full decades of THORP operation -with and without substitution.

The amounts of fuel reprocessed in these scenarios is given in Table 8, with THORP ceasing reprocessing from end 99 (Stop Now) to end of third decade (2020+) for ‘Blue Sky’.

Table 8. THORP scenarios (lifetime te)

Scenario	Tonnes Fuel Reprocessed			Variance from current business plan /te		
	Te reprocessed post 1/4/98					
	AGR	LWR	Total	AGR	LWR	Total
T5. Blue Sky	5,600	17,900	23,500	0	+11,100	+11,100
T4. Current business plan	5,600	6,800	12,400	0	0	0
T3. Fulfil existing contracts	5,600	5,200	10,800	0	-1,600	-1,600
T2. Baseload	2,200	4,800	7,000	-3,400	-2,000	-5,400
T1. Stop now	1,100	1,800	2,900	-4,500	-5,000	-9,500

NB additional fuel for blue sky assumed to be overseas LWR (Light Water Reactor).

These scenarios produce the wastes and variances shown in Table 9 if substitution is not enacted and all ILW is returned to overseas customers. Substitution of LLW only, which is current government policy, was not examined, as LLW volumes have not been included in this report.

Table 9. Impact of THORP reprocessing scenarios on ILW volumes
(assumes no substitution - i.e. ILW is returned to overseas customers)

	Conditioned waste volumes / m^3				
	Operations wastes			Decommissioning	Total
	Generated	Returned	Remaining		
T5. Blue Sky	127,000	15,000	112,000	97,000	209,000
T4. Current business plan	118,000	6,000	112,000	97,000	209,000
T3. Fulfil existing contracts	117,000	5,000	112,000	97,000	209,000
T2. Reprocess baseload fuel only	114,000	4,000	110,000	97,000	207,000
T1. Stop now	110,000	2,000	108,000	97,000	205,000

The variants in reprocessing give the variations in waste generated as seen in Table 10.

Table 10. Impact of THORP reprocessing scenarios on volume of waste generated

	Variance of waste volumes / m^3	
	ILW	HLW
T5. Blue Sky	+9,000	+1,330
T4. Current business plan	0	0
T3. Fulfil existing contracts	-1,000	-190
T2. Reprocess baseload fuel only	-4,000	-500
T1. Stop now	-8,000	-820

The volume of ILW which would be returned to overseas customers is seen in Table 11, with the resulting UK inventory from THORP given in Table 12.

Table 11. Volume of ILW which could be returned to overseas customers

	Volume of waste returned in the absence of substitution /m^3
T5. Blue Sky	15,000
T4. Current business plan	6,000
T3. Fulfil existing contracts	5,000
T2. Reprocess baseload fuel only	4,000
T1. Stop now	2,000

Table 12. Impact of THORP reprocessing scenarios on ILW volumes
(assumes that substitution takes place - i.e. all ILW remains in the UK)

	Conditioned waste volumes / m^3		
	Operations	Decommissioning	Total
T5. Blue Sky	127,000	97,000	224,000
T4. Current business plan	118,000	97,000	215,000
T3. Fulfil existing contracts	117,000	97,000	214,000
T2. Reprocess baseload fuel only	114,000	97,000	211,000
T1. Stop now	110,000	97,000	207,000

Note: All scenarios assume that Magnox reprocessing continues according to the Magnox current business plan scenario. All figures rounded to the nearest 1,000 m^3

4.9. Storage

All the above scenarios were examined against the current BNFL plans for waste stores and against the outline planning permissions already granted. The BNFL document already referenced groups the stores into four groups:

- Encapsulated Product Stores (ILW)
- Engineered Drum Stores (PCM – Plutonium Contaminated Material)
- MBGWS (Miscellaneous Beta/Gamma Waste Store)
- VPS (Vitrified Product Storage - HLW)

The conclusions are that only if the ‘Blue Sky’ scenario materialised for both Magnox and THORP would extra stores over current plans be predicted: one each for the first three stores groups. In the event the expectation would be that improvements in waste volume generation would be sufficient to remove the need for stores additional to current plans.

5. Summary of Results of Scenarios

Magnox

5.1. The range of ILW volumes from the Magnox scenarios (THORP current business plan) is shown in Figure 1. The maximum variation from the current business plan is + 3% to - 5% on the total UK inventory, rising to + 6% to - 8% if decommissioning wastes are excluded. The minimum volume is associated with the scenario involving an immediate cessation of reprocessing. If the minimum scenario was considered to be reprocessing of existing fuel, the range would become + 3% to - 2% (or + 6% to - 3% if decommissioning wastes are excluded).

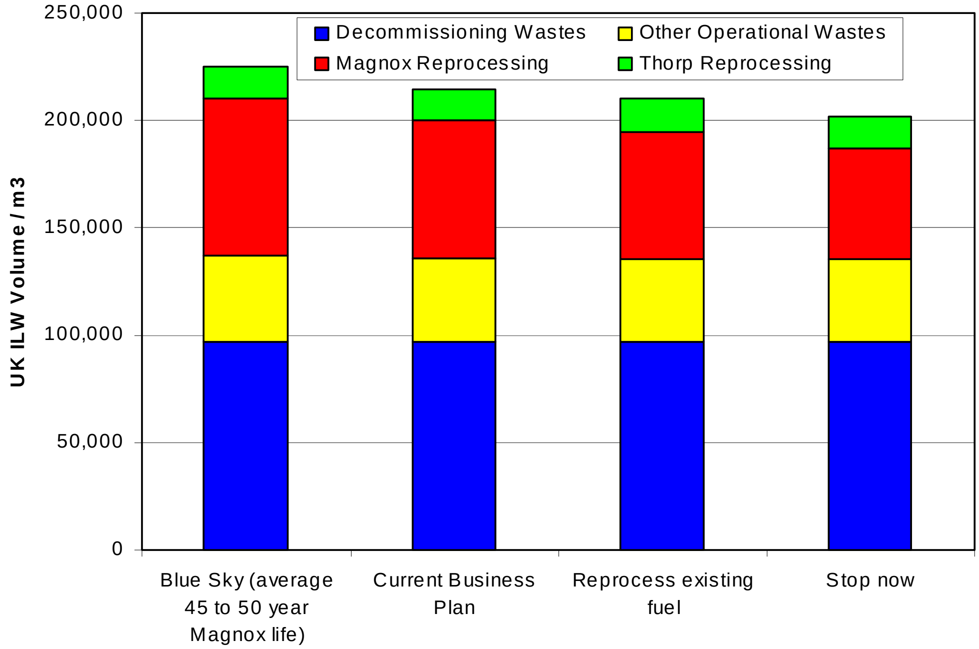


Figure 1. ILW volumes, Variation in Magnox reprocessing only. (Data from Table 6)
'Other operational wastes' includes all UK operational wastes other than from reprocessing, including waste from reactor operation.

5.2 The HLW picture (and the implications for the continued reprocessing of Magnox fuel through B205) is more contentious. The 'Stop Now' variant refers to the immediate cessation of Magnox reprocessing, which would result in the cessation of Magnox electricity generation. This would leave around 6,600 te Magnox fuel in core and in pond to be managed as HLW. The WWG acknowledged that the choices available in terms of the immediate cessation of Magnox reprocessing are very limited - with an operational regime in which reprocessing is the only short- to-medium-term viable option given a wet handling route at most magnox stations, the absence of alternative dry storage, and the uncertainies involving the achievement of long term passively safe storage for this highly reactive fuel. This fuel must be maintained under quiescent or inert conditions. Its wet or dry storage in its current form would involve commitment to maintaining safety systems and procedures which would impede the achievement of passive safety criteria. It was also noted that the planning, procedural requirements and construction of dry stores would take at least 6 years and that during the construction phase, 'in pond' and possibly 'in core' Magnox fuel would have to be reprocessed. The small difference in waste arisings between 'stop now' and the Reference Case led to a reluctant acceptance by the NGOs that the latter could be supported, although the WWG recognises that the choice of future reprocessing and Magnox generation strategy would not be made on the basis of waste volumes alone (see para 2.2).

5.3 The WWG considers that dry storage of magnox fuel in its current form, although technically feasible, does not meet the objective of long term passively safe storage. To do so would require research and development of dry handling routes and/or drying facilities, as well as the definition, construction and operation of a facility to condition the fuel into a form suitable for passive storage and which did not preclude eventual disposal, followed by suitable interim storage.

5.4. Even so, some parties in the main Stakeholder Dialogue group maintain the view that these practical difficulties could be overcome. While accepting the possible need to reprocess some Magnox spent fuel which is already wet and corroded, they would advocate maximising the amount of Magnox fuel, currently in stores or ponds, going into dry storage.

5.5. This will clearly be a matter for discussion at future working groups.

5.6. The agreement on scenarios did not, however, extend to the 'Blue Sky' case, where the amount of extra fuel reprocessed, at nearly 11,000te (with its attendant separation of plutonium) over the 'Reprocess Existing Fuel' case, would be considered by the NGO's to justify a further overall review by the Spent Fuel Management Options Group.

5.7 The amount of Pu and depleted uranium produced is directly proportional to the amount of fuel reprocessed, and this will have implications if waste policies change or these materials were to be managed in a regime equivalent to waste.

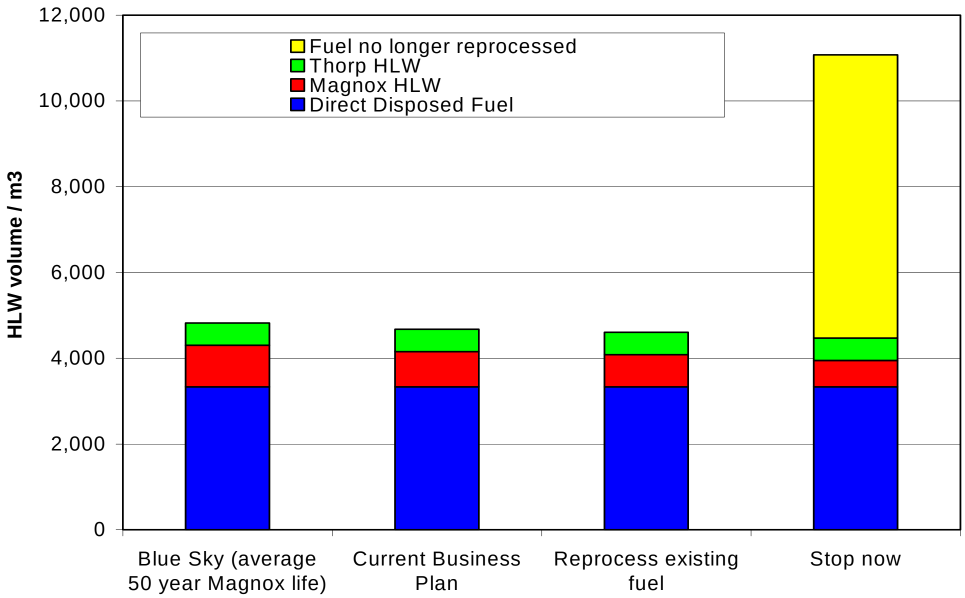


Figure 2. Volume of Magnox HLW (Data from Table 7)
'Direct disposed fuel' refers to Sizewell B and some AGR fuel.

THORP

5.8. The variations in the THORP ILW volumes from the five scenarios is seen in Fig 3. The maximum variation from the current business plan is + 4% to -4% on the total UK inventory, rising to +8% and -7% if decommissioning wastes are excluded.

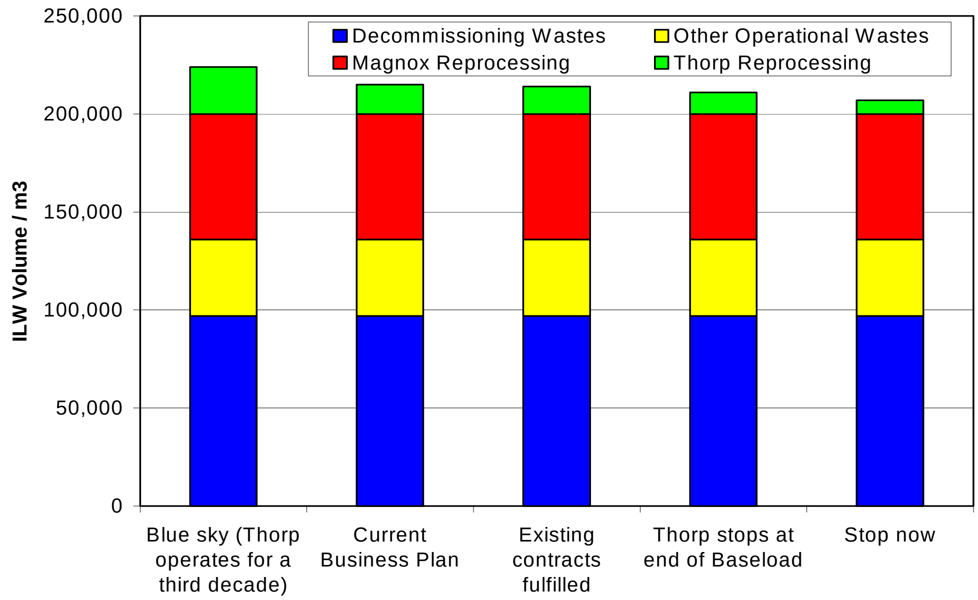


Figure 3. ILW Volumes, Variation in THORP reprocessing only, substitution assumed to take place and all ILW stays in UK (Data from Table 12) 'Other operational wastes' includes all UK operational wastes other than from reprocessing, including waste from reactor operation.
For the without substitution case, the effect on HLW volumes is seen in Figure 4**.**

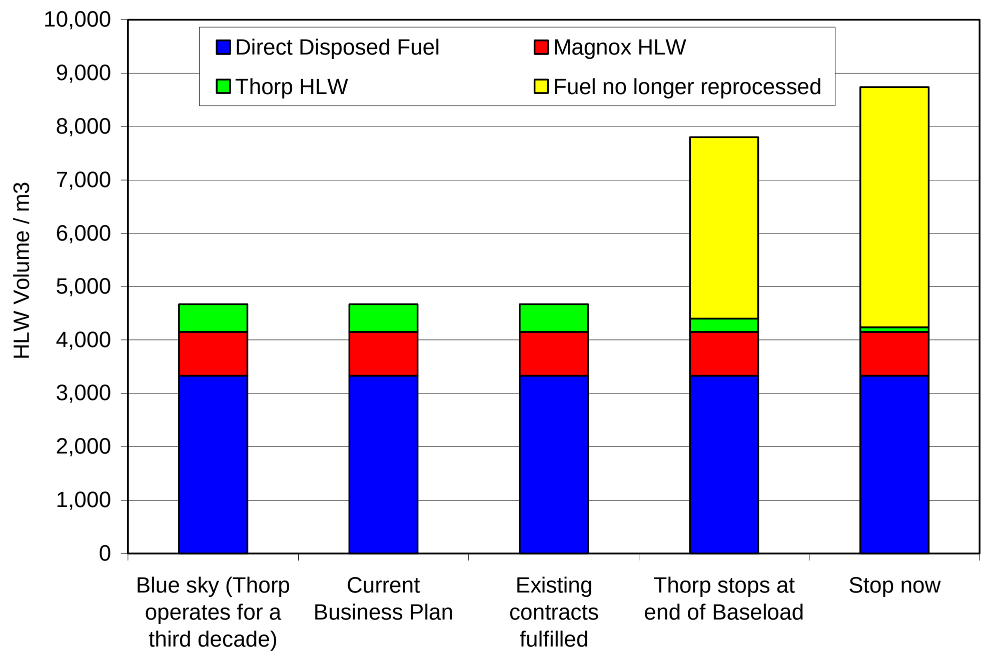


Figure 4. HLW Volumes, Variation in THORP reprocessing (no substitution)
(Data from Tables 2, 7, 10) 'Direct disposed fuel' refers to Sizewell B and some AGR fuel.

5.9. There is no significant difference between vitrified HLW arisings in the current business plan and the 'Blue Sky' case as additional THORP business is assumed to come from overseas. Even without substitution, HLW will be returned to overseas customers. The only difference between the scenarios is thus that the extra HLW that is generated is stored at Sellafield prior to vitrification and export.

5.10. Reductions below this see increases in HLW volumes as more AGR spent fuel (which has a greater HLW volume) is considered to be directly disposed or stored. The WWG noted, however, that in the case of the AGR fuel concerned, there was not the compelling case that long term passively safe storage is impractical. The industry representatives did, however, point out that some conditioning would be necessary and there were still some technical questions on the ease and longevity of long term storage.

5.11. The amount of Pu and depleted uranium produced for retention in the UK is directly proportional to the amount of AGR fuel reprocessed (provided that Sizewell B fuel remains stored), and this will have implications if waste policies change or these materials were to be managed in a regime equivalent to waste.

5.12. The impact of substitution on ILW volumes retained in the UK is seen in Figure 5.

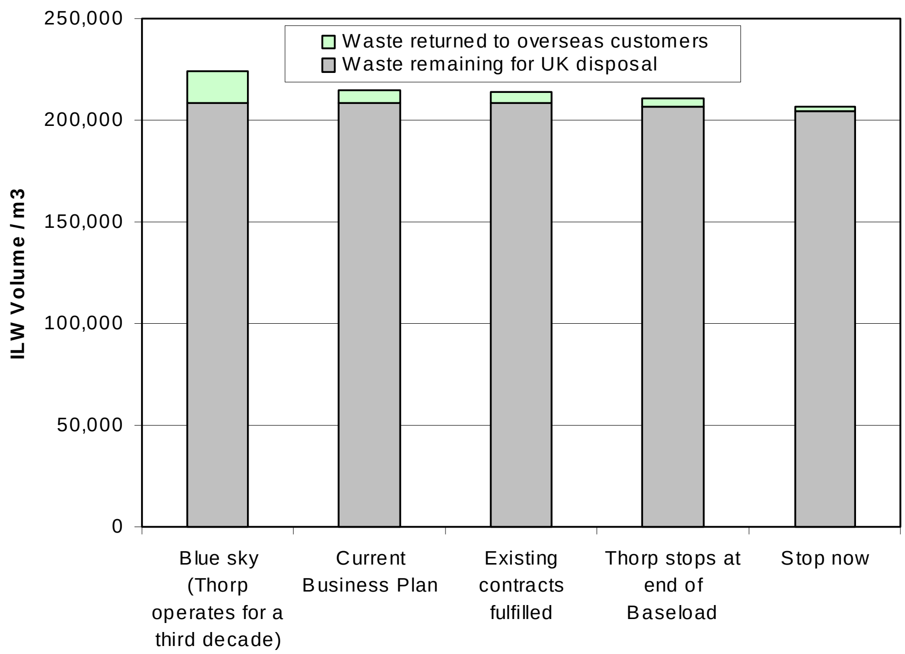


Figure 5. Impact of Substitution (Data from Tables 9, 12)

5.13. Substitution would involve increases in the ILW volumes requiring management in the UK ranging from 7% for the Blue Sky case to 1% for the Stop Now scenario. This assumes the current business plan Magnox reprocessing scenario and includes all wastes, including decommissioning wastes. If decommissioning wastes are excluded, the increase in ILW requiring disposal in the UK taking into account the impact of substitution range from + 13% for the Blue Sky scenario to + 2% for the Stop Now case. Assuming the current business plan Magnox reprocessing scenario, the difference in the volume of vitrified HLW requiring disposal in the UK would range from - 7% in the Current business plan to - 22% in the Blue Sky scenario if substitution is adopted. These figures make no allowance for the spent fuel which may require management. This is 3300 m^3 of fuel - from AGR's and Sizewell B. With this included in the total the -7% becomes -2% and the -22% becomes -6%.

5.14. The WWG agreed that waste volumes alone would not provide a definitive judgement on substitution, and that other factors such as transport and socio-economic factors would need to be evaluated. Similarly the group could not agree on a favoured THORP scenario, but recognised that the waste volumes provided an input to the succeeding group on reprocessing, which would need to consider other factors such as discharges, Pu use, and socio-economic factors.

6. Areas of Agreement

6.1. This report summarises the progress made by a sub-group of 15 stakeholders from the overall group of 80, in providing guidance for BNFL's waste management strategy. It aims to provide a framework on which future work can build, and should be viewed as a 'work in progress' status report of one aspect of the overall Stakeholder Dialogue.

6.2. The WWG considered a wide range of issues which are discussed elsewhere in this report. While many areas examined led to a restating of different views, there was a substantial degree of agreement on other issues which are listed below:

6.3. All waste, whether currently generated or derived from historical activities should be put into a conditioned form as soon as possible for passively safe storage and in a form which is deemed compatible with future storage and disposal options.

6.4. The consensus on science currently available to justify ultimate disposal is not universally accepted and must be reviewed.

6.5. The company's adoption of interim above ground passively safe retrievable monitorable storage needs to be accompanied by an active science and engineering programme which examines the viability of future options post the 50-100 year life of the stores. Such options could include further periods of surface storage (both short and long term), or monitorable and retrievable underground storage or disposal if this could be demonstrated as inherently safe.

6.6. There was broad acceptance of the waste volume figures for both THORP and Magnox contained in the final draft of the BNFL document 'Response to WWG Request'.

6.7. Due to operational and technical considerations and the reactive nature of spent Magnox fuel, it was agreed that to stop the reprocessing of Magnox fuel now (as defined in one of the waste scenarios and in practice referring to the end of the year) was not considered reasonably practicable and in terms of the small additional percentage of waste arisings was discounted in favour of the current business plan. This agreement, however, would require review in the event that the company made a policy decision to extend the lifetime of their Magnox plant.

6.8. The long term storage or direct disposal of Magnox fuel is likely to be more problematical than storage or the direct disposal of AGR fuel.

6.9. The waste management implications of substitution are not solely related to volume but may depend on other issues such as transport and socio-economic considerations.

6.10. There is adequate currently planned storage capacity for reprocessed wastes except for those which would arise under the 'blue sky', scenario.

6.11. The amount of storage of AGR fuel which would be required under the 'baseload' or 'stop THORP now' scenarios would have other implications beyond those relating directly to the fuel and volumes, such as planning, worker dose and the impact on discharges etc.

6.12. Issues relating to waste arisings and the management of those wastes under different scenarios cannot be considered from one narrow perspective. They must be considered alongside such issues as discharges, job implications and the overall impact which different management and operational options have on the broad socio-economic situation at a local, regional and national level.

7. Implications of Group Agreement

7.1. Facilities

- The long term storage of Magnox fuel is not contemplated by the group, but this should need to be re-examined if the Company were to opt to extend Magnox lifetimes. The stores currently planned will cover all programme options except the combined ‘Blue Sky’ for both THORP and Magnox.

- Long term interim storage of AGR fuel under ‘Stop THORP Now’ and ‘Baseload Only’ options would have implications over and above fuel storage volumes; e.g. planning permission, worker dose, discharges.

- The conversion from temporary to potentially permanent storage would require an ongoing programme of work to underwrite the life of the stores and the wasteform, and of programmes of store refurbishment or renewal, or of waste repackaging.

7.2. Planning and Regulatory

- The conversion from interim to potentially permanent storage would have regulatory, planning and public acceptance implications.

- One immediate implication is that the length of the planning approval, 30 years, is considerably less than the assumed lifetime of the buildings.

- All the planning implications for BNFL of potentially permanent storage are at Sellafield unless AGR fuel is stored at reactor site of origin. This could also be an implication of the re-examination sought if the ‘Magnox Blue Sky’ case is adopted.

7.3. Socio-economic

With the exception of Sizewell B all the socio-economic implications of potentially permanent storage are at Sellafield unless AGR fuel is stored at reactor site of origin. This could also be an implication of the re-examination sought if the ‘Magnox Blue Sky’ case is adopted.

The socio-economic implications of the scenarios are wider than simply a consideration of waste volumes and technical requirements for storage.

Other operational choices/timescales associated with the scenarios will have an impact on employment levels.

These socio-economic effects are important and must be modelled to allow the holistic consideration of the different scenarios.

The acceptability of long-term final management solutions will depend on a range of important issues such as:

- a demonstrably robust and accepted scientific and political consensus.
- multi-stakeholder agreement in respect of operational programmes
- public acceptability of the finality of the proposed solution to the waste problem
- a transparent and open-handed process

7.4. General

It would seem sensible for further work by succeeding groups to build on the scenarios defined by the WWG.

8. Recommendations and Suggestions for Future Work

8.1. This report summarises the progress made by a sub-group of 15 stakeholders from the overall group of 80, in providing guidance for BNFL's waste management strategy. It aims to provide a framework on which future work can build, and should be viewed as a 'work in progress' status report of one aspect of the overall Stakeholder Dialogue.

8.2. The WWG urges all stakeholders party to the dialogue process to accept the following principles, statements and positions, and to use these to inform and refine the task of making a final set of recommendations to the company through which it can improve its environmental performance.

- All existing waste and waste arisings must be packaged in passively safe, monitorable and retrievable interim storage in the shortest possible time.

- Subject to satisfactory performance and safety review, interim storage offers a feasible management option for 50 years and beyond but research must continue into long term storage and the possibility of disposal. The Company cannot rely solely on others: it must be actively involved in research.

- Within the next 50 years existing and future planning and regulatory controls will make it necessary to periodically revisit the adequacy of interim stores as consents expire, control regimes are improved or alters or as waste management policy is redefined The opportunity to revisit research, advancing technology, waste minimisation and compaction, against the background of changing values must be accepted.

- The Company must continue to successfully embrace change. The nine scenarios developed by the WWG provide a preliminary framework within which strategic options can be considered objectively. This framework could therefore be adopted and developed for use in all research and analysis conducted in connection with the BNFL Stakeholder Dialogue.

8.3.The work of the WWG has been limited to evaluation and comparisons which could be performed within the waste area. Real decision making on future scenarios requires the evaluation of factors in other areas, for example safety, discharges, stored products, generation and practicalities of the management of raw waste, hazards, social factors, transport and the like. These comparisons will be central to the work of future groups, and the methodology by which this is achieved will be the major challenge of this work..

8.4. The different scenarios:

- will have different discharge implications which need to be taken into account
- produce different amounts types and forms of stored waste which may give differing risks and hazards
- will affect Company income streams and therefore the ability to fund action
- will produce differing amounts of potentially reusable Pu and U which would have implications if waste policies change or these materials were to be managed in an equivalent regime
- will give different occupational doses which needs to factored into decision making
- could give differing or continuing needs for transport
- will give differing socio-economic effects which must be evaluated
- will have differing public and political acceptability aspects over the range of stakeholders
- will give differing regulatory considerations
- will have safeguards, proliferation implications and institutional control aspects that need to be taken into consideration

8.5. With time the weight attached to each of the factors will change and this must be acknowledged by the Company and future Working Groups.

8.6. Socio-economic effects are accepted as crucial to the development of nuclear waste management. However there is a paucity of empirical data upon which to base evaluation. Research must be commissioned by the Company in partnership with stakeholders to model socio-economic effects. The study should look primarily but not solely at West Cumbria and should be conducted through a mutually acceptable process.

8.7. The WWG did not consider timing of decommissioning as this must involve an overall evaluation, but this should be addressed in future work.

8.8. Whatever the complexion of future working groups as decided by the stakeholders at the November meeting, the WWG is of the opinion that the recommendations and findings associated with the scenarios examined in its work, together with the recommendations from the DWG, should form an information bank against which future discussions and examinations can be set.

8.9. As indicated above, we believe that the kernel of the work still to be carried out in the second round working groups will be the socio-economic impacts of the scenarios considered above.

8.10. As will be evident by much of the above, there is a fundamental divergence of views within the group on the role and appropriateness of reprocessing. For the guidance of future work on this topic, the Company's views are given in Appendix 3, and the NGOs have summarised their views in the document '"NGO Views on Reprocessing Following BNFL Documentation", attached as Appendix 4.

8.11.Process observation: The failure to mention the Magrox possibility during the initial scenario setting raised considerable concerns amongst NGO representatives. It was accepted that the scenarios examined in this document were proposed in order to examine the range of options and outcomes. The implications on waste volumes from the Magrox scenario are within this range. However the impact of Magrox on extended Magnox lifetimes could be significant and therefore it is very important that the company finds ways of discussing and examining any alternatives at an appropriate early stage as part of the stakeholder dialogue.

8.12. While there will doubtless be challenging discussions , the WWG sincerely hope that after the full and exhaustive conclusion of the work of future working groups, the stakeholders will be in a position to make a set of balanced, realistic and self-evident recommendations to the company which will significantly enhance its stated desire to improve its environmental performance.

Appendix 1

Papers Considered or Generated by the Waste Working Group

Appendix 1.
Papers Considered or Generated by the Waste Working Group

BNFL Ongoing Stakeholder Dialogue
Waste Working Group - Summary of Documents Circulated

Date:	**Document:**	**Provided By:**
27 May 1999	• Draft Groundrules - Main Group Meeting, 17 March 1999 - *The Environment Council*	The Environment Council
	• Draft Groundrules - Waste Working Group, 2nd Draft, 27 May 1999 - *The Environment Council*	The Environment Council
	• Waste Working Group Objectives/Success Criteria/Outcomes - Discussion Draft - *The Environment Council*	The Environment Council
	• NII's Regulation of Radioactive Waste Management and Decommissioning of Nuclear Licensed Sites - *HM Nuclear Installations Inspectorate*	David Mason, NII
	• Regulatory Aspects of Decommissioning in the UK - *David Mason, HM Superintending Inspector, Nuclear Safety Directorate*	David Mason, NII
	• Reality Check: Friends of the Earth Response to the Report by the House of Lords Select Committee on Science and Technology (Session 1998-99, 3rd Report, HL Paper 41) Management of Nuclear Waste - *Dr Rachel Western and Dr Patrick Green, Friends of the Earth*	Rachel Western & Pad Green, Friends of the Earth
17 June 1999	• Extract from "Radioactive Waste - Where Next?" - *Parliamentary Office of Science & Technology 1997*	Grace McGlynn, BNFL

17 June 1999	• Initial BNFL Response to House of Lord's Committee Conclusions and Recommendations - *BNFL* •	Colin Duncan, BNFL
2 July 1999	• Summary of the derivation of radiation dose limits and the actual impact of BNFL's activities Report 990266/01; 28 June 1999 - *D Jackson, B Lambers; Westlakes Scientific Consulting Ltd*	Gregg Butler, Westlakes Scientific Consulting
6 July 1999	• Stakeholder Dialogue - BNFL Response to Waste Working Group Questions • Sensitivity of waste volumes to reprocessing and substitution - *Gordon Bryan; BNFL* 6-7 July 1999 Copy of slides presented at Waste Working Group Meeting; 6-7 July 1999	Grant Gilmour, BNFL with Elaine Simpson and Gordon Bryan, BNFL Gordon Bryan, BNFL
26 July 1999	• NGO Comments on "BNFL Response to Waste Working Group Questions". 26 July 1999 - *Pad Green Friends of the Earth; Pete Wilkinson, Pete Wilkinson Environmental Consultancy*	Pad Green, Friends of the Earth
10 August 1999	• BNFL Stakeholder Dialogue Groundrules for the Working Groups 3rd Draft, 19 July 1999 - *The Environment Council*	The Environment Council
26 August 1999	• Socio-Economic Impacts	Brian White, Copeland Borough Council

27 August 1999	• BNFL Response To NGO Comments: Copy cover letter - *Grant Gilmour, BNFL* Response to Questions from NGOs - *G Bryan, Elaine Simpson, BNFL* • BNFL Response to Waste Working Group Request for Waste Scenario Analysis • Reprocessing Scenarios and Waste Volumes, PowerPoint presentation, *Gordon Bryan, BNFL*	Grace McGlynn, BNFL
7 October 1999	• NGO Views Following BNFL Documentation Produced 27 August 1999 - *Pad Green, Rachel Western, Pete Wilkinson* 6 October 1999	Pad Green, Friends of the Earth Pete Wilkinson, Wilkinson Environmental Consultancy

Appendix 2

Membership of the Waste Working Group

Appendix 2
Membership – Waste Working Group

Gregg Butler	Westlakes Research Institute
David Butler	British Energy
Simon Candy	BNFL
Grant Gilmour	BNFL
Pad Green	Friends of the Earth
John Kane	GMB
Grace McGlynn	BNFL
David Mason	NII
Keith Parker	BNIF
Derek Taylor	European Commission
Patrick Van den Bulck	CND
Brian White	Copeland Borough Council
Pete Wilkinson	Pete Wilkinson Environmental Consultancy
Jamie Woolley	UK Nuclear Free Authorities

With thanks to

Gordon Bryan	content specialist
Elaine Simpson	content specialist
Rachel Western	Friends of the Earth

And The Environment Council, facilitators

Important note:

The views in this report are those of the working group members and their respective organisations with the exception of regulators who represent current government policy only and the National Steering Committee of Nuclear Free Local Authorities which by the date of publication had not had the opportunity to endorse it.

The views expressed in the report may not reflect those of all the stakeholders present at the main group meeting on the 25/26 November 1999.

Appendix 3

BNFL Response to Waste Working Group Request for Waste Scenario Analysis

BNFL Response to Waste Working Group Request for Waste Scenario Analysis

THE ENVIRONMENT COUNCIL

Registered Charity No. 294075 Certificate of Incorporation No. 2004003 VAT No. 577 8121 11

1. Introduction

1.1 This document has been prepared as part of the BNFL ongoing stakeholder dialogue. It specifically responds to a request from the Waste Working Group meeting held on the 6th and 7th of July to provide information on the waste implications of various possible future scenarios. It is intended that this document be used as a common basis for future informed discussion on BNFL waste management strategy by members of the Waste Working Group only.

2. Structure of the Response

2.1 This scenario analysis document supersedes the information pack presented to the Waste Working Group on the 6th and 7th of July. For that reason, BNFL have responded separately to the questions pertinent to that pack. Future discussion on assumptions and data will focus on information directly related to the Scenario Analysis presented in this document.

2.2 The document has been structured to address different considerations outlined by the group related to waste generation, waste storage and treatment capacity, Pu and Uranium production and also the waste implications of not reprocessing spent fuel. The scenarios presented for proposed Magnox / Thorp operational lifetimes directly respond to those requested by the Waste Working Group. These scenarios are selected as realistic bounding cases from which to determine the waste implications and are not representative of any pre-determined BNFL operating strategy.

3. Scenario description and context

3.1 The scenarios requested at the Waste Working Group meeting were:

Magnox

Magnox 1: Reprocessing is terminated now (end 1999)
Magnox 2: BNFL Reference Case - business as usual, lifetime of 37 years
Magnox 3: Blue Sky - Lifetime extension to 50 years.

Thorp

THORP 1: Reprocessing is terminated now (end 1999) - with and without substitution
THORP 2: THORP Baseload Contracts - with and without substitution
THORP 3: THORP Post Baseload Contracts- with and without substitution
THORP 4: Blue sky - to be defined by BNFL-with and without substitution -

NB Blue Sky figure to be set at a level which might reflect the company’s most optimistic but never the less realistic ceiling.

3.2 Tables 3.1 and 3.2 below quantitatively define each scenario by the tonnes of fuel reprocessed.

Table 3.1

Magnox scenarios (te fuel reprocessed from 1/4/98)

	te reprocessed post 1/4/98	Variance from reference /te
Blue Sky	19,000	+7,500
Reference	11,500	0
Reprocess existing fuel	8,100	-3,400
Stop now	1,500	-10,000

NB above figures rounded to the nearest 100 te. More than 40,000 te fuel reprocessed prior to 1/4/98

Table 3.2

Thorp scenarios (lifetime te)

Scenario	Tonnes Fuel Reprocessed			Variance from reference /te		
	Te reprocessed post 1/4/89					
	AGR	LWR	Total	AGR	LWR	Total
Blue Sky	5,600	17,900	23,500	0	+11,100	+11,100
Reference	5,600	6,800	12,400	0	0	0
Contracted	5,600	5,200	10,800	0	-1,600	-1,600
Baseload	2,200	4,800	7,000	-3,400	-2,000	-5,400
Stop now	1,100	1,800	2,900	-4,500	-5,000	-9,500

NB additional fuel for blue sky assumed to be LWR.

3.3 As stated in paragraph 2.2 these scenarios respond directly to the scenarios generated at the Waste Working Group and are not a reflection of any intended future BNFL operational strategy.

4. Sources of waste and waste data

4.1 Radioactive wastes are generated from a wide range of activities. These include not only activities associated with the “nuclear industry”, but more general medical and industrial activities. Periodically the Department of the Environment, Transport and the Regions (DETR) and UK Nirex Ltd. (Nirex) commission the production of a national radioactive waste inventory. This comprises several volumes which contain data on the volume, radionuclide content, physical and chemical characteristics of not only the radioactive wastes that already exist in the UK, but those which are expected to be generated in the future. The document contains a very substantial amount of data and compilation and publication takes a significant amount of time. Publication of the 1998 Inventory (referred to in this document as the Inventory) is imminent.

4.2 The Inventory presents data in a number of ways. Volumes and activities are given for each waste produced on each site. Summaries are also produced which summarise the volume of waste produced at each site, by each operator, by each branch of the industry and by the whole country. Waste volumes are quoted in two states: as stored and conditioned. The as stored volume is the volume that the waste occupies before any treatment or packaging. For example the as stored volume of a liquid waste is simply the volume of the liquid. In many cases the as stored and conditioned waste volumes for a given waste stream are different. For example conditioning or treatment may involve evaporation or compaction which reduce the waste volume. Conversely the addition of cement powders to a liquid waste may result in a volume increase. The conditioned waste volume is the volume of waste once it has been conditioned or packaged into a container. *All waste volumes quoted in this report are conditioned waste volumes*.

4.3 The Inventory classifies all wastes according to the level of activity they contain. The main waste classifications are:

High Level Waste is any waste which generates sufficient heat that this factor needs to be taken into account in designing storage facilities. NB this is not a quantitative definition and in practice in the UK this classification is primarily applied to the concentrated fission product solution produced when uranium and plutonium have been extracted from dissolved nuclear fuel. (It is also applied to the vitrified waste form produced from this solution and redundant equipment contaminated with these materials). Spent fuel is generally not regarded as waste. However if reprocessing is curtailed any remaining fuel would be treated as HLW.

Intermediate Level Waste is any waste which exceeds the upper limit of Low Level Waste, but which is not High Level Waste.

Low Level Waste is any waste which contains not more than 4 GBq/te of alpha emitting nuclides and not more than 12 GBq/te of beta/gamma emitting nuclides per tonne of waste. NB in order to be accepted for disposal at Drigg, LLW must not only meet these criteria, but must meet waste acceptance criteria which in some cases place lower limits on activity content. This means that there are wastes which meet the formal LLW definition, but which cannot be disposed of at Drigg. This is particularly the case for wastes with a significant content of alpha emitting nuclides.

4.4 Within the Inventory each waste stream is assigned a unique identifier. This identifier contains 3 components: a number designating the waste producer, a letter identifying the site on which the waste is produced and a further number identifying the waste stream itself. Each waste stream is also given a brief description. For example stream 2D34 is given the descriptor SIXEP Sludge. The waste associated with reprocessing are given the codes 2D (Magnox), 2F(existing Thorp contracts) and 2H (fuel which is expected to be reprocessed in Thorp, but for which contracts have yet to be signed). Appendix 1 lists these wastes and provides a slightly fuller description of where the waste comes from, how it is stored and how it is, or will be, conditioned for storage and disposal.

4.5 The data in the Inventory is based on an assumed reprocessing scenario. The reprocessing scenarios are described in the Inventory [i]. The assumption for Magnox reprocessing is that Calder Hall and Chapelcross operate for 45 years and that other Magnox reactors operate for an average of 37 years. Under this scenario Magnox reprocessing is scheduled to continue until 2008/9. The total amount of fuel reprocessed after April 1998 (the reference date for the Inventory) is 11,500 te. The Thorp reprocessing scenario is that reprocessing will continue until 2013/14 by which time a total of 12,400 te of fuel will have been reprocessed. This 12,400 comprises 5,600 te of AGR fuel (for which contracts have been signed) and 6,800 te of LWR fuel (of which 5,200 te is currently subject to contracts).

4.6 Using the waste volumes and the reprocessing scenarios it is possible to calculate how much waste is generated on average from each te of fuel reprocessed. Table 4.1 lists the ILW that is forecast to be produced from reprocessing all the fuel that is currently contracted to Thorp. This shows that reprocessing 5,600 te of AGR fuel will generate about 8,500 m^3 of waste, about 1.5 m^3/te (8,526 / 5,600). However the graphite and stainless steel listed under 2F07 and 2F08 are components of the AGR fuel assembly which are removed to reduce the volume of material requiring pond storage. This material will be removed irrespective of whether the fuel is actually reprocessed. The volume of the remaining wastes, which are in fact directly linked to reprocessing is about 4,200 m^3. Thus the volume of ILW generated as a result of AGR reprocessing is about 0.8 m^3/te (4,225 / 5,600). A similar analysis shows that the volume of waste attributable to reprocessing 5,200 te of LWR fuel is about 3,900 m^3, about 0.8 m^3/te (3,887 / 5,200).

4.7 Some care is required in using this type of calculation to calculate waste volumes for alternative Magnox reprocessing scenarios. A significant proportion of the wastes listed in the Inventory are associated with historic reprocessing activities (see notes in Appendix 1. Many of these wastes are no longer produced. In order to calculate a similar unit rate of arising only wastes arising in the future should be considered. However even here some care is need to avoid producing a misleading figure. For example one of the Magnox waste streams listed, 2D42, is pond furniture. This is equipment used in the ponds for fuel storage. At the moment it is still in use, but once the ponds are empty the equipment will be disposed of as waste. Early cessation of reprocessing would not reduce the amount of this equipment in the pond (it is already there). Similarly an extension to the quantity of Magnox reprocessing or an extension in the duration of reprocessing would not increase the volume of this equipment, it would simply remain in use for longer and be declared to be a waste at a later date. In another case, EARP floc (2D27), a significant proportion of the future arisings of the floc will be generated when concentrates which have been accumulated since the mid 1980’s are decontaminated. A proportion of Plutonium Contaminated Material (2D03) and Miscellaneous Beta Gamma Waste (2D39) will not be directly associated with reprocessing activities. Taking all of these factors into account the unit rate of arising of ILW from Magnox reprocessing will be about 1.2 m^3 / te.

Table 4.1

ILW Volumes from Contracted Thorp Reprocessing [ii]

Nirex stream number	Description	Conditioned waste volume / m^3			Comments
		Total	AGR	LWR	
2F02	PCM	625	324	301	
2F03	AGR Hulls	2,439	2,439		AGR waste
2F04	LWR hulls	2,318		2,318	LWR waste
2F05	MBGWS	103	53	49	
2F06	Barium carbonate	442	229	213	
2F07	AGR graphite	3,759	3,759		AGR waste
2F08	AGR stainless	542	542		AGR waste
2F09	MEB crud	161		161	LWR waste
2F10	Cent cake	1,114	578	537	
2F11	SIXEP IX and sand	17	9	8	
2F13	EARP	465	241	224	
2F21	Maintenance scrap	124	64	60	
2F24	WEP maintenance scrap	34	18	16	
	Total	12,143	8,256	3,887	

NB this table excludes waste streams 2F26, 2F27, 2F31, 2F32 and 2F33. These wastes were produced from historic oxide fuel reprocessing and were not produced in Thorp. These wastes have a combined volume of about 72 m^3. This data is based on reprocessing 5,600 te of AGR fuel and 5,200 te of LWR fuel.

4.8 The volume of HLW resulting from the reprocessing of 1 te of fuel is dependent on the burn-up of the fuel. The greater the irradiation of the fuel, the larger quantity of fission products and waste actinides will be present and therefore the greater the volume of HLW that will be generated.

4.9 Taking into account both the vitrified HLW and the maintenance waste from the vitrification plant that will be contaminated with HLW the total volume of HLW generated from the existing Thorp contracts will be 845 m^3 [iii]. This waste is associated with reprocessing a total of 10,800 te of fuel (5,600 te AGR and 5,200 te of LWR). Thus the average rate of arising is about 0.08 m^3/te. In practice the AGR fuel will typically have a lower burn-up than the LWR fuel. This means that on average the unit rate of arising will be less than 0.08 m^3/te for AGR fuel and more than 0.08 m^3/te for LWR fuel. It would be appropriate to use these unit rates to determine the impact of reductions to the total reprocessing programmes.

4.10 There is a general trend towards increased fuel irradiation with time. The wastes arising from reprocessing fuel in Thorp for which contracts have yet to be signed are identified in the Inventory with the prefix 2H. The Inventory shows a total volume of 197 m^3 [iv] associated with the 1,600 te of fuel, equivalent to a unit rate of arising of about 0.12 m^3/te. This is a more appropriate unit rate to use in considering the impact of additional Thorp reprocessing beyond the reference scenario.

4.11 The unit rate of arising of HLW from Magnox reprocessing can be determined in a similar way. The Inventory shows arisings of HLW from 1998 onwards (as stored, before vitrification) to be 537 m^3 [v]. With a conditioning factor of 0.348 this gives a volume of vitrified HLW of 187 m^3 . Adding a further 32 m^3 of and maintenance waste from the vitrification plant that will be contaminated with HLW gives a total HLW volume of 219 m^3 from 11,500 te of fuel, nearly 0.02 m^3/te.

4.12 Most of the scenarios involving an early end to reprocessing would leave substantial quantities of irradiated fuel requiring storage and disposal. In 1993 the OECD published a report which provides details of various international concepts for spent fuel disposal. The German scheme, involving packaging fuel assemblies into Pollux disposal flasks, is typical of the type of scheme described. The *internal* dimensions of the Pollux flask are quoted as 5m in length, with a diameter of 1m [vi], giving an internal volume of just under 4 m^3. This flask typically holds about 4 te of fuel [vii]. Thus, stored in this form the fuel would occupy about 1 m^3/te and would require disposal to the same standards as HLW.

4.13 The unit rates of arising for ILW and HLW are summarised in Table 4.2. These can be used in conjunction with the fuel tonnages from the reprocessing scenarios to determine the impact of the reprocessing scenarios on waste volumes.

Table 4.2

Unit Rates of ILW and HLW Arising From Reprocessing

	Waste volume / m^3/te	
	ILW	HLW
Magnox	1.2	0.02
AGR	0.8	0.08
LWR (reduction in reprocessing*)	0.8	0.08
LWR (increase in reprocessing*)	0.8	0.12

* when compared to existing contracts

5. Waste Volumes

5.1 The purpose of this section is to determine the impact on the volume of waste requiring disposal in the UK of the alternative reprocessing scenarios presented in section 3. The Inventory contains an estimate of the ILW and HLW that will require disposal in the UK which will form the reference case for comparative purposes. The lifetime arisings of ILW for the whole of the UK are summarised in Table 5.1. Similarly lifetime HLW volumes are listed in Table 5.2. Note that in both cases the volumes refer to materials which are currently regarded as wastes. Therefore materials such as spent fuel are not included in the HLW figures.

Table 5.1

Total UK ILW Arisings

	ILW Volume / m^3	
	Operations	Decommissioning
BNFL [viii] (Sellafield, Calder & Chapelcross)	79,806	31,591
BNFL (Reactor sites)	13,490	28,507
BNFL (Other)	334	78
British Energy [ix]	7,297	24,088
UKAEA [x]	12,621	8,332
Ministry of Defence [xi]	3,275	4,789
Urenco [xii]	4	
Nycomed Amersham [xiii]	665	
Others [xiv	68	
	117,560	97,385

Table 5.2

Total UK HLW Arisings

	Volume / m^3
	HLW
BNFL (Sellafield, Calder & Chapelcross)	1,864
UKAEA	22
	1,886

5.2 This section will summarise the waste volume implications of the reprocessing scenarios set out in section 3. In general a simple approach can be taken to calculating the waste volume for each scenario using the difference in the number of tonnes of fuel to be reprocessed and the unit rates of waste arising presented in section 4.

Magnox Reprocessing Scenarios

5.3 The reference date for the Inventory is April 1998. The waste arisings from Magnox reprocessing are based on reprocessing 11,500 te of Magnox fuel from this date onwards. The alternative Magnox reprocessing scenarios are summarised in Table 5.3 and are presented in terms of a comparison with this reference case.

Table 5.3

Magnox reprocessing scenarios (te fuel reprocessed from 1/4/98)

	te reprocessed post 1/4/98	Variance from reference /te
Blue Sky	19,000	+7,500
Reference	11,500	0
Reprocess existing fuel	8,100	-3,400
Stop now	1,500	-10,000

NB above figures rounded to the nearest 100 te. In addition more than 40,000 te of Magnox fuel was reprocessed prior to 1/4/98

5.4 Table 5.4 sets out the impact of these reprocessing scenarios on national ILW and HLW waste volumes. These figures have been derived using the unit rates of arising quoted in paragraphs 4.10 (1.2 m^3/te ILW) and 4.11 (0.02 m^3/te HLW). These show that the Blue Sky scenario would add around 9,000 m^3 of ILW and 150 m^3 of HLW to the national inventory of wastes. In addition the extension to reactor lifetimes would also result in s slight increase in ILW volume. This is estimated to be around 1,000 m^3 [xv], thus increasing the impact on UK volumes from an increase of 9,000 m^3 to 10,000 m^3. At the other end of the scale an immediate cessation of Magnox reprocessing would reduce lifetime ILW volumes by about 12,000 m^3 and HLW volumes by about 200 m^3. However this would also leave legacy of around 6,600 te of Magnox fuel which would require storage and some form of treatment for long term storage and disposal. In order to avoid this situation the early cessation of reprocessing would need to be accompanied by early reactor closure. This would result in a reduction of about

1,000 m^3 of ILW from reduced reactor operations for both of the early closure scenarios.

Table 5.4

Impact of Magnox reprocessing scenarios on waste volumes

	Variance of waste volumes / m^3	
	ILW	HLW
Blue Sky	+10,000	+150
Reference	0	0
Reprocess existing fuel	-5,000	-70
Stop now	-13,000	-200

5.5 The impact on UK lifetime waste volumes is illustrated in Table 5.5 and 5.6. In both cases the assumption if that Thorp operates according to the assumptions set out in the Inventory (see paragraph 4.5).

Table 5.5

Impact of Magnox reprocessing scenarios on ILW volumes

	Conditioned waste volumes / m^3		
	Operations	Decommissioning	Total
Blue Sky	127,000	97,000	224,000
Reference *	118,000	97,000	215,000
Reprocess existing fuel	114,000	97,000	211,000
Stop now	106,000	97,000	203,000

* Assumes Thorp operates as per Thorp reference scenario. All figures rounded to the nearest 1,000 m^3

Table 5.6

Variation in Magnox vitrified HLW volumes

	HLW Volume / m^3	Fuel requiring disposal / te
Blue Sky	970	0
Reference *	820	0
Reprocess existing fuel	750	0
Stop now	620	6,600

* Assumes Thorp operates as per Thorp reference scenario

Thorp Reprocessing Scenarios

5.6 The Thorp reprocessing scenarios that have been considered are summarised in Table 5.7. The blue sky scenario assumes that Thorp operates for thirty years, an extension of 10 years over the reference case. For the purposes of this exercise it has been assumed that when compared to the reference scenario the additional fuel is all overseas LWR fuel. Waste volumes have been calculated assuming about 0.8 m^3/te of ILW and 0.12 m^3/te of HLW is generated from each tonne of fuel that is reprocessed (see Table 4.2).

Table 5.7

Thorp lifetime reprocessing scenarios

	Te reprocessed post 1/4/89	Variance from reference /te
Blue Sky	23,500	+11,100
Reference	12,400	0
Fulfil existing contracts	10,800	-1,600
Reprocess baseload fuel only	7,000	-5,400
Stop now	2,900	-9,500

5.7 The 1,600 te of fuel which comprises the difference between the reference scenario and the scenario involving stopping reprocessing once existing contracts have been filled is again all overseas ILW fuel. The 5,400 te of fuel which would be avoided if reprocessing ceased at the end of the baseload period comprises 3,400 te AGR fuel and 2,000 te of LWR fuel. The 9,500 te that would be avoided if reprocessing stopped at the end of March 2000 comprises about 4,500 te AGR fuel and 5,000 te PWR fuel.

5.8 In calculating the impact on requirements for ILW storage or disposal it is necessary to consider not only how much more (or less) waste will be generated in each scenario, but also the extent to which waste is returned to overseas customers. Contracts signed with overseas customers since 1976 have contained a clause that provides for the return of wastes generated by reprocessing to the country of origin. BNFL have proposed that this clause could be enacted by substituting one waste form for another. Specifically that ILW should be retained in exchange for the return of additional HLW. Table 5.8 shows the variance in the ILW and HLW volumes generated by Thorp reprocessing, when compared to the reference scenario.

Table 5.8

Impact of Thorp reprocessing scenarios on volume of waste generated

	Variance of waste volumes / m^3	
	ILW	HLW
Blue Sky	+9,000	+1,330
Reference	0	0
Fulfil existing contracts	-1,000	-190
Reprocess baseload fuel only	-4,000	-500
Stop now	-8,000	-820

5.9 Table 5.9 gives the volume of ILW that would be returned to overseas customers if substitution does not take place. Tables 5.10 and 5.11 show how much ILW would require disposal in the UK in the event that substitution does not take place (Table 5.10) and substitution does take place (Table 5.11). These tables illustrate the fact that if substitution does not take place increasing the amount of overseas fuel to be reprocessed has no impact on the long term storage and disposal requirements in the UK. This is because all of the additional waste that is generated can be returned to the customers.

Table 5.9

Volume of ILW which could be returned to overseas customers

	Volume of waste returned in the absence of substitution /m^3
Blue Sky	15,000
Reference	6,000
Fulfil existing contracts	5,000
Reprocess baseload fuel only	4,000
Stop now	2,000

Table 5.10

Impact of Thorp reprocessing scenarios on ILW volumes
(assumes that substitution takes place - i.e. all ILW remains in the UK)

	Conditioned waste volumes / m^3		
	Operations	Decommissioning	Total
Blue Sky	127,000	97,000	224,000
Reference *	118,000	97,000	215,000
Fulfil existing contracts	117,000	97,000	214,000
Reprocess baseload fuel only	114,000	97,000	211,000
Stop now	110,000	97,000	207,000

* Assumes Magnox reprocessing continues according to the Magnox reference scenario
All figures rounded to the nearest 1,000 m^3

Table 5.11

Impact of Thorp reprocessing scenarios on ILW volumes
(assumes no substitution - i.e. ILW is returned to overseas customers)

	Conditioned waste volumes / m^3				
	Operations wastes			Decommissioning	Total
	Generated	Returned	Remaining		
Blue Sky	127,000	15,000	112,000	97,000	209,000
Reference	118,000	6,000	112,000	97,000	209,000
Fulfil existing contracts	117,000	5,000	112,000	97,000	209,000
Reprocess baseload fuel only	114,000	4,000	110,000	97,000	207,000
Stop now	110,000	2,000	108,000	97,000	205,000

5.10 The impact of substitution on HLW volumes is slightly different. There is no question whether vitrified HLW will be returned to overseas customers. The only question is whether *additional* HLW will be returned in exchange for retaining ILW.

5.11 The Inventory shows that for the reference scenario Thorp reprocessing will generate about 1,040 m^3 of vitrified HLW [xvi]. Tables 5.12 and 5.13 show how the volume of vitrified waste remaining in the UK would vary between the reprocessing scenarios. Table 5.12 shows vitrified waste volumes in the event that substitution takes place. The figures are inevitably an estimate as approval has not yet been given for substitution, therefore the precise basis has yet to be agreed. The figures assume that an equivalence system based on toxic potential, as proposed by BNFL, is adopted. Table 5.13 shows HLW volumes in the event that substitution does not take place. Both tables also identify the additional quantity of fuel requiring disposal as a result of the curtailment of reprocessing. This is in addition to any fuel for which reprocessing plans do not exist. For the purposes of this exercise this is estimated to be around 3,400 te. This comprises the lifetime arisings of fuel from Sizewell B (about 1,000 te [xvii]) and the component of the lifetime AGR fuel discharges which are not included in the Thorp reference reprocessing programme (about 3,400 te [xviii]).

5.12 Table 5.12 shows that if substitution is approved an increase in the amount of overseas fuel that is reprocessed reduces the volume of vitrified waste requiring disposal in the UK. This is because not only would the HLW generated as a result of reprocessing the fuel be returned to the customer, but an additional quantity of HLW would be returned. This would effectively come from the stock of waste that would otherwise be disposed of in the UK.

5.13 Table 5.13 illustrates the fact that if substitution does not take place the volume of vitrified waste requiring disposal in the UK is solely dependent on the amount of UK fuel reprocessed.

Table 5.12

Variation in Thorp Vitrified HLW volumes (assumes substitution - i.e. ILW is retained and additional HLW returned to overseas customers in its place)

	Vitrified waste / m^3			Increase in fuel for disposal
	Generated	Returned	Remaining	
Blue Sky	2,370	2,140	230	
Reference	1,040	610	430	
Fulfil existing contracts	850	390	460	
Reprocess baseload fuel only	540	350	190	3,400
Stop now	220	160	60	4,500

Table 5.13

Variation in Thorp Vitrified HLW volumes (assumes no substitution)

	Vitrified waste / m^3			Increase in fuel for disposal
	Generated	Returned	Remaining	
Blue Sky	2,370	1,850	520	
Reference	1,040	520	520	
Fulfil existing contracts	850	330	520	
Reprocess baseload fuel only	540	290	250	3,400
Stop now	220	130	90	4,500

Combined Scenarios

5.14 The extreme range of waste volumes would be represented by the combined blue sky scenarios and the combined stop now scenarios. Tables 5.14 to 5.17 give the total ILW and vitrified waste volumes, both with and without substitution.

5.15 Table 5.14 shows that in the event that substitution is approved the combined Magnox and Thorp blue sky scenarios would result in an increase of about 8% in total ILW volumes when compared to the reference case. The combined stop now scenarios would result in a reduction of about 10%. However BNFL do not consider this to be a practicable scenario as it would leave about 6,600 te of Magnox fuel which would require long term storage and disposal. Technically the minimum scenario would involve reprocessing all existing Magnox fuel. This would result in a reduction of less than 6% when compared to the reference case.

5.16 Table 5.15 shows that in the event that substitution is not approved and overseas ILW is returned to the country of origin, the combined Magnox and Thorp blue sky scenarios would result in an increase of only about 5% in total ILW volumes when compared to the reference case. The combined stop now scenarios would result in a reduction of about 8%. However BNFL do not consider this to be a practicable scenario as it would leave about 6,600 te of Magnox fuel which would require long term storage and disposal. Technically the minimum scenario would involve reprocessing all existing Magnox fuel. This would result in a reduction of around 4% when compared to the reference case.

5.17 Table 5.16 shows that in the event that substitution is not approved and no additional overseas HLW is returned to the country of origin, the combined Magnox and Thorp blue sky scenarios would result in an increase of only about 11% in total vitrified HLW volumes when compared to the reference case. This is the result of reprocessing additional Magnox fuel. The combined stop now scenarios would approximately halve the volume of vitrified HLW requiring disposal. However BNFL do not consider this to be a practicable scenario as it would leave about 6,600 te of Magnox fuel which would require long term storage and disposal. Technically the minimum scenario would involve reprocessing all existing Magnox fuel. This would result in a reduction of around 40% when compared to the reference case. In both of these scenarios around 4,500 te of AGR fuel would no longer be reprocessed and would require long term storage and disposal. This would occupy at least 4,500 m^3 when packaged for disposal.

5.18 Table 5.17 shows that in the event that substitution is implemented, the combined Magnox and Thorp blue sky scenarios would result in an decrease of about 4% in total vitrified HLW volumes when compared to the reference case. This is the result of returning additional HLW to overseas customers in return for keeping ILW. The combined stop now scenarios would approximately halve the volume of vitrified HLW requiring disposal. However BNFL do not consider this to be a practicable scenario as it would leave about 6,600 te of Magnox fuel which would require long term storage and disposal. Technically the minimum scenario would involve reprocessing all existing Magnox fuel. This would result in a reduction of around 40% when compared to the reference case. In both of these scenarios around 4,500 te of AGR fuel would no longer be reprocessed and would require long term storage and disposal. This would occupy at least 4,500 m^3.

Table 5.14

UK ILW volumes for combined scenarios
(with substitution)

Scenario		Conditioned Waste Volume / m^3				
		Operational Wastes			Decommissioning	Total
Magnox	Thorp	Volume produced	Volume returned overseas	Revised total UK volume		
Blue sky	Blue sky	137,000	0	137,000	97,000	234,000
Reference	Reference	118,000	0	118,000	97,000	215,000
Existing fuel	Stop now	105,000	0	105,000	97,000	202,000
Stop now	Stop now	97,000	0	97,000	97,000	194,000

NB all figures rounded to the nearest 1,000 m^3

Table 5.15

UK ILW volumes for combined scenarios
(no substitution)

Scenario		Conditioned Waste Volume / m^3				
		Operational Wastes			Decommissioning	Total
Magnox	Thorp	Volume produced	Volume returned overseas	Revised total UK volume		
Blue sky	Blue sky	137,000	15,000	122,000	97,000	219,000
Reference	Reference	118,000	6,000	112,000	97,000	209,000
Existing fuel	Stop now	105,000	2,000	103,000	97,000	200,000
Stop now	Stop now	97,000	2,000	95,000	97,000	192,000

Table 5.16 **UK Vitrified HLW volumes for combined scenarios (no substitution)**

Scenario		Volume of HLW / m^3				Increase in quantity of fuel requiring disposal / te
		Volume produced	Exported to customers	Retained in UK	Variance from reference	
Magnox	Thorp					
Blue sky	Blue sky	3,340	1,850	1,490	+150	
Reference	Reference	1,860	520	1,340	0	
Existing fuel	Stop now	970	130	840	-500	4,500 AGR
Stop now	Stop now	840	130	710	-630	4,500 AGR 6,600 Magnox

NB all figures rounded to the nearest 10 m^3.

Table 5.17 **Combined scenarios (substitution- i.e. additional HLW returned in place of ILW)**

Scenario		Volume of HLW / m^3				Increase in quantity of fuel requiring disposal / te
		Volume produced	Exported to customers	Retained in UK	Variance from reference	
Magnox	Thorp					
Blue sky	Blue sky	3,340	2,140	1,200	-50	
Reference	Reference	1,860	610	1,250	0	
Existing fuel	Stop now	970	160	810	-440	4,500 AGR
Stop now	Stop now	840	160	680	-570	4,500 AGR 6,600 Magnox

NB all figures rounded to the nearest 10 m^3.
Assumes Magnox reactors closed in the stop reprocessing now scenario, but assumes AGR reactors continue in all scenarios.

6 Treatment & Storage Implications at Sellafield

6.1 The data in section 5 presents the total UK volumes of waste and the changes generated by assuming different reprocessing lifetimes. The impact of these changes affects the treatment plants and storage capacities required at Sellafield.

6.2 For the purposes of this assessment the combined stop now scenario is not considered credible. Alternative wet or specialised dry storage would be required for the spent Magnox fuel which could not be constructed to the stop now timescales. It is assumed that if the stop Magnox now scenario were to be imposed, then it would also be a requirement to simultaneously close all remaining Magnox reactors to a similar timescale. Fuel would have to be held within the reactor and existing storage facilities until alternative storage and ultimately alternative treatment process for the fuel were developed and constructed. This is not considered a viable option. The near term closure scenario is therefore taken to be reprocess existing committed Magnox fuel scenario combined with the stop Thorp now scenario.

6.3 In many cases , treatment of waste separated by reprocessing, financially supports the treatment of decommissioning waste streams, particularly for ILW waste streams. Some of these decommissioning wastes require treatment beyond the current reprocessing lifetime and would therefore benefit financially from the contribution made by 'blue sky' additional reprocessing. Conversely, stopping reprocessing now would leave the decommissioning and clean up work for treatment and storage but with no contribution to treatment costs from external sources.

6.4 Storage requirements can be grouped by families of waste products as follows;

- Vitrified Product Store (VPS)
- Encapsulated Product Stores (EPS)
- Engineered Drum Stores (EDS, for plutonium contaminated materials)
- Miscellaneous Beta Gamma Waste Stores (MGBGWS)

6.5 Table 6.1 presents the current planned capacity and the volume expected in store at Sellafield on the basis of our reference case. Table 6.1 also presents volume reduction required to avoid or increase planned storage capacity.

Table 6.1

	Conditioned Waste Volumes m^3			
	EPS	**EDS**	**MBGWS**	**VPS**
Planned storage capacity	80,000	13,000	4,700	1200
Reference case planned storage uptake	70,000	12,000	3,300	1070
Spare capacity if reference case scenario	> 10,000	> 1,000	> 1,400	> 130

6.6 Table 6.2 summarises the scenarios that impact on the waste storage requirements by type of store. Further details and supporting data are contained in Appendix 2.

Table 6.2

Scenario	**Store Type**			
	EPS	**EDS**	**MBGWS**	**VPS**
Thorp and Magnox Blue Sky	1 new store	1 new store	1 new store	no new stores

These figures assume that all none -UK HLW is returned to customers and the basis of determination is internal BNFL planning assumptions.

Not surprisingly, the combination of 'blue sky' is the only scenario that requires new store build beyond current planned capacity. Even in this case the additional capacity required is at most marginal and would be accommodated either by store extensions or more likely by future improvements in packing efficiencies and waste minimisation initiatives to reduce generated volumes. No scenarios avoid construction of planned capacity.

7 Plutonium (Pu) and Reprocessed Uranium (RepU)

7.1 Plutonium and Reprocessed Uranium are not currently classified as waste products. BNFL believe that these materials have an economic value and can contribute to generation of nuclear electricity and reductions in $C0_2$ emissions. Certainly overseas customers wish to convert their Pu and Uranium into fuel as part of their recycling initiatives.

7.2 Pu and RepU are currently stored in purpose built stores in a safe, monitored, retrievable and safeguarded condition. The products are in a satisfactory form suitable for storage for decades. The only potential life limiting factors BNFL envisage are the storage facilities themselves requiring maintenance or in the deterioration of the storage drum or can. BNFL's experience in management of waste storage facilities is extensive, as is the available knowledge and previous experience of repackaging this material (having performed this operation in the past). Sufficient storage capacity exists for all UK material to be housed and managed in this way and therefore, in this scenario there is no impact on BNFL Waste Management Strategy.

7.3 Current UK policy does not require Pu or RepU to be disposed within a deep repository. It is therefore difficult to predict the required waste form should it be decided to dispose of this material in the future. Declaring current and future stocks of Pu and RepU as waste, prior to understanding of the package criteria, could lead to decisions which expose future operatives to additional activities, increasing the dose uptake and risk on the basis that technological change may determine more suitable packages and forms for disposal.

7.4 BNFL understand the NGO's need to understand the impact on waste management generation if, an underlying perception is, of tens of thousands of m^3 of potential waste existing in the form of Pu and RepU. For illustrative purposes, then BNFL have, using the Lawrence Livermore National Laboratory paper, dated 3rd October 1997 (Fissile Material Disposition Programme Final Immobilisation Form Assessment and Recommendation) derived a conditioned volume for Pu. To determine the overall volumes of conditioned material, BNFL have assumed the volume of Pu to be converted, to be as quoted in the Royal Society Report (Management of Separated Plutonium) and BNFL's submission to the House of Lords Science and Technology Committee of approx. 100 tes. The volume equates to 2,200 m^3. In this form the waste would typically under our UK waste classification system fall within the ILW category. The volume quoted equates to under 2% of all operational ILW volumes and an increase of less than 1% of total disposal volumes including historic wastes and decommissioning.

7.5 No process is currently available for conversion of RepU into a conditioned volume. Using internal BNFL assumptions it has been assumed that the “as stored” volume would be a good indication of the final disposal volume. On that basis around 3,500 m^3 of material would exist, increasing disposal volumes of operational wastes by approximately 3% and overall UK waste Volumes by less than 2%.

7.6 Sufficient storage capacity exists to house these products within existing facilities. On the basis of the argument not to preclude future use of the material and International technological waste management developments, there is a benefit to continuation of reprocessing. The basis of the argument lies not just in the low increase on waste volumes, but the time-scale to develop alternatives such as dry storage and the then subsequent increase in HLW volume.

8 Impact of stopping reprocessing

8.1 Reprocessing overseas fuel in the UK generates valuable income. BNFL is one of the UK's largest earners of Japanese yen. The company has a 16 year order-book for Thorp worth over £12 billion roughly half of which is with overseas customers. Thorp supports over 6,000 direct/indirect skilled jobs, mainly in West Cumbria and there are very good prospects of the plant winning a further £5 billion worth of overseas reprocessing business and £2 billion worth of related MOX exports in the years ahead.

8.2 BNFL's positive impact on Britain's economy more generally, was clearly brought out last autumn, when BNFL's Shareholder, the Department of Trade and Industry, announced that the National Health Service would receive an extra £100 million. This was due to BNFL's improved cash flow, which resulted from additional payments under our overseas reprocessing contracts.

8.3 However, even ignoring these huge economic benefits to "UK plc" there are some other compelling reasons why the UK should continue to reprocess:

Reducing discharge and waste treatment costs

Spent fuel from the UK's Magnox stations must be reprocessed in a timely fashion. If that does not happen it will corrode and become more difficult to manage over the long-term.

Magnox reprocessing at Sellafield has been ongoing since 1952. During this time more than 40,000 tonnes of fuel has been reprocessed and some 55 tonnes of Magnox generated plutonium is now stored at Sellafield. In 1981 it was decided to store certain Magnox generated effluent on the site pending the commissioning of the new suite of clean-up plants which were opened, with Thorp, in 1994. Between 1981 and 1994 more than 8,000 cubic metres of this liquid was therefore stored which would otherwise have been discharged to sea without treatment.

Thorp cost £1.85 billion whilst advanced payments from THORP's overseas customers to date amount to around £2.3 billion. This includes their contribution to a suite of clean-up plants which treats the stored UK historical legacy and ongoing Magnox-generated liquid effluent, as well as the effluent arising from Thorp. In addition THORP's overseas customers contribute to the on-going running costs of these shared clean-up plants. Without THORP's overseas customers a disproportionate share of these costs would therefore fall to the UK Magnox programme.

Reprocessing overseas fuel through Thorp is therefore substantially reducing the costs of treating UK generated historic and future nuclear waste which would otherwise have to be passed on to UK customers.

Moreover, the money which overseas customers pay for reprocessing services also allows a more cost effective reduction of Sellafield's overall discharges. Thus yet further reductions have been economically justifiable than would have been the case without THORP's overseas customers' contribution. Indeed it is estimated that the impact of Sellafield's sea discharges without THORP's contributions would have been six times higher than they are today.

Enhancing safeguards

Since 1985 BNFL has spent some £250 million on security measures at Sellafield. A further £10 million is spent annually on security and safeguards associated with safeguarding plutonium on the site. Due to the Magnox programme some 55 tonnes of plutonium are already stored at Sellafield. Guarding one tonne of plutonium is as costly as guarding 50 tonnes of plutonium. The issue surrounding plutonium is not the quantity stored, but the international safeguards and security regime to which the stored material is subjected. The better funded the regime then the better the safeguards. By contrast, under-funding lowers safeguards and security standards (c.f. the Former Soviet Union) unless the state bears the ongoing costs. Over 35 per cent of ongoing safeguards and security costs at Sellafield are currently borne by overseas reprocessing customers. Given that 55 tonnes of UK Magnox generated plutonium is already on the site and would have to be safeguarded, all of these costs would fall onto the UK without overseas reprocessing.

Conserving Resource

Reprocessing recovers uranium and plutonium for re-use. So far 15,000 tonnes of recycled uranium has been made into new fuel. One tonne of plutonium when recycled as MOX fuel contains the same amount of energy as two million tonnes of coal. MOX fuel is not new, it was first loaded into a small Pressurised Water Reactor in Belgium in 1963. In that same year it was also loaded into the prototype Advanced Gas-cooled Reactor at Sellafield. Since then more than 400 tonnes of MOX fuel has been safely loaded into reactors around the world and more than 30 European reactors are licensed to burn it. Not reprocessing would mean throwing this energy resource away.

Some argue that there is plenty of uranium and that it is cheap so there is no need to recycle especially with the hiatus in the fast breeder programme. However, there is also plenty of sand in the world yet recycling glass is seen as a responsible conservation measure. Providing it is done safely, and with care for the environment, why is recycling nuclear fuel any different? Some also argue that it is uneconomic to reprocess and use MOX fuel. On the other hand, THORP’s customers wish to continue reprocessing and have indicated that they want their plutonium returned to them as MOX fuel. Most of these customers are companies which are publicly quoted on the stock exchanges of their various countries. Only last year, the newly privatised British Energy agreed reprocessing contracts with BNFL worth up to £1.8 billion. Moreover, recycling nuclear fuel fits in with the strategic energy policy of our Japanese customers who seek self-sufficiency following the oil-price shocks of the 1970's. They argue that, despite today’s plentiful uranium supplies this may not always be the case.

Reducing overall radiation doses

Not reprocessing would mean more direct disposal of spent fuel and more freshly mined uranium would be needed to make new fuel. Mining fresh uranium also discharges radioactivity into the environment. The Government's Radioactive Waste Management Advisory Committee (RWMAC) has said that reprocessing, including recycling, involves a lower radiation dose to the public compared with a fuel cycle only ending with direct disposal.

9 Summary of findings.

9.1 The key findings of the BNFL review of the reprocessing scenarios presented are that;

9.2 Stopping reprocessing now is not a credible option given the difficulties this scenario would present in terms of timescales for alternatives if they could be made technically acceptable.

9.3 Additional waste volumes generated as a consequence of reprocessing equate to a small percentage increase in UK ILW volumes whilst cessation of reprocessing adds around 200% increase in HLW volumes

9.4 Cessation of reprocessing now does not avoid the need for additional storage facilities as currently planned. Even at the maximum reprocessing “blue sky” throughput scenario presented to BNFL storage families are increased by only 3. Moreover it is unlikely given appropriate management control and operational improvements in waste minimisation and packing efficiencies that these stores would be needed on the “blue sky” premise.

9.5 Stopping reprocessing now removes non UK and future projected UK income contribution to UK waste treatment, decommissioning and clean up work.

9.6 Pu and RepU are currently in a passively safe, monitored, retrievable, form safeguarded in accordance with international standards. In a waste scenario BNFL have shown that storage capacity already exists to house any possible projected volumes of those materials

Sellafield (Magnox) Operational / POCO Wastes (HLW and ILW)

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2D02	High Level Liquid Waste – fission product concentrate from Magnox reprocessing. This waste is stored in stainless steel tanks in B215. Waste is vitrified into stainless steel containers.	Continued reprocessing produces additional waste	790
2D46	High Active Technical Waste. Highly active liquid is vitrified in the Waste Vitrification Plant. The equipment used to produce this glass has a finite life. This stream is the redundant equipment which is contaminated with highly active glass. The equipment will be size reduced and packaged into the same type of stainless steel containers as the glass.	Continued reprocessing produces additional waste. NB a large proportion of the future arisings of this waste will be the result of vitrifying existing stocks of High Level Liquid Waste	32
2D03	Plutonium Contaminated Material (PCM) stored (untreated) in mild steel drums at a variety of locations on the Sellafield site, in the magazines at Drigg and in a purpose built store at Drigg. This waste will be supercompacted and cemented into stainless steel drums.	Continued reprocessing produces additional waste. NB a proportion of future arisings are associated with decommissioning and maintenance activities not directly related to reprocessing	4,350
2D06	Larger items of PCM packaged inside plywood or glass fibre crates stored at a variety of locations on the Sellafield site. Also filters used to filter air from areas and gloveboxes where plutonium is handled – stored at a variety of locations on the Sellafield site, in the magazines at Drigg and in a purpose built store at Drigg. These items will be size reduced, packaged into 200 litre drums and then supercompacted and cemented into stainless steel drums	Continued reprocessing produces additional waste. NB the majority of future arisings are associated with decommissioning and maintenance activities not directly related to reprocessing.	2,897

2D07	Magnox and aluminium fuel cladding mixed with miscellaneous solid wastes from historic reprocessing programmes. The waste is stored in dry concrete vaults in B41. No waste has been placed in this building since about 1964. This waste will be retrieved from the vaults and cemented into $3m^3$ stainless steel boxes.	There will be no further arisings of this waste	4,690
2D08	Magnox fuel cladding mixed with miscellaneous solid items of waste from historic reprocessing programmes. The waste is stored under water in concrete silos (compartments 1 to 6 of B38). The Magnox metal has largely corroded to form a magnesium hydroxide sludge. B38 was first used in 1964. No further wastes will be placed in these silos. The wastes will be retrieved, dried and supercompacted before being cemented into stainless steel drums.	There will be no further arisings of this waste	4,320
2D09	Magnox fuel cladding mixed with miscellaneous solid items of waste from historic reprocessing programmes. The waste is stored under water in concrete silos in the first extension to B38 (compartments 7 to 10 & 12). The Magnox metal has largely corroded to form a magnesium hydroxide sludge. No further wastes will be placed in these silos. The wastes will be retrieved, dried and supercompacted before being cemented into stainless steel drums.	There will be no further arisings of this waste	3,600
2D11	Pond sludge which has accumulated in the B29 storage pond. The sludge is largely magnesium hydroxide resulting from the slow corrosion of Magnox fuel. B29 was superseded by B30 in about 1964. There will be no further arisings of this waste. The sludge will be retrieved, dried and supercompacted before being cemented into stainless steel drums.	This waste stream is not connected to future reprocessing programmes.	380
2D12	Assorted items of solid wastes stored under water in skips in the B29 storage pond. The waste will be retrieved and cemented into $3m^3$ stainless steel boxes.	There will be no further arisings of this waste	180

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2D13	Skips containing AW500 ion exchange resin stored under water in the B30 storage pond. This ion exchange resin was used to remove soluble radionuclides from pond water before the introduction of the Site Ion Exchange Plant (SIXEP) in 1985. There will be no further arisings of this waste. The waste will be retrieved and cemented into $3m^3$ stainless steel boxes.	This waste stream is not connected to future reprocessing programmes.	629
2D14	Assorted items of redundant equipment stored under water in the B30 storage pond. The waste will be retrieved and cemented into $3m^3$ stainless steel boxes.	This waste stream is not connected to future reprocessing programmes.	336
2D15	Assorted items of redundant equipment stored under water in bays adjacent to the main storage pond in B30. The waste will be retrieved and cemented into $3m^3$ stainless steel boxes.	This waste stream is not connected to future reprocessing programmes.	490
2D16	Pond sludge which has accumulated in the B30 storage pond. The sludge is largely magnesium hydroxide resulting from the slow corrosion of Magnox fuel. Some sludge has been removed from the pond and is now stored in stainless steel tanks in SIXEP. The sludge will be retrieved, dried and supercompacted before being cemented into stainless steel drums.	There will be no further arisings of this waste.	480
2D17	Concreted waste stored in skips, under water in the B30 storage pond. These comprise fragments of Magnox fuel assemblies which were cemented into storage bins in the 1970's.	There will be no further arisings of this waste.	74
2D18	Pond sludge stored in the B31 storage pond. This is the same type of waste as stream 2D16. Most of the sludge from this pond has been retrieved and transferred to stainless steel tanks in SIXEP. The waste will be retrieved and cemented into $3m^3$ stainless steel boxes.	There will be no further arisings of this waste.	50

Appendix 1 continued

2D19	Alumino-ferric floc stored in concrete tanks in B241. This waste is a floc suspended in a liquid supernate and was produced by an effluent treatment process that is no longer in use. The floc will be filtered and the supernate will be treated in EARP. The resulting floc will be cemented into stainless steel drums	There will be no further arisings of this waste.	5,469
2D21	Miscellaneous items of solid waste stored in a facility which was originally constructed for use as a sand bed filter (B243). The waste is not packaged. It will be retrieved and packaged into boxes for storage.	A small quantity of waste will arise in the future ($<5m^3$), but the quantity will not be dependent on the amount of reprocessing.	922
2D22	Magnox fuel cladding from historic reprocessing programmes. The Magnox is stored under water in concrete silos in the second extension to B38 (compartments 13 & 14). The Magnox metal has partially corroded to form a magnesium hydroxide sludge. No further wastes will be placed in these silos. The waste will be retrieved, dried and supercompacted before being cemented into stainless steel drums.	There will be no further arisings of this waste	918
2D23	Filters stored in a concrete box under B39. These will be retrieved and packaged during decommissioning.	There will be no further arisings of this waste.	16
2D24	Magnox fuel cladding from historic reprocessing programmes. The Magnox is stored under water in concrete silos in the third extension to B38 (compartments 16 to 18). The Magnox metal has partially corroded to form a magnesium hydroxide sludge. The waste will be retrieved, dried and supercompacted before being cemented into stainless steel drums.	There will be no further arisings of this waste	959
2D25	Miscellaneous solid items of primarily beta-gamma waste stored in Compartment 15 of B38. The waste is stored under water. The waste will be retrieved and cemented into stainless steel packages	A small quantity of waste will arise in the future ($<5m^3$), but the quantity will not be dependent on the amount of reprocessing.	224

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2D26	Ion exchange resin and sand stored in large stainless steel tanks in SIXEP. The ion exchange resin is used to remove soluble activity from fuel storage pond water. The sand is used as a filter bed to remove solid, particulate material from the same pond water. The same ion exchange resin and sand will also be used to treat the liquid effluents when existing wastes are retrieved from storage silos and ponds. The waste will be retrieved, dried and supercompacted before being cemented into stainless steel drums.	Future arisings of this waste will be the result of both ongoing reprocessing and historic waste treatment.	1641
2D27	The Enhanced Actinide Removal Plant (EARP) is used to remove activity from a variety of liquid effluents. The product of the process is a ferric floc. This floc is cemented into stainless steel drums.	Ongoing Magnox reprocessing will continue to generate EARP floc. Some of the future arisings will be generated from the processing of liquid effluent concentrates that have been accumulated since 1984.	9,208
2D33	FHP sludges. The Fuel Handling Plant (FHP) is the third generation Magnox fuel storage pond and decanning facility. Control of the pond chemistry results in far less corrosion of the fuel that was experienced in B30. Nevertheless small quantities of sludge are expected to be produced. The sludge will be transferred to stainless steel tanks in SIXEP. They will then be retrieved, dried, supercompacted and cemented into stainless steel drums.	Future arisings of this waste will be dependent on the quantity of fuel stored in the pond and the length of the storage period.	47
2D34	SIXEP sludge from sand filters and transfers. The operation of the ion exchange columns and sand filter beds are described under stream 2D26. The sludge described here is any solid, particulate material removed by the sand filters. The solids are removed by back flushing the sand beds. The solids are stored with the retrieved pond sludges in a large stainless steel tank in SIXEP.	Future arisings of this waste will arise from both reprocessing activities and historic waste retrievals	295

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2D35	Magnox fuel cladding from historic reprocessing programmes. The Magnox is stored under water in concrete silos in the fourth extension to B38 (compartments 19 to 22). The Magnox metal has partially corroded to form a magnesium hydroxide sludge. Some of the Magnox metal has been retrieved and cemented into stainless steel drums in the Magnox Encapsulation Plant. Some further Magnox metal will be retrieved and treated in the same way. The remaining material will retrieved, dried and supercompacted before being cemented into stainless steel drums.	There will be no further arisings of this waste	1,063
2D36	Control rods are stored in a dry brick and concrete structure in B137. Some activated aluminium scrap is stored under water.	There will be no further arisings of this waste	0.3
2D37	Spent cartridges and a small amount of beta gamma scrap are stored inside steel tubes in a brick and concrete structure in B138 and B124	There will be no further arisings of this waste	6
2D38	Magnox fuel cladding is removed before the fuel elements are reprocessed. The Magnox metal is cemented into 500 litre stainless steel drums in the Magnox Encapsulation Plant (MEP), which was commissioned in 1990. The drums are stored in the Encapsulated Product Stores.	Continued reprocessing produces additional waste	9,518
2D39	The Miscellaneous Beta Gamma Waste Store (MBGWS) was commissioned in 1990. It largely superseded the use of compartment 15 of B38 for the storage of solid items with a low alpha content. Wastes which comprise redundant items and filters are packaged into large (about 3.5 m^3) concrete lined mild steel boxes. The boxes of waste are stored in a purpose built store.	Future arisings of this waste will be the result of both ongoing reprocessing and historic waste treatment.	3,490

2D42	Magnox pond furniture. These are the skips and containers that are used to hold Magnox fuel in the Fuel Handling Plant pond. They are still in use but will be declared waste when they are no longer required at the end of their life. They may be ILW or LLW.	These items already exist. Additional reprocessing will not increase the volume of this waste stream.	4,800
Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2D44	Miscellaneous items of beta/gamma waste stored in a tank in B211. This material will be retrieved and packaged when the building is decommissioned	There will be no further arisings of this waste.	135
2D45	The construction of Tokai Mura Magnox fuel is unusual. The end of the fuel assembly must be cut off before the metal fuel cladding can be removed. The pieces of fuel assembly are referred to as Tokai Mura End Crops. Currently a quantity of these end crops are stored in the Fuel Handling Plant storage pond. They will subsequently be encapsulated into 500 litre stainless steel drums using cement.	Future arisings of this waste are associated with the decanning of existing stocks of this fuel. No further waste of this type is anticipated.	31
2D55	District hazard filters. These filters are stored in B204 and will be retrieved and packaged when the building is decommissioned.	There will be no further arisings of this waste	14
2D56	Maintenance wastes from the Encapsulation Plant Maintenance Facility. Redundant small items of plant arising from maintenance activities. Wastes are cemented into stainless steel drums and stored in a purpose built store.	Continued reprocessing produces additional waste	6
2D57	Segregated Effluent Treatment Plant (SETP) hydrocyclone solids. SETP is used to monitor and treat low level liquid effluents on the Sellafield site. One of the treatments applied is the removal of particulate material using a hydrocyclone. This waste stream comprises the small quantity of solids that are removed using this process.	Continued reprocessing produces additional waste	9

2D58	Uranium residues in B29. This waste stream is a collection of fuel fragments and residues which are currently stored in skips under water in the B29 fuel storage pond. This waste will be retrieved from the pond and cemented into $3m^3$ stainless steel boxes.	There will be no further arisings of this waste.	22

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2D59	Tokai Mura End Crops and magazines in B30. Tokai Mura End Crops are described under waste stream 2D45. A quantity of these end crops are stored in bins, which in turn are stored in skips under water in the B30 storage pond. These wastes will be retrieved and cemented into stainless steel boxes.	There will be no further arisings of this waste.	180
2D60	Alumni-ferric floc stored in concrete tanks in B242. This waste is a floc suspended in a liquid supernate and was produced by an effluent treatment process that is no longer in use. The floc will be filtered and the supernate will be treated in EARP. The resulting floc will be cemented into stainless steel drums	There will be no further arisings of this waste.	47
2D61	Assorted items of redundant items and fuel furniture stored in skips under water in the B30 storage pond. This waste is currently stored in a large number of skips. In the future it will be collected and consolidated into a smaller number of skips. It will then be retrieved and cemented into $3m^3$ stainless steel boxes.	There will be no further arisings of this waste.	56
2D63	B241 Clinker Beds. This material is the contents of sand and gravel filter beds located in the base of the concrete tanks containing waste stream 2D19 (alumino-ferric floc). Once the floc has been removed this material will be retrieved and cemented into stainless steel packages.	There will be no further arisings of this waste	960
2D66	Barium carbonate slurry will be produced when liquid effluents from the off-gas scrubber system on the Magnox dissolver are treated to remove radioactive carbon. The waste will be cemented into stainless steel drums.	The waste will be generated from future reprocessing activities.	704

Appendix 1 continued

Sellafield Operational / POCO wastes (Thorp – existing contracts)

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2F01	High Level Liquid Waste - fission product concentrate from Thorp reprocessing. This waste is stored in stainless steel tanks in B215. Waste is vitrified into stainless steel containers.	Continued reprocessing produces additional waste	795
2F22	High Active Technical Waste. Highly active liquid is vitrified in the Waste Vitrification Plant. The equipment used to produce this glass has a finite life. This stream is the redundant equipment which is contaminated with highly active glass. The equipment will be size reduced and packaged into the same type of stainless steel containers as the glass.	Continued reprocessing produces additional waste. NB a proportion of the future arisings of this waste will be the result of vitrifying existing stocks of High Level Liquid Waste	49
2F02	Plutonium Contaminated Material (PCM) arising from Thorp reprocessing and MOX fuel fabrication stored (untreated) in mild steel drums at a variety of locations on the Sellafield site. The waste will be supercompacted and cemented into stainless steel drums.	Continued reprocessing produces additional waste	625
2F03	AGR fuel cladding. Following dissolution of the oxide fuel the stainless steel fuel cladding from AGR fuel is encapsulated into 500 litre drums using cement. The drums are stored in purpose built stores.	Continued reprocessing produces additional waste	2,439
2F04	LWR fuel cladding. Following dissolution of the oxide fuel the zircaloy fuel cladding from LWR fuel is encapsulated into 500 litre drums using cement. The drums are stored in purpose built stores.	Continued reprocessing produces additional waste	2,318

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2F05	The Miscellaneous Beta Gamma Waste Store (MBGWS) is used to package and store solid items with a low alpha content. Wastes, which comprise redundant items and filters, are packaged into large (about 3.5 m^3) concrete lined mild steel boxes. The boxes of waste are stored in a purpose built store.	Continued reprocessing produces additional waste	103
2F06	Barium Carbonate Slurry. The off-gas from the Thorp dissolver is scrubbed to remove radioactive carbon. The end product is a slurry of barium carbonate. This is encapsulated into 500 litre drums using cement. The drums are stored in a purpose built store.	Continued reprocessing produces additional waste	442
2F07	AGR graphite. AGR fuel assemblies contain a graphite sleeve. This sleeve is removed and crushed prior to reprocessing. The graphite used to be packaged into mild steel drums, but is now packaged into 500 litre stainless steel drums. These drums are stored in a purpose built store.	Continued reprocessing produces additional waste	3,759
2F08	AGR stainless steel. The individual pins in an AGR fuel assembly are held in position using a series of stainless steel grids and braces. These are removed when the pins are consolidated for storage prior to reprocessing. These items are crushed and placed in 500 litre stainless steel drums for storage. The drums are placed in purpose built stores.	Continued reprocessing produces additional waste	542
2F09	MEB crud. LWR fuel is transported in “Multi Element Bottles” (MEBs). Sometimes these bottles can contain activated corrosion products from the inside of the reactor. These solid particles are flushed out of the bottles and collected. They are then encapsulated into 500 litre drums using cement. The drums are stored in a purpose built store.	Continued reprocessing produces additional waste	161

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2F10	Centrifuge cake. When oxide fuel is reprocessed the fuel is dissolved in nitric acid. Small quantities of insoluble material from the fuel remain in suspension. These solids are removed using a centrifuge. This material is known as centrifuge cake. This is encapsulated into 500 litre drums using cement. The drums are stored in a purpose built store.	Continued reprocessing produces additional waste	1,114
2F11	SIXEP ion exchange resin and sand. Similar to stream 2D26, but arises from the treatment of materials associated with oxide fuel storage and reprocessing.	Future arisings of this waste will be dependent on the quantity of fuel stored in the pond and the length of the storage period.	17
2F13	EARP floc. As stream 2D27 except that the effluents giving rise to the floc originate from Thorp. In practice this waste stream is not physically segregated from the floc produced from the treatment of Magnox effluents.	Continued reprocessing produces additional waste	465
2F15	Multi Element Bottles. These are the containers in which fuel is transported and stored within the Thorp ponds. They are currently in use, but will be declared waste when reprocessing ceases. It is currently anticipated that at least 80% of these bottles will be classified as LLW.	These items already exist and will be unaffected by the extent of future reprocessing	1,723
2F21	Maintenance scrap. Periodically components need to be replaced on the machine which cuts up oxide fuel prior to reprocessing. The components are placed in steel baskets which are subsequently cemented into 500 litre stainless steel drums. These drums are stored in purpose built stores.	Continued reprocessing produces additional waste	113
2F24	Waste Encapsulation Plant (WEP) scrap. The waste is maintenance waste from the waste encapsulation plant which is used to cement a number of Thorp wastes into stainless steel drums	Continued reprocessing produces additional waste. However a proportion of the future throughput of WEP will be supercompacted historic Magnox wastes	34

Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2F26	LWR pond sludge. The sludge is a combination of algae, debris and guano which is suspended in the pond water in the B27 fuel storage pond. The waste will be retrieved dried and supercompacted before being cemented into stainless steel drums.	Decommissioning of this pond is scheduled to begin within 5 years.	8
2F27	AGR pond sludge. The sludge is a combination of algae, debris and guano which is suspended in the pond water in the B310 fuel storage pond. The waste will be retrieved dried and supercompacted before being cemented into stainless steel drums.	Future arisings of this waste will be dependent on the quantity of fuel stored in the pond and the length of the storage period.	1
2F31	Zircaloy hulls in B38. This waste is the fuel cladding from early oxide fuel reprocessing which took place in the 1970's. The zircaloy fuel cladding is stored under water in a concrete silo (compartment 11 of B38). The wastes will be retrieved and cemented into stainless steel drums.	This is a historic waste which is not linked to Thorp reprocessing.	43
2F32	Zircaloy hulls in B29. This waste is the fuel cladding from early oxide fuel reprocessing which took place in the 1970's. The zircaloy fuel cladding is stored in skips in the B29 storage pond. This waste will be retrieved and transferred to compartment 11 of B38 (with waste stream 2D31). It will then be retrieved and cemented into stainless steel drums.	This is a historic waste which is not linked to Thorp reprocessing.	9
2F33	Early oxide reprocessing waste. This waste is fuel cladding from early oxide fuel reprocessing which took place in the 1970's. The stainless steel fuel cladding is mixed with other debris and sand in a silo in B204. This will be retrieved and transferred to compartment 11 of B38 (with waste stream 2D31). It will then be retrieved and cemented into stainless steel drums.	This is a historic waste which is not linked to Thorp reprocessing	11
2H01	AS 2F01	Continued reprocessing produces additional waste	190
2H02	As 2F 04	Continued reprocessing produces additional waste	799

2H03	As 2F06	Continued reprocessing produces additional waste	64
2H04	As 2F02	Continued reprocessing produces additional waste	31
2H05	As 2F05	Continued reprocessing produces additional waste	4
Stream	Stream Description / Location / Treatment	Relationship to Future Reprocessing	Lifetime Conditioned Waste Volume / m^3
2H06	As 2F09	Continued reprocessing produces additional waste	39
2H07	As 2F10	Continued reprocessing produces additional waste	357
2H09	As 2F13	Continued reprocessing produces additional waste	64
2H10	As 2F11	Future arisings of this waste will be dependent on the quantity of fuel stored in the pond and the length of the storage period.	3
2H13	As 2F22	Continued reprocessing produces additional waste	7
2H14	As 2F21	Continued reprocessing produces additional waste	14

Appendix 2

Change to Storage Requirements

Waste Family EPS

Store Data	**Volumes (m^3)**
Planned capacity	80,000
Reference case uptake	70,000
Store capacity	17,000
Volume increase for additional store	> 10,000
Volume decrease to avoid planned store	> 7,000
Current built capacity	51,000

Scenario Impacts	**Volume Change (m^3)**	**Store Requirements**
Magnox Scenarios		
Magnox Blue Sky	+ 7,600	No change
Reference case	0	-
Reprocess Existing	- 3,200	No change
Thorp Scenarios		
Thorp Blue Sky	+ 6,000	No change
Reference Case	0	-
Reprocess Contracted Fuel	- 1,000	No change
Stop Thorp Baseload	-3,100	No change
Stop Thorp March 1999	-5,300	No change
Combined Scenarios		
Thorp and Magnox Blue Sky	+ 13,600	1 additional store
Reference case	0	-
Reprocess existing Magnox and stop Thorp	-3100	No change

Volumes rounded to the nearest $100m^3$

Waste Family EDS

Store Data	**Volumes (m^3)**
Planned capacity	13,000
Reference case uptake	12,000
Store capacity	7,500
Volume increase for additional store	> 1,000
Volume decrease to avoid planned store	Planned capacity constructed
Current build capacity	13,000

Scenario Impacts	**Volume Change (m^3)**	**Store Requirements**
Magnox Scenarios		
Magnox Blue Sky	+ 800	No change
Reference case	0	-
Reprocess Existing	- 400	No change
Thorp Scenarios		
Thorp Blue Sky	+ 600	No change
Reference Case	0	-
Reprocess Contracted Fuel	- 100	No change
Stop Thorp Baseload	- 400	No change
Stop Thorp March 1999	- 600	No change
Combined Scenarios		
Thorp and Magnox Blue Sky	+ 1,400	1 additional store
Reference case	0	-
Reprocess existing Magnox and stop Thorp	- 1,000	No change

Volumes rounded to the nearest $100m^3$

Waste Family MBGWS

Store Data	**Volumes (m^3)**
Planned capacity	4,700
Reference case uptake	3,300
Store capacity	4,700
Volume increase for additional store	> 1,400
Volume decrease to avoid planned store	Planned capacity constructed
Current build capacity	4,700

Scenario Impacts	**Volume Change (m^3)**	**Store Requirements**
Magnox Scenarios		
Magnox Blue Sky	+ 900	No change
Reference case	0	-
Reprocess Existing	- 400	No change
Thorp Scenarios		
Thorp Blue Sky	+ 1000	No change
Reference Case	0	-
Reprocess Contracted Fuel	- 200	No change
Stop Thorp Baseload	- 600	No change
Stop Thorp March 1999	- 1000	No change
Combined Scenarios		
Thorp and Magnox Blue Sky	+ 1,900	1 additional store
Reference case	0	-
Reprocess existing Magnox and stop Thorp	- 1,300	No change

Volumes rounded to the nearest $100m^3$

Waste Family VPS

Store Data	**Volumes (m^3)**
Planned capacity	1,600
Reference case uptake	1,070
Store capacity	1,200
Volume increase for additional store	> 130
Volume decrease to avoid planned store	Planned capacity constructed
Current build capacity	1,200

Scenario Impacts	**Volume Change (m^3)**	**Store Requirements**
Magnox Scenarios		
Magnox Blue Sky	+ 100	No change
Reference case	0	-
Reprocess Existing	- 50	No change
Thorp Scenarios		
Thorp Blue Sky	+ 0 (waste repatriated)	No change
Reference Case	0	-
Reprocess Contracted Fuel	- 100	No change
Stop Thorp Baseload	- 250	No change
Stop Thorp March 1999	- 470	No change
Combined Scenarios		
Thorp and Magnox Blue Sky	+ 150	No change
Reference case	0	-
Reprocess existing Magnox and stop Thorp	-60	No change

Volumes rounded to the nearest $10m^3$

Appendix 4

NGO views on reprocessing following BNFL documentation produced 27 August 1999

Appendix 4:
NGO VIEWS ON REPROCESSING FOLLOWING BNFL DOCUMENTATION PRODUCED 27 AUGUST 1999

1. INTRODUCTION

The WWG NGOs are grateful to BNFL for providing such a detailed document (Appendix 3). The following, as agreed at the last WWG meeting, represents a brief initial response that indicates some differences of view that should form the basis of future discussions and some additional points where NGOs would welcome additional technical clarification - these are marked 'Q:'.

In order to progress the production of the report to the main group in a timely fashion this document contains an overview response rather than a consideration of the detailed points. Broadly speaking the main points of disagreement between BNFL and NGOs are over:

- the economic and reuse benefits, or otherwise, of reprocessing;
- radiation, volume and hazard considerations in comparisons of reprocessing with alternatives.

2. ECONOMIC CONSIDERATIONS

At Section 9.5 of Appendix 3, BNFL state that stopping reprocessing would remove a source of future income which enables them to progress with site decommissioning and cleanup work. NGOs believe that this is one of the central issues for discussion in the subsequent dialogue working groups on reprocessing.

NGOs agree with BNFL that an increasing source of profitable future income will come from BNFL's overseas clean-up contract work. In 1996 Mel Draper of the Department of Trade and Industry indicated that the size of the US market was $227bn[1] and he stated that;

> "*The UK is poised at the early phases of a new industry*"[2]

The issue to be discussed is whether BNFL will be on a sounder financial footing in the medium term if it offered its existing customers the opportunity of renegotiating existing reprocessing contracts into storage contracts. For example, an independent economic analysis commissioned by Friends of the Earth, and published as *THORP*, *the Case for Contract Renegotiation*, concludes that significant savings would be made if reprocessing contracts were switched to storage (£440-526 million for German contracts and £209- £571 for Japanese contracts.[3])

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1 Mel Draper, *A Government View of Nuclear Liabilities Management*, in Nuclear Plant Life and Liabilities Management, IBC London 19-20 November 1996, p7

2 Draper (1986) p8

3 THORP, the Case for Contract Renegotiation, FOE (1999) pxv

This follows an earlier analysis that suggested that in many of the circumstances analysed, THORP emerged as a loss-maker in terms of expected future net avoidable cash flows.[4] For NGOs, THORP's operating and throughput problems - and the operating losses for THORP recorded in this years annual accounts - add weight to our view.

NGOs accept that there may be socio-economic impacts of such a transition out of reprocessing and consider that this should also be one of the key questions that a possible future socio-economic study to focus on .

3. REUSE CONSIDERATIONS

Many of the comparisons between reprocessing and alternatives assume that the materials separated by reprocessing are reused. However, NGOs believe that such comparisons should also take account of the actual levels of reuse. For instance, Gregg Butler (1998) has stated:

> "*the main UK imponderable is whether the uranium and plutonium produced by reprocessing will actually be recycled*"[5]

One of the main historical reasons for the UK reprocessing programme was that the resultant separated uranium and plutonium would be used to fabricate fresh nuclear fuel elements. However the optimistic predictions of the 1970s have not transpired.

Plutonium may be reused either in fast breeder reactors or in MOX fuel which contains plutonium mixed with uranium. However the UK fast reactor programme has been cancelled, similarly MOX use is not currently planned for the UK.[6]

Uranium reuse is also in cessation. In May 1991 BNFL former chief executive, Neville Chamberlain stated;

> *"Most reprocessors at the moment, that is customers of reprocessing, regard their recycled uranium as free issue of nil value"*[7].

About 95% of the output of a reprocessing plant is reprocessed uranium (RepU). Originally it was commonly accepted within the nuclear industry that RepU would be reused. However, by 1990, this decision was almost completely reversed.[8] Reuse of reprocessed uranium stopped in the UK in 1987.[9,10,11]

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4 Sadnicki (1998) Future THORP Avoidable Cash Flows, p6
5 Butler (1998) Interdisciplinary Science Review, Vol. 23 No 3, p296
6 HL Paper 41, (1999) pp 62-63
7 Minutes of Oral Evidence by BNFL, *British Nuclear Fuels plc: Report and Accounts 1989-90*, House of Commons Energy Committee, Session 1990-91, London: HMSO p9
8 *Reprocessing, A Review of the Issues*, NUKEM Market Report 10/90, p5.
9 Wilkinson, W.L. *et al. Spent Fuel Management Strategy in the United Kingdom*, In Back End of the Nuclear Fuel Cycle: Strategies and Options, Proceedings of a Symposium, Vienna, 11-15 May 1987, IAEA Vienna (1987) p38
10 Jackson, K. *The Recycling of Plutonium and Uranium*, The Uranium Institute Annual Symposium, London 1993, p1
11 Gareth Thomas, BNFL, e-mail to Rachel Western, 23 April 1999

Although it was planned to use a plant (line 3 hex) to process RepU from THORP, work on this plant has stopped due to lack of customer interest.[12]

NGOs therefore consider that BNFL's view - that the UK stocks of separated nuclear materials produced by reprocessing possess a value - is not shared by its customers. Although it is possible that this may change, in the view of the NGOs this is unlikely for both technical and economic reasons.

3.1 UK Plutonium and MOX

In their response to questions, (August 1999) BNFL state that 'calculations have shown that handling 60-year old Magnox Pu in SMP would be possible'. However, the information available from Patterson (1992)[13], and NEA (1989)[14] makes clear that there are ageing considerations that may affect the relevance of presently separated stocks to future utilisation as MOX. Further, information available to Friends of the Earth under Chatham House rules indicates that 'it is quite obvious that a significant proportion of Magnox plutonium is not suitable for utilisation as MOX'. Clearly this matter cannot be resolved at present due to the lack of referenced data. NGOs would welcome further clarification on this issue:

Point 1: The proportion of Magnox plutonium presently usable in SMP and the effect which the ageing of this plutonium has on that proportion is of concern to the NGOs who feel this is an important issue for the Reprocessing Group to address

In addition, limitations due to potential reactor capacity must also be considered. In their response to questions BNFL state that 'the potential exists for additional capacity from Nuclear Electricity generation.' NGOs and BNFL obviously have the differing views on the likelihood of a renaissance of nuclear power, but it is the view of NGOs that the current problems of nuclear power - economic, scientific and technical -essentially rule out additional nuclear capacity.

Due to the particular problems associated with plutonium separation and the build up of plutonium stocks, NGOs do not consider that additional plutonium stocks should be built up on the off-chance that they may one day be used.

In Section 8.3 of Appendix 3, BNFL pose the question 'why is reprocessing and reuse any different than glass recycling?'. NGOs would reply that there is a significant difference due to the production of liquid HLW, separated plutonium and discharges that arise from reprocessing that rule out reprocessing as a sustainable waste management method. Some of these issues are outlined below.

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12 Gareth Thomas, BNFL, e-mail to Fred Barker 3 November 1998, Gareth Thomas e-mail to Rachel Western 9 August 1999

13 Patterson (1992) in IMechE, The Management of Irradiated Fuel, p40

14 NEA (1989) Plutonium Fuel an Assessment, p37

4. RADIATION CONSIDERATIONS

In Section 8.3 of Appendix 3, BNFL refer to a RWMAC statement on radiation doses arguing that reprocessing leads to a lower overall dose burden than the alternative. Although no reference is given it is assumed that BNFL are referring to RWMAC's Eleventh Annual Report (1990), Chapter Four. Unfortunately the data in this report is problematic and cannot support the assertion made. The report refers to an unpublished EUR report prepared by the NRPB. The EUR report gives a higher risk for spent fuel disposal than for vitrified HLW disposal due largely to the technetium-99 isotope.[15] The assumptions concerning technetium are drawn from the 1989 Grambow paper presented at an IAEA conference.[16,17] However, in this paper Grambow states that the technetium assumptions are derived;

> "*For the sake of conservatism and without strong experimental evidence*"[18]

Further Grambow states;

> "*The discourse above naturally leads to an attempted comparison between glass and spent fuel, but the scientific basis for such a comparison is still limited.*"[19]

Even more problematic is the fact that the study did not consider the doses arises from the long term disposition of the separated materials plutonium and uranium.[20] Shelley Mobbs of the NRPB stated;

> "*It was not possible to compare the two options as concepts because a number of important factors were not taken into account in the study.*"[21]

Further, RWMAC stated;

> "*There is little information available on the impacts of the use of MOX fuel in thermal reactors and of commercial scale fast reactors and meaningful comparisons are difficult.*"[22]

More information is given on present day doses arising from both storage and reprocessing. RWMAC stated;

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15 EUR 13561 (1991) p21
16 EUR 13561 (1991) pp 11,18
17 Grambow (1989) in IAEA Safety Assessment of Radioactive Waste Repositories, Paris 1989
18 Grambow (1989) p451
19 Grambow (1989) p454
20 Mobbs (1992) in IMechE, The Management of Irradiated Nuclear Fuel, Manchester, November 1992, p73
21 Mobbs (1992) p75
22 RWMAC (1990) p41

> "*Reprocessing, by releasing the wastes confined within the spent fuel elements, increases the volume of radioactive waste and the amounts of radioactive material released into the environment in effluent discharges.*"[23]

Rather than stating that the dose would be lower RWMAC concluded that the doses arising from reprocessing were broadly comparable to the doses arising from storage and direct disposal.[24] In the view of NGOs a more comprehensive study that took into full consideration the problematic nature of the data together with the need to include all material streams would indicate a lower overall impact for storage than arises from reprocessing. This could also form the basis of further discussion.

5. VOLUME CONSIDERATIONS

The data produced by BNFL for the WWG looks at the impact of future reprocessing compared to the large volume of existing waste. Another method of comparison would be to compare the impacts of reprocessing - in terms of waste volumes for both materials currently viewed as waste and for materials currently considered potentially reusable - with the impacts of the main alternative, spent fuel storage. On a simple cursory basis, NGOs would assert that as a minimum reprocessing ,increases the capacity requirements for waste handling as compared to spent fuel storage.

5.1 Uranium

The recently released Quantisci report (Version 1.0 June 1999 Draft) contains information on the possible impact of the disposal of uranium. Quantisci quote an inventory of 100, 000 tonnes of uranium, including depleted uranium and RepU (pages 7 & 9) and a conditioned volume of 10,000 cubic metres (page 13). It is not clear from the DTI press information (supplied by BNFL in their first response) what is the tonnage of RepU and what is the tonnage of depleted U from enrichment.

Point 2: The NGOs feel that a review of the current stocks of reprocessed uranium and depleted uranium in conditioned and unconditioned form would be useful to the task of reviewing the possible impacts associated with the disposal of uranium allowing future discussions to focus on the waste management implications of declaring these materials as waste..

5.2 Conditioned ILW and LLW Volumes

The 1998 UK Waste Inventory refers to 'only small volumes of waste being generated during the long term storage of AGR spent fuel'[25]. This is not the case for reprocessing which generates significant volumes of waste.

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[23] RWMAC (1990) p35
[24] RWMAC (1990) p40
[25] DETR/RAS/99.009, July 1999, p19

Point 3: In respect of determining the volumes of ILW and LLW generated as a result of long term storage of Magnox fuel, AGR and LWR fuel, NGOs feel it would be valuable to be able to quantify these volumes in order to compare them to the volumes of ILW and LLW generated by reprocessing.

5.3 Plutonium

Both the Environment Agency and Quantisci note that the disposal of plutonium could have a significant impact on repository design due to considerations of criticality. BNFL's statement (section 7.4, appendix 3) that plutonium disposal would add 2% to repository volumes implies that they do not agree. The waste management implications of declaring plutonium a waste could be the subject of future discussions.

Point 4: Repository design for conditioned, separated plutonium in the event of that material being declared a waste would be affected by the need to avoid criticality. A review of such effects on design would be valuable to future discussions.

6. HAZARD CONSIDERATIONS

In addition to the engineering considerations associated with the design and capacity impacts of reprocessing, the impact of reprocessing on the hazard presented by the materials treated must also be considered. Reprocessing is a chemical treatment which transforms solid nuclear fuel rods into a variety of chemical forms that require a high degree of surveillance and further treatment. Of particular concern are the untreated intermediate level wastes, high level liquid wastes and the separated plutonium streams which present a significant potential hazard.

NGOs consider it important that the hazards arising from these chemical streams, including the maximum credible accident scenarios, are included in the comparative analysis of reprocessing with spent fuel storage. Thus discussion of different scenarios should not just focus on a comparison of conditioned waste streams but also the wastes in the raw untreated form produced by reprocessing, particularly when they are likely to remain in this state for a period of years. However, one further are of potential disagreement between the company and NGOs may be over what constitutes a credible accident scenario. Some of the risks associated with these raw material streams are considered below.

6.1 ILW

The NII review of ILW waste storage in the UK (1999) reports that around 15% of the raw ILW stored at Sellafield has been conditioned to a passive safe state. (p5). This leaves a considerable volume that remains to be treated. The report goes on to refer in detail to the conditions of raw wastes held at Sellafield. For example the report refers to the plutonium release hazard presented by plutonium contaminated waste (p9) and the potential hazard presented by the combustible solvents in medium active liquor storage (p10). It is important to note that the conditioning of the reprocessing wastes represents an additional processing stage and that the wastes are initially produced in the raw state.

Point 5: The volume of existing raw wastes at Sellafield is known to be considerable with only 15% of raw ILW having been conditioned. Future discussions should embrace consideration of the volume of existing wastes and the time taken to condition them.

6.2 HLW

Irradiated fuel that is sent to Sellafield for reprocessing contains actinides and fission products. As a result it is intensely radioactive.[26] When unloaded from the reactor the fuel contains uranium, fission products (up to 3% wt.) and actinide elements (up to 1.5% wt.).[27] Following reprocessing the majority of the plutonium and uranium are separated and the remaining actinides and fission products are held in a nitric acid solution. The NII have stated that:

> "*So long as waste remains in liquid form and therefore dispersible, it presents a hazard to those who work there and potentially to the public or the environment.*"[28]

On 27 August 1999 the HSE wrote to Friends of the Earth stating;

> "*we are anxious to see the hazard i.e. the potential source term, which relates to the quantity of high level waste stored in liquid form (HAL), reduced as soon as it is reasonably practicable.*"[29]

In contrast where spent fuel is held in storage it does not enter the liquid phase, therefore the dispersion hazard referred to by the NII is significantly reduced. The storage of spent fuel (including AGR and Magnox fuel) is discussed in IAEA Technical Report No 290 (1988).

In the view of NGOs the fact that the raw waste presented by reprocessing is in the dispersible liquid form presents a significant reason why reprocessing exacerbates the waste management task.

6.3 Unconditioned Plutonium

At 9.6 of Appendix 3 BNFL state their view that the plutonium produced by reprocessing is held in a passively safe form. Due to the significant security and safeguarding requirements of plutonium held in its current unconditioned form the NGOs would challenge whether this meets the WWG definition of passive safety. NGOs would point to the growing body of opinion that regards separated plutonium as a high risk material that should be declared as a waste in order that it may be chemically conditioned to reduce the risk presented. NGOs consider that as reprocessing inevitably produces plutonium in the separated form, it cannot be seen as a technology that optimises the passive management of nuclear materials.

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26 See for example IAEA Technical Report Series No 290 (1988) p17
27 BNFL, Nuclear Fuel Reprocessing Technology, 1992, p4
28 NII Sellafield Audit (1986) Vol. I p1
29 Letter from Janice Tebb (HSE) to Rachel Western (FOE) 27 August 1999

7. CONCLUSION

In the view of NGOs, reprocessing exacerbates waste management problems and should be phased out as quickly as it practicable and feasible. It does not provide materials that are attractive for reuse and it does not represent a secure source of income. In contrast the burgeoning cleanup industry offers enormous financial rewards. In addition to providing no advantages, reprocessing presents significant disadvantages. It presents an immediate radiation dose due to its intrinsic discharge of radioactive materials to the air and sea; it increases the volume of nuclear materials that must be dealt with and most importantly it generates materials that represent an extremely serious public hazard. This is of particular concern for high level liquid waste and for separated plutonium.

Pad Green, Rachel Western and Pete Wilkinson
6 October 1999

Endorsed by CND

i. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, pages 18 and 19 of Chapter 3,

ii. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 6, page 156

iii. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 6, page 156, waste streams 2F01, 2F01/C and 2F22.

iv. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 6, page 156, waste streams 2H01 and 2H13.

v. The 1998 United Kingdom Radioactive Waste Inventory, Detailed information for BNFL wastes: Calder Hall, Capenhurst, Chapelcross, Sellafield and Springfields, DETR/RAS/99.003, page 44 (waste stream 2D02)

vi. The cost of high level waste disposal in geological repositories, OECD, 1993. Page 103, Annex 1.

vii. The cost of high level waste disposal in geological repositories, OECD, 1993. Page 28.

viii. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 3, Tables A3.3b and A3.4b, pages 122 and 125

ix. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 3, Tables A3.5b and A3.6b, pages 127 and 129

x. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 3, Tables A3.7b and A3.8b, page 131 and 133

xi. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 3, Tables A3.9b and A3.10b, page 135 and 136

xii. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 3, Table A3.1b, page 119

xiii. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 3, Table A3.11b, page 137

xiv. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 3, Table A3.12b, page 138

xv. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 2, Table A2.3b, page 108. This tables shows arisings post 2000 of 915 m^3

xvi. The 1998 United Kingdom Radioactive Waste Inventory, Main Report, DETR/RAS/99.009, Annex 2, Table A2.5b, page 110

xvii. Based on a 40 year life and an assumed 25te per year fuel discharge

xviii. Lifetime arisings given in the British Energy Prospectus as 7,400 te. Plus an estimated 600 te from 5 year lifetime extensions to Hunterston B, Hinkley Point B, Heysham 2 and Torness. 600 te derived from typical annual discharges of 15 te per reactor (Fuel-Trac).

Appendix 5

Terms of Reference of the Waste Working Group

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BNFL Working Group Terms of Reference - WASTE

Background

These terms of reference have been collated from the issues and conclusions of the BNFL Stakeholder Dialogue Main Group Meeting on 17th March 1999. It is open to the Waste Working Group (WWG) to amend them, or to set itself wider or more restricted terms, always bearing in mind that it should not diverge from the consensus of the main group, and will be reporting back to the main group.

In the event of the WWG raising objections as to the interpretation of the following headings, the Co-ordinating Group (CG) might contact members of the original *Scope, Aims*, *Planning* & *Information Needs* sub-groups, to ensure that these summaries reflect their intentions.

Overall

The WWG needs independent facilitation.
The WWG will need to agree criteria for judging its own success.
Wherever possible there must be continuity of individuals as members of the WG membership, with substitutes deputising only where absolutely necessary.
A decision should be taken by as to whether feedback between meetings should be available only to members of the WWG, or should also be made available to the Main Group/Discharges Group.
Should the WWG agree at the outset that its remit finishes on presentation of its recommendations in November, or is it preferable to let the Group decide as its work progresses?

Scope

The Scope should be defined by the Aim, currently proposed as "To review and recommend a strategy or strategies to guide BNFL's management of radioactive waste".

Therefore, should the WWG redefine the Aim, the Scope may also need to be re-examined.

The Scope refers to two aspects:
1. The nature of the radioactive waste to be considered for the November meeting
2. The aspects to be taken into account by the Principles

To address these in turn:

1. Radioactive waste

There are many types of radioactive waste. It is proposed that the WWG consider:
- High-level and Intermediate-level solid and liquid radioactive wastes stored at BNFL sites (Sellafield, Capenhurst and Springfields).
- The WG may also decide to consider
    - Plutonium
    - Decommissioning wastes

2. The aspects of radioactive waste management

The guiding principles should take the following into account:
- The needs both of present and of future generations
- Management of both current and future radioactive waste, and consideration of its origins
- All management options - not only disposal
- International issues and developments
- Lessons from 'sustainable development' approaches to broader waste management

Aims
The proposed aim is:
"To review and recommend a strategy or strategies to guide BNFL's management of radioactive waste".
The aim is supplemented by actions which will lead to the aim:

- reviewing actual and potential radioactive waste management problems
- identifying a range of possible solutions
- recommending a course of action.

The WWG will advise the Main Group - some participants would like to influence UK policy more directly, but the Group agreed that its remit does not extend as far as this. However, 'business as usual' will continue to influence the larger picture.

The WWG will develop its view of the guiding principles for BNFL's radioactive waste management policy, using a process which will include:

- Listing the concerns and issues which the principles should address (environmental, health & safety issues, together with economic aspects and identification of any conflicts of interest which would need to be resolved)
  A suggestion may be to examine the impacts in the context of sustainable development - the environmental, societal and economic implications
- Considering the various management and minimisation options which may address these concerns and issues, including BNFL's current policies
- Making a comparative analysis of these options
- Making recommendations

The WWG may decide to expand these areas.
Planning
The WWG will agree its own Terms of Reference, liaising where necessary with the CG.
These will include a clear statement/confirmation of the WWG status and operating principles.
These may include:

Status
The working group's task is to inform and influence BNFL's decision-making, and that of the other stakeholders

Operating Principles

- The WWG needs administrative and logistical support (secretariat) which will be provided by the Environment Council.
- The WWG should be able to hear third parties, for example experts on specific issues.
- The funding of the WWG and recovery of costs by individual members must be agreed. They must be transparent, and be seen not to affect the group's neutrality.
- There should be a method of ensuring the free flow of information between WWG members between meetings. It has been suggested that the Environment Council might post WWG information on its website, accessible either only to WWG members, or also to the Main Group / Discharge Group.
- The WWG will need to agree an Agenda for its term of operation - roles, meetings, timings.

Information Needs

Information will be needed both from BNFL and other sources, surrounding the issues to be addressed under *'Aims'*. This will provide an informed basis for discussion. All organisations represented on the WG will make information needed by the Group available to it. Where information is held by third parties, a decision will be made as to whether the WWG or the CG will obtain it. Ground rules for the use of such information will need to be agreed.
Information which the WWG may decide it needs:

- External factors which may affect the work of the WWG (legislation, Government interests, Reports)
- Information on the impacts of radioactive waste (where appropriate at local, national & international levels) on the environment, health, communities (employment) and the economy.
- Information on public attitudes and perceptions surrounding the management of radioactive waste.
- Information on the different management options and strategies, and the different approaches (including national policies and international comparisons)

Information on waste inventories (current and anticipated) and BNFL's own contribution, in the context of radioactive waste as a global issue

Appendix 6

Stakeholder Comments

Comments for inclusion with the Waste Working Group Draft Interim Report

1. Proliferation

CND welcomes the recognition in paras 3.10 and 8.4 of the Interim Report that safeguards, proliferation implications and institutional control aspects need to be taken into consideration when implementing strategies for the management of nuclear materials, especially plutonium and spent nuclear fuel. The non-proliferation regime cannot be secure whilst the long- term management problems for these materials remain unsolved.

We note that, during its study into excess weapons plutonium disposition, the US National Academy of Sciences Committee on International Security and Arms Control (CISAC) was given briefings by nuclear weapons experts from the Lawrence Livermore and Los Alamos National Laboratories. Whilst the briefings and subsequent report to CISAC remain classified, an unclassified version of the overview to the report is available (1).

The overview states:

"This report illustrates two facts:
1. Reactor-grade (RG) plutonium, such as that produced in commercial power reactors, can be used to construct a nuclear weapon with a yield of at least a kiloton.
2. RG plutonium can be separated from spent nuclear fuel with modest facilities and equipment."

The overview goes on to say:

"It is commonly believed that spent fuel is so radioactive (self-protecting) that it could not be stolen and processed by a terrorist group. Unfortunately, 10 to 15 years after reactor discharge, the radiation dose rate near spent fuel is greatly reduced. A subnational or terrorist group willing to incur substantial, but not lethal, radiation doses could obtain Pu by stealing and processing irradiated spent fuel."

For the non-proliferation regime, therefore, strategies for containing nuclear materials need to take into account factors such as the possibility of improved accountability, security and control offered by consolidated surface storage, perhaps under regional or international auspices, as compared to widespread on-site storage.

Similarly, the desirability of the early sealing of a repository to prevent recovery of plutonium for weapons use should be part of the equation when contemplating long-term monitored, retrievable and accessible storage. It is not just that, as time passes, the intrinsic barriers to plutonium recovery from spent fuel lessen, but that diversion from storage facilities may become more difficult to detect as inventories increase. Likewise, accessible inventories of spent fuel readily to hand may prove tempting as a source of energy at a later date, and such use could, itself, then become a cover for the recovery of plutonium for military purposes.

In short, any strategy for plutonium and spent nuclear fuel management should aim to prevent or, at least, severely discourage the recovery of plutonium for nuclear weapons.

2. Magrox

The late admission that BNFL is considering using Magrox fuel has radical implications for the balance of the 9 scenarios, which would presumably have been constructed differently if the WWG had had early knowledge of this option. Magrox use could extend the lifetime of Magnox reactors significantly, although any such extension would invalidate the consensus agreement over Magnox reprocessing.

3. Options

CND are concerned that the "Stop Now" option was presented in terms which rendered it clearly invalid: a scenario with a December 1999 cut-off date cannot be used in future work. The "Blue Sky" option, however, is referred to directly or indirectly throughout the report (see, eg, pp 3, 18, 20). Thus the scenarios have a pro-industry bias, although purporting to be "a preliminary framework within which strategic options can be considered objectively."

References

1. Sutcliffe,WG and Trapp, TJ (eds), Extraction and Utility of Reactor-Grade Plutonium for Weapons, LLNL, UCRL-LR-115542, 1995. Unclassified overview available at http://www.rtpc.com/livermore.htm

COUNTY COUNCIL

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2nd February 2000

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The Environment Council
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LONDON
WC1V 7VW
FAO: Schia Mitchell
Project Operations Manager
BY FAX & FIRST CLASS POST

Dear Ms Mitchell

CUMBRIA COUNTY COUNCIL COMMENTS ON THE INTERIM REPORTS OF THE WASTE WORKING GROUP & DISCHARGES WORKING GROUP IN THE BNFL NATIONAL DIALOGUE

The following comments can be referred to and apply to both the Waste & Discharges Working Group reports.

Cumbria County Council welcomes both reports as a major step forward towards common understanding amongst all stakeholders as to the basic scenarios for managing waste and reducing discharges. We do not wish to offer any detailed observations or criticisms of the current text in the Interim Reports.

In respect of waste, we are pleased that the report emphasises the need to ensure all waste arisings are packaged in passively safe, monitorable and retrievable interim storage, while acknowledging that research must continue on long-term storage and the possibility of disposal. We are, however, particularly pleased that the report notes that the House of Lord's recommendation that the disposal programme be immediately re-launched, is not shared by members of the Waste Working Group.

We are also pleased that both reports see the need to urgently assess the socio-economic consequences for West Cumbria. There would be significant effects for West Cumbria from accelerated plant closures under the "Stop Now" or similar scenario. There could also be significant economic opportunities presented by the "Blue Sky" scenario. We consider there is thus a need to bring forward work urgently to provide baseline economic and social impact data and then assess the consequences of each scenario. The long-term role of Sellafield in the economy of West Cumbria needs to be given careful consideration, and the County Council would be pleased to assist the dialogue process in developing socio-economic data analysis and evaluation to inform the future proposed reports on Spent Fuel Management Options and Plutonium / Mox.

Yours sincerely

W Minto CBE DL
Leader, Cumbria County Council

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8 February 2000

MEMO

TO: Environment Council
FROM: Gordon Thompson
RE: BNFL National Stakeholder Dialogue

1. Introduction

This memo provides some brief comments on the 18 January 2000 draft interim reports of the Discharges Working Group and the Waste Working Group. Gordon Thompson has prepared these comments on behalf of the Institute for Resource and Security Studies (IRSS). Thompson has represented IRSS on the Main Group of the Stakeholder Dialogue, and attended a November 1999 meeting in Manchester, where earlier drafts of the two reports were discussed. IRSS requests that this memo be attached to the two interim reports when they are made public later this month.

2. Scope, nature and quality of the Working Group reports

Decision-making in the UK about nuclear projects has consistently suffered from the lack of a key ingredient. That ingredient is the comprehensive, objective assessment of options for action. Such an assessment should be performed prior to the commitment of resources to a particular course of action. The assessment should identify and characterize a range of options. It should be carried out within the culture of science, which calls for openness, accountability, objectivity, clear statement of assumptions, and the use of peer review. The publication of such an assessment would support an informed public debate, and would increase the probability that wise decisions are taken.

The two Working Group reports represent a step toward meeting this need. However, they require substantial improvement, as illustrated by the following examples:

(a) Both reports present quantitative findings which are derived from analytic models that are not identified, whose assumptions are unstated, and for which there is no accountability.

(b) Both reports combine technical analysis with judgements about what is politically or economically practicable, with no clear distinction between these modes of discussion.
(c) The Discharges Working Group report repeatedly refers to "dose" without defining this parameter. In fact, the report uses a composite, theoretical dose. This practice can obscure important information about the distribution of incorporated radioactivity within the human body.
(d) The Waste Working Group report presents its results almost entirely in terms of waste volume. In fact, volume is only one indicator of radioactive waste characteristics, and may not be the most relevant indicator when matters such as the cost and risk implications of a waste management option are being assessed. The report ignores the implications of storing high-level radioactive waste at Sellafield as a liquid, a practice which holds the potential for a very large release of radioactivity.
(e) Both reports employ a set of scenarios that reflect arbitrary judgements, unsupported by technical analysis, especially in connection with the ending of Magnox reprocessing.
(f) Both reports present quantitative findings in a manner that can obscure differences between the future outcomes of alternative scenarios. This occurs when the incremental outcomes (e.g., waste volume) of decisions yet to be taken are lumped together with the outcomes of decisions taken in the past.
(g) Both reports appear to imply that policy decisions can be made while viewing particular issues (e.g., waste volume) in isolation. In fact, an integrated analysis that addresses all significant issues is a necessary precondition for making wise decisions.

3. The model of dialogue that underlies these reports

In the UK, BNFL represents a large concentration of capital, has considerable political influence, and has connections throughout the power structure. Its business plan is seen as an extension of state strategy. It continues to perform military functions, and preserves a tradition of secrecy.

The participants in this stakeholder dialogue are representatives of: (1) BNFL and its employees or contractors; (2) central government agencies; and (3) nongovernmental bodies and local governments. For convenience, let us call the third set of participants the Outsiders. This is apt because these participants have no formal power, limited financial resources, and (like the general public) limited access to relevant information. The Outsiders are a diverse, argumentative group, and they rarely speak with a single voice. Yet, over the years they have accrued public support, and have a reasonable record of accuracy in their assessment of issues.

Why has BNFL decided to spend money and staff time on dialogue with Outsiders? The short answer is that problems have arisen in the implementation of BNFL's business plan. Having tried other approaches to solving these problems, BNFL has now decided to sit down with its critics, to identify possible areas of common interest. That should be a welcome development. Unfortunately, however, the dialogue in the Working Groups appears to have become focussed on the question: "Can a deal be made between BNFL and the Outsiders, wherein each side makes compromises?"

There are three big problems with a dialogue that follows a deal-making model of this type. First, there is a significant asymmetry between BNFL and the Outsiders, in wealth and access to the power structure. This asymmetry could skew the outcome of the dialogue. Second, the Outsiders have no mandate from the public, and there will inevitably be argument within the Outsider camp about the acceptability of particular compromises. As a result, any deal involving significant compromise by Outsiders will be a fragile thing, and may not last. Third, a deal-making model of dialogue does not address the true nature of the problems that hinder the implementation of BNFL's business plan. Those problems are real, were not created by the Outsiders, and can only be addressed by changing the business plan.

4. A better model for dialogue

In IRSS's view, this stakeholder dialogue would be more productive if it focussed on identifying, and characterizing as accurately as possible, the options for future action by BNFL. Those options must begin with present realities, but their future development should encompass changes, perhaps major changes, in BNFL's business plan. In this options-characterizing model, participants in the dialogue would resist the temptation to apply value judgments or make deals. Instead, they would concentrate on developing a full suite of options, and on characterizing those options in an objective, clear-headed manner. The findings of this exercise would be made available to the general public. Any deals would then be made openly, in the political arena, which is where they belong.

As evidenced by the two Working Group reports, dialogue participants have put effort into examining options for future action by BNFL. This work could provide a basis for some useful analysis. To date, however, the analysis has suffered because the participants' attention has been diverted to deal-making. If that diversion were to cease, what steps could be taken to move this stakeholder dialogue toward an options-characterizing model? One step would be to examine future scenarios in an integrated, instead of a piecemeal, fashion. All of the significant issues would be considered in parallel. Another step would be to analyse issues by employing the culture of science. Political judgements would be made in other fora.

****

First Update

Meeting: 31 October 2000

Waste Working Group

An Update on the WWG Interim Report of 28 February 2000 in the light of the BNFL announcement on Magnox station lifetimes of 23 May 2000

Background

1. The announcement made by BNFL on 23 May 2000 considerably changed the planning assumptions which were current during the deliberations of the Waste Working Group which led to the publication of its Interim Report on 28 February 2000.

2. This announcement caused considerable controversy within the stakeholder dialogue, and this has been examined in a draft working paper prepared by a Task Group of Stakeholders (Magnox Station Lifetimes and Reprocessing Throughput, Magnox Task Group Draft Working Paper, issued 10 November 2000). It was also felt relevant to re-examine the WWG's Interim Report in the light of the 23 May statement, and this has been done by reconvening the original Working Group on 31 October 2000. Appendix 1 lists those present at this meeting.

3. This Working Paper presents an update on the WWG Interim Report, and is referenced back to it. The two documents taken together thus represent the views of the Working Group with respect to the currently declared BNFL programmes.

4. BNFL provided at the meeting a draft document which detailed the amount of fuel, waste assumptions, and waste volumes which would be associated with the achievement of the programme announced on 23 May. This was critiqued at the meeting, and the resulting version is attached as Appendix 2. By arranging peer reviews of the BNFL paper, all stakeholders subsequently satisfied themselves that the basic facts presented are a reasonable representation of the new programme, and can be used in this update at the same level of confidence as the figures utilised in the 28 February report. One item not fully dealt with at the time – the derivation and timing of the additional 400tU of fuel, and this was remitted to the SFMOWG for resolution between Green and BNFL Experts. Appendix 2 reproduces the 23 May announcement, also gives the current position on fuel stocks and future fuel usage (Table 6).

5. Appendix 2 includes the previous 'Magnox Blue Sky' programme scenario for comparative purposes. This is however, no longer relevant because of the 23 May announcement.

6. The 23 May Statement involves the potential use of Magrox fuel in Oldbury and Wylfa. This fuel type was not studied by the WWG but was the subject of a process observation *(Para 6 page 1, para 8.11 page 22).* This fuel type is being examines by the SFMOWG, and the basic assumptions and quantities of fuel and waste are given in Appendix 2. It may be helpful for SFMOWG to examine a scenario where Magrox fuel is not adopted to see the effects of Magnox use to end of life in Oldbury and Wylfa.

7. While the lead times of Magrox development and Magnox dry stores could be comparable, Magrox development is driven by the need to divert arisings from B205 which is not expected to operate beyond 2012 while at the same time maximizing the operational lifetimes of Oldbury and Wylfa stations.

8. Note that references in italics are to the 28 February WWG Interim Report, while references to other sections of the present update are in normal script.

Key Points – Executive Summary

9. The overall change in the scope of the 28 February WWG Interim Report is the withdrawal by BNFL of the 'Blue Sky' option. This removes from consideration the upper end of the Magnox fuel and reprocessing envelope.

10. The most significant change to items in the Executive Summary concerns the 'reluctant acceptance of the NGO's that the *(reference case)* could be supported' *(Para 2 page 2).* Notwithstanding the withdrawal of the 'Blue Sky' option, NGO's now considered that the increase of 610te in planned fuel usage and later closure of B205 (from 'about 2008/9' to 'around 2012…' represented by the 23 May programme (see Table 2 Appendix 2) was sufficient to undermine their 'reluctant acceptance'. Their current position was as stated for the 'Blue Sky' programme (11,000 te increase) – that there should be 'a further overall review by the Spent Fuel Management Options Group' *(Para 6 page 2)*. The SFMOWG is in any case carrying out such a review.

11. The 23 May programme adds to the NGO's concern that *"The vitrification programme could not be described as prompt and might slip further" (Para 3 page 1 penultimate sentence)* – a situation exacerbated by the additional fuel requiring reprocessing as a result of the announcement.

12. The waste storage aspect of the 23 May programme have been examined, and the withdrawal of the 'Blue Sky' option means that all waste scenarios now examined can be accommodated within currently planned waste storage *(Para 4 page 3)*.

13. With these exceptions all the major points of the WWG Interim Report remain unchanged.

Detailed Points – Main Report

13. This section comments on effects on the body of the WWG Interim Report. The statistics relevant to the 23 May programme are given in Appendix 2, this involves additions to *Tables 3, 4, 5, 6 and 7*. *Figure 1 and figure 2* are revised. The change in the Magnox reference programme is small enough to have no noticeable effect on *Figures 3, 4 and 5*.

14. Note that all the percentage changes in waste volumes remain appropriate unless otherwise stated.

15. The hope that the WWG waste profiles would be used in ongoing studies *(para 2.6 page 6)* has in fact occurred, and the information in Appendix 2 of this update will be

fed into both the Spent Fuel Management Options and Plutonium Working Groups. The 23 May announcement led to the reconvening of the WWG on 31 October which produced this report, and to the forming of the Magnox Task Group as already referenced.

16. The 1998 UK Waste Inventory included assumptions on Magnox lives *(para 4.3 page 9)* essentially identical to the WWG report reference case. The 23 May announcement programme, if realised, would give a change when fed through to the inventory. The figures in Appendix 2 indicate that the effect on *Tables 1 and 2* would be insignificant.

17. As noted in para 9 of this update, the 'reluctant acceptance' by the NGO's *(Para 5.2 page 15)* that the Current Business Plan could be accepted has been undermined by the shift to the 23 May programme. The delayed closure of B205 and the increased amount of fuel led NGO's to consider that, notwithstanding the withdrawal of the 'Blue Sky' option, a further overall review was justified *(para 5.5,5.6 page 16)*. Such a review is in fact in progress in the SFMOWG. It is the company's view that the withdrawal of the 'Blue Sky' option was in part influenced by the dialogue process.

18. In *Para 5.13 page 18* the overall effect of substitution on waste volumes is examined. The return of extra HLW in substitution for ILW reduces the amount of HLW in the UK. The potential addition of 2000te of Magrox fuel (Para 3.4 Appendix 2) to the amount of spent fuel to be managed gives a higher total inventory of HLW and therefore reduces the percentage reduction which substitution would give. The last two sentences of *5.13* would then recalculate to ''This is 5300m3 of fuel - from AGR's, Sizewell B and potentially Magrox. With this included in the total the -7% becomes -1% and the -22% becomes -4%.'

19. The broad acceptance of the waste figures mentioned in *para 6.6* extends to the current figures in Appendix 2 (see also para 4 of this update). It should be noted that as Magrox trials are in the early stages, the figures for magrox waste volumes are inevitably estimates rather than figures based on experience.

20. *Para 6.7 page 19* reiterates the acceptance of the then-current business plan, but concludes that 'This agreement, however, would require review in the event that the company made a policy decision to extend the lifetime of their Magnox plant'. In the NGO view the 23 May triggered such a review, with the results already reported in paras 9 and 16 above.

21. Storage capacity has been re-examined (Paras 5.1, 5.2 Appendix 2) and with the 'Magnox Blue Sky' case no longer included all waste scenarios can be stored in existing and planned waste stores, so the caveats at the end of *para 6.10, page 19* and *Bullet 1, para 7.1 page 20* are no longer relevant.

22. *Bullet 1, para 7.1 page 20* calls for a re-examination of long-term Magnox fuel storage if 'the company were to opt to extend Magnox lifetimes'. As already mentioned such a review is in any case being undertaken by SFMOWG.

Update of Recommendations

23. There has been positive progress on many of the areas of recommendation. The scenarios put forward by the WWG have in fact been utilised in the current working groups *(Para 8.2 page 21)*, and will continue to be used as updated by this note.

24. The need for holistic and balanced solutions *(Paras 8.4, 8.5)* is also being taken forward in the current working groups.

25. Socio-economic factors were emphasised as being important *(Paras 8.6, 8.8)* and a Socio-economic study is now in progress under the direction of a sub-group of the Stakeholder Dialogue.

26. As already mentioned, the necessity for Magrox to be properly examined *(Para 8.11)* has been taken on board, and the quantities given in Appendix 2 will be taken on board by the current working groups.

Appendix 1. Attendance at meeting of reconvened waste working group on 31 October

Gordon Bryan	BNFL
Gregg Butler	Westlakes Research Institute
Simon Candy	BNFL
Grant Gilmour	BNFL
Dick Haworth	NII
Grace McGlynn	BNFL
Brian White	Copeland Bough Council
Pete Willkinson	Peter Willkinson Environmental Consultancy
Jamie Woolley	UK Nuclear Free Authorities

Appendix 2. Magnox Station Lifetime Announcement – BNFL Note for Information

1. Introduction

1.1 In February of this year, the Waste Working Group (WWG) produced a report on waste generation from BNFL owned operations. The report gave information on volumes and types of waste generated from a selection of potential reprocessing scenarios, concluding a programme of work undertaken by the WWG in 1999. However, as a feed into the overall stakeholder dialogue process the report was considered to be interim, reflecting the ongoing nature of the dialogue.

1.2 The reprocessing scenarios in the report considered bounding cases for both Thorp and Magnox programmes, called the 'stop now' and 'blue sky' options. The report also presented the 'current business plan', the BNFL business plan at that time.

1.3 In May 2000, BNFL announced a change to the expected operational lifetimes of the Magnox power stations (see section 2 below). This change has had a consequential effect on the programme for reprocessing Magnox fuel, as well as introducing the potential use of Magrox (an oxide based fuel) for Wylfa and Oldbury stations.

1.4 This note presents the impact of that announcement in terms of waste volumes and storage implications. The intention is to provide the reconvened WWG with concise, updated information on which to make informed changes to any conclusions and recommendations in the report. To aid brevity and clarity, Thorp is assumed throughout to operate as per the 'reference' case and Thorp scenario information is omitted. Any waste impact from Magrox is presented alongside Magnox information.

1.5 Cross references to the interim report are marked thus […]. Additions made to tables are marked in bold.

2. BNFL Announcement on Magnox Lifetimes

2.1 BNFL is today announcing a lifetime strategy for its fleet of Magnox nuclear power stations. The strategy provides a phased programme for the cessation of electricity generation at the eight stations, most of which began operating in the 1950s and 1960s.

2.2 The reactors are licensed to operate for between 33 and 50 years and this early announcement of the Company's strategy for the lifetimes of the stations will allow operational plans to be optimised. For business reasons, Hinkley Point A will not be brought back into service from its current shutdown.

2.3 With today's announcement the Magnox station lifetimes will be planned as follows:-

Station	Licensed lifetime	Age at Cessation of Generation	Latest date for end of Generation
Calder Hall	50	50	2006 - 2008
Chapelcross	50	50	2008 - 2010
Bradwell	40	40	2002
Hinkley Point A	40	35	2000
Dungeness A	40	40	2006
Sizewell A	40	40	2006
Oldbury*	40	45	2013
Wylfa*	33	45 / 50	2016 / 2021

* Continuing to run Oldbury and Wylfa to these dates depends upon the development and use of Magrox fuel. Magrox is a fuel in which uranium is used in ceramic oxide rather than metal form. A decision on the use of Magrox fuel will be taken in around 2003. Oldbury and Wylfa will also need to undergo a Periodic Safety Review in order to secure operation to these dates.

2.4 The Chief Executive Norman Askew said: "Everyone knows that these stations have a finite life and there has been speculation as to our intention regarding their operating lives.

2.5 The reason we are making this announcement today, well ahead of time, is to provide certainty about the future for all concerned. It will bring clarity to the Company's business plans, explains our plans to our employees and provides us with time to work with the communities around our stations on plans for decommissioning.

2.6 "These stations were pioneers in the nuclear industry and have made, and are continuing to make, a huge carbon-free contribution to the electricity generating industry. This decision will mean that the reactors will not be run beyond the dates announced. However, both market conditions and technical issues could result in earlier closure."

2.7 The lifetime strategy announcement means that the Magnox reprocessing plant (B205) at Sellafield will close once all Magnox fuel has been reprocessed. It is expected that this will be around 2012 although this could be later depending on throughput schedules achieved. Based on the same programme, Magnox fuel production, which is carried out at the Company's fuel manufacturing site at Springfields, near Preston, will cease by 2010.

2.8 The end of Magnox reprocessing at Sellafield will significantly reduce discharges even further and virtually eliminate the already low discharges of Technetium. Total liquid discharge impact, which is already minute, will further reduce by more than 80 per cent. In the meantime BNFL will continue to work on abatement technology for Technetium and, if successful, will reduce discharges even sooner.

3. Impact on Assumptions and Scenarios

3.1 The implications of the announcement on assumptions within the interim report are:

3.2 **Reactor Lifetimes** [page 9, paragraph 4.3, subheading 2]
The detailed lifetime proposal for each reactor is contained in the announcement above. The following two points contrasts the lifetime announcement with the assumptions in the interim report:

- Calder Hall and Chapelcross operate for 50 years under the lifetime strategy announcement, previously assumed to be 45 years in the business plan and 50 years in the 'blue sky' option.
- The other stations operate for an average of 42 years under the lifetime strategy announcement, previously assumed to be 37 years in the business plan case and 50 years in the 'blue sky' option.

3.3 **Reprocessing** [page 9, paragraph 4.3, subheading 3]
The announced lifetime strategy states that Magnox reprocessing operates to around 2012 although this could be later to depending on throughput schedules achieved. This operating programme accommodates the lifetime extension of Chapelcross and allows Wylfa and Oldbury to transition to Magrox fuel (see 3.4 below). Compared with the previous assumption of 2008/9, the 2012 date in the announced lifetime strategy represents an extension of approximately 3-4 years.

3.4 **Magrox** [referenced on page 22, paragraph 8.10]
Continuing to run Oldbury and Wylfa to the dates in the announcement depends upon the development and use of Magrox fuel. Magrox is a fuel in which uranium is used in ceramic oxide rather than metal form. Subject to our obtaining NII approval, it would be our intention to begin a trial loading in Calder Hall before the end of the year[1] to gain information about the performance of the fuel. Until we have the results of any trials, we would not be in a position to decide whether to proceed with the proposed transition from Magnox to Magrox fuel. Further information can be obtained in appendix 4 & 5

However, for the purposes of this note and to present the waste impact from loading Magrox fuel it is assumed that Wylfa and Oldbury will begin loading Magrox from 2006. The Magrox fuel will gradually replace the Magnox charge in the reactor over a period of 5 years. Therefore all Magnox fuel is likely to be discharged from these reactors by 2011. It is assumed that approximately 2000

[1] Extract from the Sellafield Newsletter, dated 3 November
" Week Ending Friday 3 November 2000 682

Fuel Trial
Calder Hall Reactor 1 has returned to power this week following its annual refuelling and maintenance shutdown. This completes the programme of such shutdowns on all four reactors for this calendar year. Part of the refuelling operation has included the loading - on a trial basis - of a new design of fuel, called MagRox, in a small number of fuel channels. The fuel is currently performing as expected.
MagRox fuel elements consist of uranium in a ceramic oxide form - similar to the type used in the majority of nuclear reactors - rather than the metallic form currently used in Magnox stations. This is the first step in a trial programme which will look at the feasibility of using MagRox in some of our other stations in a few years time."

te of Magrox fuel will be required to operate Wylfa and Oldbury to 50 and 45 years respectively.

As an oxide type fuel, the spent Magrox fuel is inherently more stable than spent Magnox fuel and could be either stored or reprocessed. Both options are presented in this note below to illustrate the range of potential outcomes.

The unit factors to convert spent Magrox fuel into reprocessed waste volumes are presented in Table 1 below.

Table 1. Unit Rates of ILW and HLW Arising from Reprocessing
[From WWG Interim Report, 28 February 2000, page 11, paragraph 4.6, Table 3]

	Waste volume / m^3/te	
	ILW	HLW
Magnox	1.2	0.02
AGR	0.8	0.08
LWR (reduction in reprocessing[1])	0.8	0.08
LWR (increase in reprocessing[1])	0.8	0.12
Magrox[2]	**1.0**	**0.04**

[1] when compared to existing contracts
[2] The unit rates for Magrox are estimates. Physically, the fuel is most similar to AGR and hence the ILW factor is based on extrapolation from the AGR figure. For HLW, it is assumed that the burnup for Magrox will be typically twice that of current Magnox fuel. Actual burnup factors will be subject to empirical data from Magrox trials.

3.5 The Magnox scenarios examined within the WWG Interim report were :

M1. The 'Stop Now' case terminated Magnox reprocessing at the end of 1999.
M2. The 'Reprocess Existing Fuel' case shut down the reactors at end 1999, and reprocessed the fuel in ponds and in the reactors. This led to a cessation of Magnox reprocessing in about 2005/6 .
M3. The 'business plan' case was based on BNFL's 1999 business plan with an average reactor lifetime of 37 years. This gave an end to Magnox reprocessing in about 2008/9.
M4. The 'Blue Sky' case assumed a life extension to 50 years.

The declared Magnox Lifetime Strategy represents a scenario which sits between the previous business plan and blue sky cases. For the purposes of this note, the new case is labelled as a variation on the previous business plan and is presented in two versions showing the impact of storing or reprocessing the Magrox fuel.

M3.a The 'Announced Lifetime - store' case is based on the declared average reactor lives of 42 years (Chapelcross and Calder Hall to 50 years) with Oldbury and Wylfa loading Magrox fuel from 2006. This gives an end to Magnox reprocessing in about 2012 although this could be later. This case assumes spent Magrox fuel will not be reprocessed.

M3.b The 'Announced Lifetime - reprocess' case is based on the declared average reactor lives of 40 years (Chapelcross and Calder Hall to 50 years) with Oldbury and Wylfa loading Magrox fuel from 2006. This gives and end to Magnox reprocessing in about 2012 although this could be later. This case assumes Magrox fuel will be reprocessed through Thorp.

3.6 It is also worth highlighting that the previous 'blue sky' option is no longer valid. BNFL has announced the strategy for station lifetimes which bounds the potential lives of the stations. The announcement reserves the option to shorten the station lives depending on market conditions and technical issues. However, to allow comparison with the interim report the 'blue sky' is re-presented below.

3.7 To ensure consistent comparison with the interim report no attempt has been made to update the other scenarios e.g. the M1 and M2 scenarios above assumed that reprocessing and reactors would stop at the end of 1999 - clearly this date has passed. However, so that the basis for the comparison is valid all data for the new scenarios are referenced back to 1/4/98 - the baseline assumed for the interim report.

3.8 In reprocessing terms, the new case is contrasted against the previous scenarios in Table 2 below.

Table 2 - Magnox / Magrox scenarios (te fuel reprocessed from 1/4/98)
[From WWG Interim report, 28 February 2000 page 11, paragraph 4.7, Table 4]

	te reprocessed post 1/4/98	Variance from reference /te
M4. Blue Sky	19,000	+7,500
M3.b Announced Lifetime - reprocess	**14,100[1]**	**+2600[1]**
M3.a Announced Lifetime - store	**12,100**	**+600**
M3. Business plan	11,500	0
M2. Reprocess existing fuel	8,100	-3,400
M1. Stop now	1,500	-10,000

[1]2000 te of this reprocessing would be Magrox fuel reprocessed through Thorp.
Above figures rounded to the nearest 100 te. More than 40,000 te fuel reprocessed prior to 1/4/98.

4. Waste Volumes

4.1 The impact of the new scenario in waste volume terms is presented in the tables and figures below.

Table 3. Impact of Magnox reprocessing scenarios on waste volumes.
[From WWG Interim report, page 11, paragraph 4.7, Table 5]

	Variance of waste volumes / m^3	
	ILW	HLW
M4. Blue Sky	+10,000	+150
M3.b Announced Lifetime - reprocess	**+3,000**	**+90**
M3.a Announced Lifetime - store	**+1,000**	**+10 (+2000[1])**
M3. Business plan	0	0
M2. Reprocess existing fuel	-5,000	-70
M1. Stop now	-13,000	-200

[1] If Magrox fuel is stored, this would generate an additional 2000m^3 of HLW assuming a unit conversion factor of 1.0m^3 / te spent fuel.
ILW figures rounded to the nearest 1,000m^3, HLW figures rounded to the nearest 10m^3.

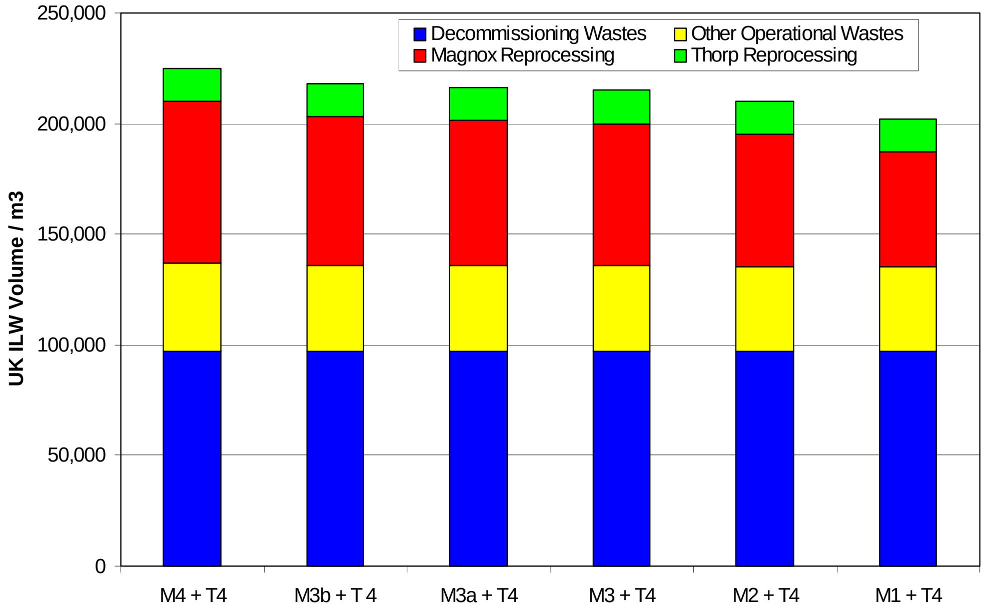
Table 4. Impact of Magnox / Magrox reprocessing scenarios on UK ILW volumes.
[WWG Interim Report, page 12, paragraph 4.7, Table 6]

	Conditioned waste volumes / m^3		
	Operations	Decommissioning	Total
M4. Blue Sky	128,000	97,000	225,000
M3.b Announced Lifetime - reprocess	**121,000**	**97,000**	**218,000**
M3.a Announced Lifetime - store	**119,000**	**97,000**	**216,000**
M3. Business plan	118,000	97,000	215,000
M2. Reprocess existing fuel	113,000	97,000	210,000
M1. Stop now	105,000	97,000	202,000

Note : All figures rounded to the nearest 1000m^3. All figures assume Thorp operates as per current business plan defined as scenario T4 on pages 12 & 13, paragraph 4.8 and Table 8 of the WWG Interim Report.

Table 4 is illustrated graphically in Figure 1 below.

Figure 1 Impact of Magnox / Magrox reprocessing scenarios on UK ILW volumes. (WWG Interim Report page 15, paragraph 5.1, Figure 1)



Note : the M4 to M1 labels refer to the Magnox/Magrox scenarios as described in section 3.5 above. +T4 indicates that in all cases Thorp is as per business plan defined on [pages 12 & 13, paragraph 4.8 and Table 8] of the interim report.

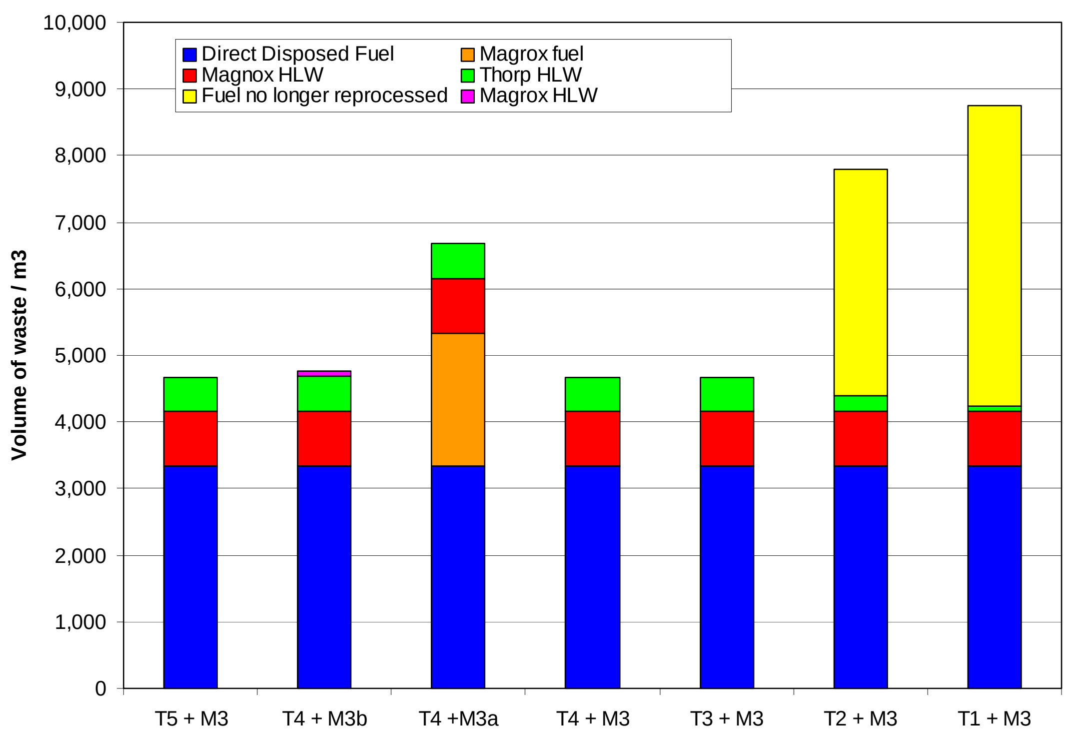
Table 5. Variation in Magnox / Magrox vitrified HLW volumes
[WWG Interim Report page 12, paragraph 4.7, Table 7]

	HLW Volume / m^3	Fuel requiring disposal / te
M4. Blue Sky	970	0
M3.b Announced Lifetime - reprocess	**910**	**0**
M3.a Announced Lifetime - store	**830**	**2,000**
M3. Business plan	820	0
M2. Reprocess existing fuel	750	0
M1. Stop now	620	6,600

Note : All HLW figures rounded to the nearest $10m^3$. All fuel figures rounded to 100te. All figures assume Thorp operates as per current business plan defined as scenario T4 on [pages 12 & 13, paragraph 4.8 and Table 8] of the interim report.

Table 5 is illustrated graphically in Figure 2 below. Figure 2 also includes variations on the Thorp scenarios to ensure consistent comparison with data presented in the interim report.

Figure 2 Impact of Magnox / Magrox reprocessing scenarios on UK HLW volumes.
[page 17, paragraph 5.8, Figure 4]



Note : the M4 to M1 labels refer to the Magnox/Magrox scenarios as described in section 3.5 above. T1 to T5 indicate Thorp scenarios as defined on pages 12 & 13, paragraph 4.8 and Table 8 of the WWG interim report.
It is assumed that 1te spent Magrox fuel occupies $1m^3$.

4.2 A key issue for the interim report was the comparison between the 'business plan' case and the 'reprocess existing fuel' case for Magnox fuel. Time has moved on since the interim report was compiled and Table 6 below presents the updated comparison. The table shows how the interim report figures were derived and how the current forecasts have been built up, comparing equivalent sets of data in the two halves of the table.

4.3 The interim report assumed that Magnox reactors would cease loading fuel from the end of 1999, therefore the interim report embodied an element of prediction insofar as the amount reprocessed is concerned. The updated position reflects the actual reprocessing which has taken place and actual stock values.

Table 6. Comparison of reprocess existing fuel with reference case / announced lifetime - store case.

	Interim Report (te fuel)		Lifetime Announcement (te fuel)
Predicted quantity reprocessed between 1/4/98 and end of 1999	1,500	Quantity reprocessed between 1/4/98 and 1/4/00	1,000
Predicted stocks at end of 1999	6,600	Stocks at 1/4/00	7,500
M2. Reprocess existing fuel	8,100[1]	Fuel in system to be reprocessed at 1/4/00	8,500
Fuel to be loaded	3,400	Fuel to be loaded	3,600
M3. Business plan	11,500[2]	M3.a Announced Lifetime - store	12,100[3]

[1] As per M2 in Table 2 above.
[2] As per M3 in Table 2 above.
[3] As per M3.a in Table 2 above.

4.4 Table 6. shows, as per Table 2 above, that the total fuel to be reprocessed post 1/4/98 has increased by 600te (i.e. the difference between M3.a and M3.). However, Table 6 also shows that the difference in fuel to be loaded has only increased by 200te (i.e. the difference between 3,600te and 3,400te on line 4 of Table 6). Therefore of the extra 600te to be reprocessed under the announced lifetime, 400te of this has already been loaded into reactors.

5. Impact on Planned Storage

5.1 Work for the interim report demonstrated that the Magnox 'Blue Sky' case did not require any stores in addition to those already planned. The 'Announced Lifetime' case is bounded by this assessment and therefore, even if Magrox is reprocessed, there are no additional stores required.

Table 7. Impact on spare storage capacity for conditioned wastes.
[WWG Interim Report, Appendix 3 - page 18, Table 6.1]

	Conditioned waste volume / m3			
	EPS	EDS	MBGWS	VPS
Planned storage capacity	80,000	13,000	4,700	1,200
Reference case planned storage uptake	70,000	12,000	3,300	1,070
Spare capacity if reference case scenario - 'business plan'	>10,000	>1,000	>1,400	>130
Spare capacity with announced lifetimes - store Magrox (M3a)	**> 9,000**	**> 900**	**~1,400**	**>120**
Spare capacity with announced lifetimes - reprocess Magrox (M3b)	**> 7,000**	**> 800**	**>1,300**	**> 40**

EPS = Encapsulated Product Stores
EDS = Engineered Drum Stores
MBGWS = Miscellaneous Beta-Gamma Waste Store
VPS = Vitrified Product Store

The spare capacity under the 'announced lifetimes' is derived by deducting the additional waste volumes highlighted in paragraph 4.1, Table 3 from the 'business plan' spare capacity set out in the middle row of Table 7.

VPS is the only store to hold HLW, thus the 130 m^3 of spare capacity reduces by the $10m^3$ and $90m^3$ of waste set out in Table 3.

The bulk of the ILW would be accommodated in Encapsulated Product Stores (EPS). Thus the additional $1,000m^3$ or $3,000m^3$ of waste has been deducted from the $10,000m^3$ of spare capacity.

In practice, a small quantity of the ILW waste is alpha waste and would be accommodated in Engineered Drum Stores (EDS). This would account for $<100m^3$ and $<200m^3$ of waste in the additional 'announced lifetime' scenarios. Similarly the volume of ILW waste to be accommodated in the Miscellaneous Beta Gamma Waste Store (MBGWS) would be $<<100m^3$ and $<100m^3$ respectively.

5.2 The tables do not account for the impact of storing spent Magrox fuel (if not reprocessed). However, as an oxide based fuel it is more stable and passively safe than spent Magnox fuel. Storage requirements would be required for 2000te of spent Magrox fuel.

Appendix 3. Background to Magnox

The announcement on Magnox lifetimes on 23 May 2000 gave the following dates for the proposed operation of Wylfa and Oldbury.

Station	Licensed lifetime	Age at Cessation of Generation	Latest date for end of Generation
Oldbury	40	45	2013
Wylfa	33	45 / 50	2016 / 2021

Continuing to run Oldbury and Wylfa to these dates depends upon the development and use of Magrox fuel. Magrox is a fuel in which uranium is used in ceramic oxide rather than metal form.

Although there has been work undertaken on Magrox fuel over the years, we have recently submitted to the NII the safety case to undertake a trial loading in Calder Hall. Subject to our obtaining NII approval, it would be our intention to begin the trial loadings before the end of the year. Until we have the results of any trials, we would not be in a position to decide whether to proceed with the proposed transition from Magnox to Magrox fuel in Wylfa and potentially Oldbury. A trial loading in Wylfa would also be required, again subject to NII prior approval. It is planned that Magrox fuel would progressively replace Magnox fuel until eventually all Magnox fuel would be replaced by Magrox. We would anticipate some 5 years to make the full transition of the reactor cores to Magrox fuel.

A decision on the use of Magrox fuel will be taken in around 2003. We would need to prepare a revised safety case for the introduction of Magrox fuel into the reactors and Oldbury and Wylfa will also need to undergo a Periodic Safety Review in order to secure operation to the dates given in the table.

There are no technical reasons why bulk quantities of Magrox fuel could not be made at Springfields but a new assembly line would have to be constructed and licensed. This could take some 4 years. However, we need to be sure of its technical and economic merits before we commit to a full commercial project.

If Magrox fuel is not used in Oldbury or Wylfa for any reason we will review their closure dates at that stage. It is true, however, that operational dates much beyond 2010 would then be unlikely because of the need to co-ordinate the closure of these stations with the eventual closure of Magnox reprocessing at Sellafield.

Answers to the specific questions submitted by CORE, CND and WANA are given on the attached sheet.

Grace McGlynn
10 August 2000

Appendix 4. BNFL Response to CORE, CND, and WANA Questions

The environmental groups CORE, CND, and WANA have posed questions specific to MagRox fuel. Both the questions and the Company response are given in this text.

CORE questions

Question	BNFL Response
Is there any indication of specific cost differences between rox and nox - and if so what are they?	MagRox fuel, which is based on the design of AGR fuel, is more technologically advanced than Magnox fuel. The cost of manufacture of a MagRox fuel element is about twice that of a Magnox element, although a MagRox element can potentially operate for longer in a reactor.
With enrichment of rox, are there any implications for use in reactor - commercial, operational, safety etc compared to Magnox?	**The burn-up characteristics of MagRox fuel in respect to reactivity differ from those of Magnox fuel. It is planned that MagRox fuel would progressively replace Magnox fuel in a reactor until,eventually, all Magnox fuel would be replaced by MagRox. The burn-up characteristics of MagRox fuel can be modified by the choice of enrichment with U_{235} and burnable poisons. It is anticipated that varying the enrichment levels and amounts of burnable poison would allow the reactor to operate at close to normal power levels during the transition and in subsequent operation.**
What levels of enrichment are projected?.	Enrichment levels of between 1.5% to 2.5% would permit normal operating conditions to prevail during all phases of operation with MagRox fuel.
How long will rox remain in reactors before removal for storage / reprocessing?	Calculations indicate that MagRox fuel inserted in a reactor during the transition from Magnox to MagRox would operate for a similar period to Magnox fuel. However, subsequently, MagRox fuel could operate for significantly longer than Magnox fuel.
What burn-up levels are projected - and how do they compare to Magnox burn-up levels?	The maximum burn up of MagRox fuel is expected to be 11Gwd/teU. This is double the current Magnox level but much less than in AGR reactors.
If to be reprocessed, what cooling time at station and in Sellafield pond?	The fuel would normally be kept for a minimum of about 100 days prior to delivery to Sellafield for storage in AGR fuel ponds. The fuel would be treated as normal AGR fuel.
For rox fabrication, will any adaptations / alterations to the Springfield's plant be required - if so, what and over what timescales?	To manufacture the required quantity of MagRox fuel it would be necessary to construct an additional assembly line. It would take about 4 years to design and construct such a facility.
Will transport of spent rox (to wherever) require any modification to existing Magnox	Over the next few years only a limited amount of MagRox fuel would need to be transported. This would consist of fuel used for trial loading and existing transport flasks can

flasks - i.e. in terms of its enrichment and burn-up?	be used without modification. Transport arrangements for MagRox fuel in bulk have not been established in detail at this stage, although limited changes to existing arrangements would be anticipated.
Why hasn't rox previously been considered as an alternative to nox?	Development of MagRox fuel has been considered for several years. MagRox fuel is most economic when used to permit Wylfa and possibly Oldbury to continue to operate. To maintain this option it is now necessary to carry out in-reactor tests of the fuel.
Is BNFL considering any other spent fuel management option for the trial rox, ex Calder, other than pond storage?	Spent MagRox fuel from the trial loading at Calder Hall Power Station will be treated in exactly the same manner as AGR fuel after post irradiation examination.

CND Questions

Question	*BNFL Response*
What are the central points to be addressed in the safety case submitted to NII for the projected tests of MagRox at Calder Hall?	A comprehensive safety case was developed for the insertion of MagRox fuel in the Calder Reactors. The fuel will be located in isolated fuel channels in the reactor and the key element of the safety case relates to the temperature of the MagRox fuel and the Magnox fuel in adjacent channels. Other considerations include fuel handling, transport and storage. A range of faults and hazards are also assessed in a manner consistent with previous studies.
What is the most likely date for the resumption of these tests?	The safety case for the trial loading of MagRox fuel is currently being discussed with the Nuclear Installations Inspectorate. The plan is to load the fuel and withdraw an initial channel of fuel for examination during 2000.
Could BNFL assure CND as to the structural integrity of the graphite moderator at Oldbury?	The integrity of the graphite moderators at all the Magnox stations is subject to an ongoing programme of investigation and testing. This includes the regular removal of samples from the graphite moderator for testing. Background information is given in the report IAEA-TECDOC-901 pages 181-191 entitled 'Radiolytic Graphite Oxidation Revisited' by P C Minshall et al dated Sept. 1995

WANA Questions
Technical Information is required

Information Required	*BNFL Response*
A comparison of power density in kW/litre between "standard" Magnox fuel, "enriched" Magnox fuel (as used at Oldbury), and the proposed MagRox fuel - recognising the difficulty in expressing the above data out of context of individual reactors, a comparison of fissile material density in appropriate units between "standard" Magnox fuel, "enriched" Magnox fuel (as used at Oldbury), and the proposed MagRox fuel.	The use of enriched fuel and MagRox fuel in the Magnox reactors is not intended to permit the reactors to operate at power levels exceeding design limits. Enriched fuel is being used principally to counteract the effect of graphite ageing and loss of moderation. MagRox fuel is being developed with a view to permitting Wylfa and possibly Oldbury to continue operating.The concentration of U_{235} is 0.72%, 0.8%, and 1.5% to 2.1% for natural Magnox, enriched Magnox, and MagRox respectively. The power output from each of these fuels is comparable.
A brief description of best estimate and pessimism graphite moderator weight loss in the worst affected parts of the Wylfa and Oldbury reactor cores as a percentage of the assumed virgin moderator unit weight.	Oldbury reactor cores experience the highest weight loss of any Magnox reactor. Average weight loss due to radiolytic oxidation is estimated to be under 10%. The maximum value of weight loss in very localised regions of the core is about twice this value. Weight loss is subjected to an ongoing monitoring and test programme. Every year samples are removed from the cores to confirm predictions of weight loss. Background information is given in the report IAEA-TECDOC-901 pages 181-191 entitled 'Radiolytic Graphite Oxidation Revisited' by P C Minshall et al dated Sept. 1995.

Second Update

Meeting: 23 November 2001

WASTE WORKING GROUP

BNFL STAKEHOLDER DIALOGUE

DRAFT REPORT OF MEETING ON 23RD NOVEMBER 2001, MANCHESTER

Present:

Grace McGlynn	BNFL
Grant Gilmour	BNFL
Richard Harris	Facilitator
Dick Haworth	NII
Brian White	CBC
Pete Wilkinson	WECL
Claire Gallery-Strong	BNFL
Schia Mitchell	The Environment Council
Phil Hallington	BNFL
Gregg Butler	Westlakes

1.0 AGENDA

1.1 It was agreed that the agenda would comprise mutual updates, the changing context of the dialogue – with particular reference to work of the Waste Group, review of the Group's existing recommendations and collation of 'evidence' regarding effectiveness of the dialogue from the Group's perspective.

2.0 UPDATES

2.1 The socio-economic report was now published and in the public domain. The Group regarded the report as a solid volume of work, because of its structure capable of forming the foundation for further study which will doubtless be required as the dialogue progresses.

2.2 The Radwaste Consultation was open until 12.3.2002. On the positive side the consultation indicated that the Government may wish to start from first principles of how the public and a broad cross section of stakeholders could be engaged as policy develops. In this respect the published socio-economic report was valuable in view of the data it contains describing the position in West Cumbria and the need to address inward investment seriously. The structure of the study also facilitates the development of illustrative future scenarios.

2.3 However there was some reservation about lack of clarity in the DEFRA document. In parts in sought broad opinion on how policy should be developed, whilst elsewhere it sought views on detail. This was seen by the Group as confusing to the general public and potentially counter productive if the aim was to attract public interest.

2.4 There was further concern about the time span – 7 years, within which policy could emerge. This impacted on accountability and was too long to wait for decisions on progress on important matters like conditioning of waste. Therefore the consultation could be seen as a missed opportunity to draw together the different elements of waste management.

2.5 For example the proposed LMA, itself a concern because of the absence of consultation from the DTI, might have been included alongside legacy waste and the concept of long-term disposal.

2.6 With respect to the search for a proven process methodology the Group was reminded that one already existed - the Stakeholder Dialogue itself. It did however note that the Minister already had a copy of its published report and the Group agreed to recommend that;

(i) The Radwaste Consultation should take on board the Waste Working Group's recommendations (with updates).

(ii) The concern of the Waste Working Group about the apparent disjointed Government approach should be conveyed to DEFRA.

2.7 The Group discussed the Energy Review. Most members felt that there had been a lack of clarity about purpose. In consequence the review was not as public friendly as it might have been. The review had been somewhat rushed and as with Radwaste there were signs that mechanisms for consultation are undeveloped in Government.

2.8 However the consensus view was that the Group must recognise the Energy Review as an opportunity for balanced comment. On this theme there was considerable discussion on what was described as a 'passivity index'. The concept was relevant to the Group because of its original recommendation that waste and waste arisings be packaged in a 'passively safe' form in the shortest possible time.

2.9 An index would provide some measure by way of the % of actual radioactivity present that was passive. Some investigative research into such an index was ongoing in organisations outside the dialogue. The principle may even be useful in other industries.

2.10 Debate ensued about how there would be steps towards 'passivity' and therefore stages or phasing of nuclear waste management improvements would be needed before a 'passive' form was achieved. But a definition of passive was not agreed. But it was agreed generally felt that;

(i) The passivity index was a good idea.

(ii) The BNFL dialogue was the process for defining it, and

(iii) Via the Coordination Group the Business Futures Working Group be recommended to take this work forward.

3.0 CHANGES IN CONTEXT OF THE DIALOGUE

3.1 After 11th September 2001 security was obviously a more important factor. The subject was being dealt with by the Plutonium Working Group in the main, although the need, identified by this Group, to shorten the time before conditioning and packaging of waste had been reinforced. It was agreed that;

This reinforces the principles already highlighted by the Waste Group (minimising waste arisings and treating and conditions as soon as practically possible)

3.2 From the Energy Review and media reports new build nuclear facilities have become a subject of conjecture. At this stage the Group need not revisit its published recommendations. Some members of the Group expressed the view that any new build it would be much preferred without reprocessing. It was agreed;

Because the Waste Working Group did not look at any new build scenarios, should new build proceed, the Group would need to revisit its

3.3 The question arose, if the dialogue included a Transport Working Group would this Group have tasks to refer to it? Because new build would generate spent fuel in such an eventuality, that could be a need. However at this stage the Waste Working Group had no requirements of the existing Transport Task Group.

4.0 EVIDENCE OF DIALOGUE EFFECTIVENESS

4.1 The socio economic report was a recommendation from this Group, and it happened. The co-funded, shared agenda basis on which the report was based exemplifies the advantages of working through the Dialogue.

4.2 Those from BNFL were able to confirm higher emphasis had been devoted within the Company to waste management issues. It was subsequently confirmed in written format that since formation of the Dialogue in 1998/99 the following estimated spend has been devoted to research into the management of nuclear waste.

Low-level waste	£ 2.4 m
High-level waste	£ 0.5 m
Intermediate level waste	£ 33.4 m

Total	**£ 36.3 m**

The Company was also able to confirm that its new Historic Waste Management Group, a new organisation of 650 persons, provides visible evidence of commitment since 2000 towards solving legacy waste. Copies of 2 BNFL documents provided to Brian White, the author of this draft report, are appended (Annex 1).

4.3 Further supporting evidence was offered by the Regulator who have been influenced by the WWG. The Regulator is now more confident that they are doing what is in the best interests of the people.

4.4 The WWG agreed that evidence of the influence existed in the fact that the Group are all now talking similar language and have a common interest in working together in this process.

5.0 REVIEW OF EXISTING RECOMMENDATIONS

5.1 In general terms it was noted that some of the recommendations were in the form of 'suggestions'. Nonetheless they did indicate a direction of change, and the scale of their influence was reflected in the speed with which some had been adopted by BNFL.

5.2 It was felt that a high discount rate was inappropriate in relation to financial discounting. It was recommended that this comment should be flagged with the Business Futures Group.

5.3 Next the Group looked at each of its published recommendations in turn and noted the following(nomenclature as in published report).

(1) The recommendation still stands. There is evidence that BNFL has taken the recommendation on board (see 4.2 and appendices). But it is recommended that the Company needs to keep doing more work to sustain progress. It is recognised that this is a long-term goal and that the Company are not there yet, but have started. This recommendation highlights again the need for a definition of passivity and measurement of progress with time.

(2) On research positive action by the Company in sponsoring University research welcome. But the Company must be

proactive, and not always wait for Government before commissioning work.

(3) Statement still stands.

(4) The framework and scenarios still valid and have been used by other working groups, in particular Spent Fuel Management. Scenarios could however be added to by Energy Review, Radwaste, any Passivity Index articulation and the LMA decision.

(5) Statement remains as given.

(6) Recommendation implemented and report completed. There will be other questions, but there is now a foundation report. This has provided a firm basis for future work both in and outside the dialogue. Whilst report didn't specifically cover impact of Magrox, it is noted that this is subject of separate working group. Some aspects of the Dialogue still to be covered on socio-economics e.g. Magnox Decommissioning. The members welcomed this as evidence of progress of WWG.

(7) Statement, as given, the meeting was itself re-evaluating earlier work.

(8) As 7.

(9) The NGO's position paper on reprocessing was to be reviewed in the light of work achieved by Spent Fuel Management Group and via the Socio-Economic Report (see Annex 2).

(10) Remains valid. Note Magrox now dropped.

(11) Remains valid.

6.0 <u>ACTIONS AND CLOSE OF MEETING</u>

6.1 Brian White was to draft the report based on flip chart sheets.

6.2 Comments needed so that the Coordination Group on 17th January 2002 could direct referrals/recommendations made by the Group as appropriate prior to publication (with appendices) for circulation.

Annex 1 of WWG update

Letters from BNFL providing information on :

- Historic Waste Management
- Money spent on research into management of radioactive wastes

BNFL

Memorandum

To: Brian White
From: Grant Gilmour
Ext: 71174
Fax: 74552
Email: grant.gilmour@bnfl.com

Date: 19 December 2001
Your ref:
Our ref:

Subject: **Waste Working Group Action**

This time last year Historic Waste Management did not exist as an organisation within BNFL.

At the November 2000 BNFL Board, Chris Loughlin, Director, Spent Fuel and Engineering, was sanctioned to create Historic Waste Management, as part of the Company's commitment for dealing with the Intermediate Level Legacy Waste on the Sellafield Site.

I was appointed as Director for Historic Waste Management (HWM), charged with delivering a strategy (by November 2001) to discharge BNFL's obligation with regard to this waste.

The strategy was presented and endorsed by the Board on 28 November 2001. In doing so endorsing the associated plan and expenditure – the implications of this in terms of BNFL's net asset deficit has been widely publicised.

This new strategy clarifies the way forward for historic liabilities, many of which predated the creation of BNFL. This will therefore increase the focus on management of the historic unclear legacy as a primary objective.

The HWM organisation during the year has grown from being non-existent to a current number exceeding 650 – with the considerable growth planned over the coming months and years as we move into implementation.

The project is on a scale substantially exceeding the building of Thorp – again re-emphasising the Company's determination and commitment to deal with this legacy.

Grant Gilmour
Project Director
Historic Waste Management

BNFL

Memorandum

To:	Brian White	Date:	19 December 2001
From:	Phil Hallington	Your ref:	
Ext:	75379	Our ref:	
Fax:	74552		
Email:	phil.j.hallington@bnfl.com		

Subject: **Waste Working Group Action**

At the recent Waste Working Group, I accepted an action to give a best guess figure on the total amount of money spent by BNFL on research into the management of radioactive wastes.

I have compiled the figures below on the basis of work carried out since the formation of National Stakeholder Dialogue ie 1998/99 – 2000/01.

The figures are:

		£m
Low Level Waste and generic programmes		2.4
High Level Waste		0.5
Intermediate Level Waste		33.4
	Total	**36.3m**

Phil Hallington
Head of Stakeholder & Regulatory Affairs
Historic Waste Management

Annex 2 of WWG update

NGO views on Reprocessing (updated Appendix 4)

NGO VIEWS ON REPROCESSING: AN ADENDUM TO APPENDIX 4 OF THE WASTE WORKING GROUP REPORT PUBLISHED IN FEBRUARY 2000.

1. This brief statement is made by those stakeholders remaining in the dialogue as it relates to spent fuel management options who represent the 'green' view of reprocessing and the nuclear industry.

2. Regrettably, the only remaining members of the spent fuel management options working group are Pete Wilkinson, a long-standing member of the green movement and co-founder of Friends of the Earth and Greenpeace UK, and Linda Hayes, founder and Chair of Cricklewood Against Nuclear Trains. The other members of the SFMOWG – notably Greenpeace, Friends of the Earth and CND – have withdrawn their participation on the grounds that the dialogue is not having sufficient impact for them to justify the dedication of scarce resources to the process. NFLAs are not represented due to a lack of funds with which to finance their representation and are absent from the SFMOWG. The Plutonium Working Group (PWG) is better represented by green opinion.

3. It was felt appropriate to ask the green members of the SFMOWG to provide this update to the original Appendix 4 of the WWG report as their spent fuel work has the greatest overlap and impact on waste issues. The comments below relate to the findings of the SFMOWG draft final report and also, peripherally, to the work of the Magnox Task Group and the socio-economic report commissioned from ERM at the instigation of the SFMOWG and the PWG with the support of the main group.

4. The authors of this note, representing their own opinions but speaking broadly from a green perspective, remain opposed to the reprocessing of spent nuclear fuel. While they accept that there is a case for reprocessing (as opposed to dry storing) all spent Magnox fuel which exists at this point in time, they cannot accept that there is any overall justification for continuing to further operate Magnox stations even to their announced lifetimes and thereby extend the period in which spent Magnox fuel is generated. Their position is that Magnox stations should be closed as soon as is practicable and that the spent fuel in existence at the end of that closure programme should be reprocessed as quickly as possible through B205 fitted with abatement as necessary to allow discharges to comply with the Ospar agreement and with the Environmental Agency's authorised discharge regime as revised. Under these conditions, the authors believe that the addition of a head-end on Thorp to allow it to accept spent Magnox fuel for reprocessing, while the resulting waste streams would be reduced significantly, remains impractical given the time and costs involved. Oxide fuel reprocessing is even less justified as it is capable of long-term dry or wet storage and in this respect they feel that the company should renegotiate domestic and foreign contracts to convert reprocessing agreements to storage agreements at the earliest possible time.

5. The authors were resigned to the fact that two 'world views' would emerge from the multi-attribute-decision-analysis (MADA) of spent fuel management

options – one environmentally biased, the other biased towards the socio-economic perspective. While this was, at the time, viewed as a disappointing if inevitable outcome of the exercise, the later strategic action plan (SAP) work more than compensated for the perceived weaknesses of the MADA process.

6. The authors accept that there is a cost/detriment aspect to reprocessing. Maintaining a buoyant regional economy brings effects which can be advantageous to the environment in that unemployment generally brings with it urban blight, an increase in crime, poorer health among the population and an overall impoverishment of the environment. The authors also accept and support the recommendations for the urgent implementation of mitigation packages to lessen the impact of the inevitable decline in traditional company activity.

7. However, they do not subscribe to the opinion that the continued reprocessing of spent fuel brings sufficient overall environmental, social, political and economic benefits to justify the practice and call for the cessation of reprocessing at the earliest practicable time, notwithstanding the inherent technical and financial problems associated with doing so as have been discussed in the SFMOWG. While acknowledging with regret that several thousand process worker jobs may be put at earlier risk in the event of immediate closure of Magnox stations, they conclude that the detriments associated with continued reprocessing outweigh the putative benefits of continued reprocessing. In addition, the long-term job prospects at Sellafield are good given a diversification programme based on waste management and clean-up. The socio-economic report demonstrates an inevitable decline in site activity within 30 years and that it is the management of that decline which will determine the impact on the region from loss of employment. The authors believe that it is prudent to act promptly to deal with a situation which is inevitable.

8. The authors are of the opinion that the Magnox fuel cycle is an inappropriate technology for a socially and environmentally responsible country. Spent Magnox fuel, wedded as it is to a management regime from which the reprocessing element can only be removed by the spending of considerable additional sums of money, is financially unviable, although costs involved will be off-set by the savings from curtailing reprocessing. When considering the post-generation, back-end costs such as defuelling, storage, spent fuel transportation, prompt conditioning requirements, long-term management of waste streams and the decommissioning of plant, the income derived from the sale of Magnox-generated electricity is tiny by comparison. The establishment of the Liabilities Management Authority which will assume ownership of all Magnox stations and associated plant by way of accepting BNFL's liabilities would appear to confirm this view.

9. Regardless of the fact that reprocessing of Magnox fuel is considered by some as the most environmentally acceptable route for this particularly reactive fuel,

the authors maintain that a prompt end to reprocessing of spent Magnox fuel would have the most advantageous outcome in respect of:

- Minimising solid waste
- Minimising separated plutonium stockpiles
- Reducing liquid and aerial waste streams
- Closing B205 as quickly as possible
- Helping to restore the UK's reputation with our European neighbours

10. As the work moved on to the more sophisticated strategic action planning (SAPs), it was clear that this process had numerous and important advantages over the MADA exercise. Crucially, it allows a wide range of views to be accommodated in the process providing all stakeholders worked on the assumption that at critical points in the plan, default situations would arise causing the reversion to contingency plans which, more often than not, would embrace actions representing an alternative view. In other words, a course of action will have locked into it automatic 'action points' if the assumptions upon which the course of action was based do not maintain. It therefore provides a vehicle for the accommodation of a broad church of opinion which will be proved wrong or right depending on the robustness or otherwise of the assumptions used to justify a course of action.

11. Most pertinent to this SAP work was the performance of B205, the performance of the vitrification lines in order to meet HAL reduction targets and, to a lesser degree, the performance of Thorp. 'Time windows for decision-making' were a useful and positive outcome of this work. The company produced a 'performance envelope' for B205, outside which its spent fuel throughput could not fall without triggering a default option to curtail the rate of spent fuel generation. During the Magnox Task Group meeting, the company indicated that B205's performance was improving and that staffing levels were being increased. While the authors applaud the company's efforts, they maintain their position that B205 should be closed at the earliest possible time before the announced date of 2012 and that, as a consequence, Magnox stations should be closed as soon as practically possible to curtail spent Magnox fuel arisings.

12. In respect some of the issues carried over from the NGO report which formed Appendix 4 of the original WWG report, the authors reiterate their views that:

    - Income from reprocessing to finance site decommissioning and clean up work remains a moot point which cannot be exhaustively examined due to the commercial nature of the costs and income involved:

    - A profitable future for the company lies in overseas clean-up work:

    - Renegotiation of contracts from reprocessing to storage would result in considerable financial savings on oxide fuel:

- Justification for reprocessing in respect of re-using uranium and plutonium is questionable:

- Quantities of existing UK plutonium are not suitable for the fabrication of Mox fuel:

- The Mox route for disposition of plutonium has yet to be assessed by the Plutonium Working Group and therefore the commissioning of SMP is opposed, especially as its commercial viability is questioned by major green organisations:

- The establishment of the Historic Waste Management Group is welcomed:

- The establishment of the LMA is likewise considered to be a potentially important step providing its infrastructure, management, funding and operation is carried out in collaboration with stakeholders and in a transparent and co-operative manner, based on an effective, inclusive and thorough process of dialogue.

13. References in respect of points referred to in this update can be found in the original Appendix 4 of the WWG report and where reference is not made to particular issues, the views contained in the previous report maintain.

Pete Wilkinson
Linda Hayes

21 February 2002