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03 October 2001

Dr Robert L Jackson
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Document Number: 378273

Dear Robert

Joint RWMAC/NuSAC Study of the Requirements for Conditioning, Packaging and Storage of Intermediate Level Waste

Please find attached our response to the questions asked by the RWMAC/NuSAC committee in your letter of 23 July 2001. I apologise for the delay in replying.

Along with our response, we have included copies of reports that we feel provide further information to some of the points that we have made. We have included a master copy of each of the documents for ease of photocopying. If you would like Nirex to supply any further copies, please let us know.

We hope that we have answered fully the questions that you posed, but if you have any points that require clarification or you would like further details or information, please do not hesitate to contact me or, alternatively, you may contact Ann McCall.

I understand that we are due to meet on 21 November to discuss our response. We will be happy to explore any issues you wish to raise.

With reference to your letter of 5 September, we will be addressing these points via separate correspondence which will follow in due course.

We look forward to meeting you all on 21 November.

Yours sincerely

Chris Murray
Managing Director

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18 October 2001

Dr Robert L Jackson
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Document Number: 379006

Thank you for your letter of 5 September. You refer to a letter of 15 March 2001 to which we responded in our letter of 24 May. Within this letter we referred to "Challenging Wastes" and provided brief details under the following general headings:

- Historical wastes
- Material where effective immobilisation is difficult
- Materials with inherent hazards
- Materials that can enhance the mobility of long life radionuclides

To ease cross-referencing, we have kept these headings, and the attached note describes the types and quantities of these wastes and the plants/processes that give rise to them. At the end of each section we detail our understanding of current progress on waste producer strategies for these materials.

I hope that the information and level of detail meets your needs, but if you require any clarification or further information please do not hesitate to contact me, or we could cover any points at our meeting on 21 November. I must stress that the information is supplied from a Nirex perspective.

Our key point is that the actual scale and distribution of "challenging wastes" is being unfolded through the Letter of Comfort process. Until we have details of specific conditioning and packaging proposals, we cannot predict the true scale of the issues.

In the UK, we have methods and processes for identifying such issues and the technology and expertise to address them. To date, we have not found any issues that could not be addressed by investigating alternative solutions. Nirex tries to ensure that any problems affecting the long-term that arise during retrieval, conditioning and packaging wastes are dealt with as soon as they are identified.

Yours sincerely

Chris Murray
Managing Director

JOINT RWMAC/NuSAC ILW MANAGEMENT STUDY
SUPPLEMENTARY QUESTIONS

Question 1

Would it be possible to give some clearer indication of the types, quantities and locations of ILW wastes that fall into the following categories: (i) historic mixtures with divergent properties; (ii) materials where effective immobilisation is difficult; (iii) materials with inherent hazards; and (iv) materials which enhance radionuclide mobility. **[Numbers added for ease of discussion]**

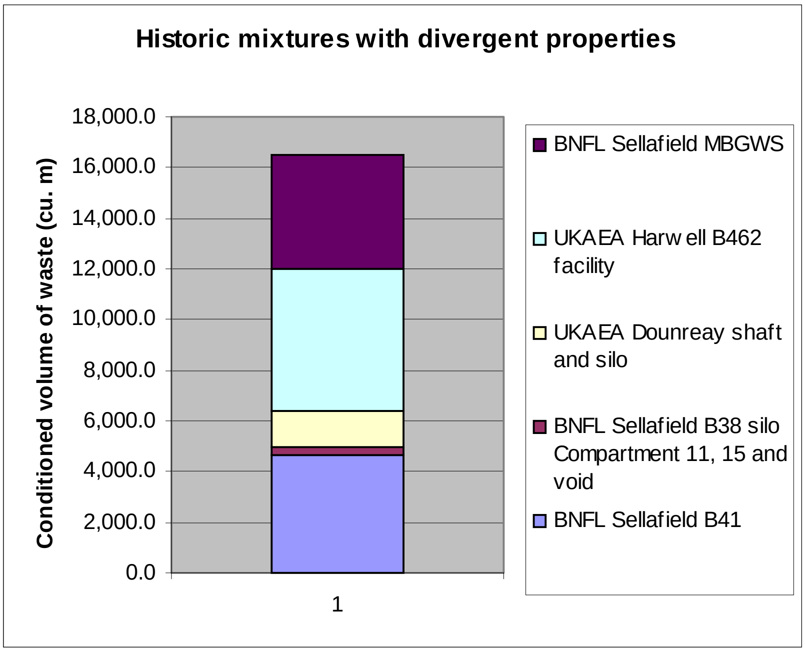
What progress has, and is being, made with the development of strategies for conditioning, packaging and storage of such wastes.

(i) Historic mixtures with divergent properties

Waste streams in this category include those associated with facilities that have accepted wastes from a number of different processes and sources such as:

- **BNFL Sellafield B41 silo**, which contains mixtures of aluminium and Magnox fuel claddings, uranium fuels, graphite, cellulosics. Total conditioned volume 4,700 m^3.
- **BNFL Sellafield B38 silo compartment 11, 15 and Void**, which contain redundant equipment from reprocessing and site operations and contaminated and activated reactor parts. Total conditioned volume of 270 m^3.
- **UKAEA Dounreay shaft and silo**, which contains mainly steels (cans, reactor sub-assembly items, filters, tanks), with smaller quantities of plastics, concrete and residual sludges and fuels. Total conditioned volume of 1,500 m^3.
- **UKAEA Harwell B462 facility**, which contains laboratory trash, concrete, lead, PVC, ion exchange material, sources, experimental rigs, steels, thorium powder, ionium sludge, HEPA filters, research reactor spent fuel, research reactor decommissioning waste. Total conditioned volume of 5,600 m^3.
- **BNFL Sellafield's Miscellaneous Beta/gamma store**, which contains a wide range of steel items (redundant plant equipment, pipework etc.) magnox, uranium, aluminium alloys, closed sources, polymers, cellulosics, vacuum bags and HEPA filters. Total conditioned volume of 4,500 m^3.

A graphical summary of these data are given below.



As noted in Nirex's letter of 24 May 2001, our view is such wastes require facilities to undertake characterisation, and where necessary segregation, to enable production of packages with properties consistent with future long-term management.

There are a number of plants which are making provision for characterisation of waste materials and segregation of problematic items or materials to facilitate the onward processing of the bulk of the wastestreams. The problematic so-called "WRATs" (Wastes Requiring Additional Treatment) are then treated off-line. This design philosophy which acknowledges some components of the waste present different hazards and will require alternative additional treatment has been adopted in a number of projects such as by UKAEA in the design of the B462.27 complex at Harwell and for the proposed Waste Treatment Plant for Dounreay shaft and silo wastes.

(ii) Materials where effective immobilisation is difficult

There are some waste types for which the achievement of immobilisation has been found by waste producers to be difficult. These include soft low density and/or absorbent wastes such as plastics/cellulosics; wastes with restricted access and/or small porosity such as HEPA filters, filter beds and ion exchange columns; and wastes which are containerised or wrapped such as drummed vault wastes, bagged waste items and supercompacted hard wastes.

Further discussion of progress on these particular wastes is summarised below.

Plastics/cellulosics

A number of plants are recognising the difficulties of direct immobilisation of uncontrolled quantities of plastic and absorbent materials. As a result they are either segregating such materials and controlling their loadings to within pre-established acceptable limits and/or are placing such materials into drums for subsequent high force compaction. BEP and WTC have 4,400 m^3 of such wastes intended for compaction. Alternatively, at Berkeley for example, there are 1,000 m^3 of mixed waste which are being sorted to ensure the plastic content does not exceed the acceptable limits for individual packages.

Filter/ion exchange materials
Conditioning of filter and ion exchange media by use of in-drum mixing systems have been successfully implemented for a number of wastestreams where provision for removal of the materials is integral within the plant design. One example is ~3,000 m^3 of Ion exchange resins at Trawsfynydd. For items where the media are not readily accessible due to the design of the filter assembly e.g. AW500 skips (600 m^3) or caesium removal units (14, 30 and 18 cartridges from their use at Bradwell, Dungeness A and Hinkley Point A respectively), difficulties have arisen. Work is in-hand to investigate novel encapsulation matrices for immobilising ion exchange media in caesium removal units as an alternative to opening the units to enable in-drum mixing. This work may lead to the development of techniques to allow in-situ immobilisation of AW500 skips and possibly even HEPA filters.

Supercompacted and Containerised wastes
Supercompaction has historically been proposed for many wastestreams but has not always been endorsed. Supercompaction has been endorsed where the supercompacted waste has been found to produce a wasteform which provides effective immobilisation of the wastes. This includes predominantly soft or compressible wastes such as a large fraction of the PCM at Sellafield (see comments on plastics above) and dried Magnox sludges known as SDP "undersize" fraction. Supercompaction was originally proposed for Harwell solid wastes in B462.27 and Dounreay "high alpha-beta gamma" wastes. However due to the hard, non-compactible nature of much of the waste, Nirex advised alternative concepts should be pursued and these plants have now adopted direct cement encapsulation. For containerised wastes, facilities are being incorporated in a number of plants to open the containerised and/or wrapped wastes, to allow inspection, monitoring, sorting and effective grout infiltration e.g. B462.27 (5,600 m^3), Berkeley vaults (1,000 m^3) WTP at Dounreay (2,800 m^3).

There are a number of plants which have been constructed which have not made provision for treating such wastes and these are subject to on-going interactions.

(iii) Materials with Inherent Hazards
Examples of materials with inherent hazards include wastes containing accessible Wigner Energy such as low temperature irradiated graphite, reactive metals, wastes containing pyrophoric materials such as uranium hydride, finely divided metals, sodium metal and wastes with high fissile contents.

Further discussion of particular wastes is summarised below.

Low temperature Irradiated Graphite
An example of where progress has been made on low temperature irradiated graphite has been with UKAEA in their plans for retrieval of the 1400m^3 of graphite from Windscale Pile 1. It is planned to anneal the graphite blocks containing Wigner energy by heating in an oven. This will release the low temperature Wigner peak in a controlled manner, prior to immobilisation. Similar wastes include other Piles (e.g. Pile 2) or low temperature reactor graphites (e.g. BEPO and GLEEP). Some plants e.g. BEP have been progressed without making provision for segregation and annealing capabilities, against the advice provided by Nirex. These plants have been involved in challenging R & D programmes to try and address key product quality and inherent safety issues and are currently under review.

Reactive Metals
Reactive metals include Magnesium, uranium, sodium and aluminium and are present in many wastes. In the case of magnesium (Magnox), substantial development has been undertaken to support the development of suitable wasteforms where evolution over time can be predicted (22,000 m^3). Similar development work has also been carried out for uranium metal (see below). In the case of sodium, plants to treat the sodium associated with

solid waste items are under development and work to confirm tolerance to any residual material after processing is in place.

For aluminium bearing streams work is on-going to develop acceptable wasteforms. This is proving challenging within existing cement systems, and in some cases require excessive restrictions on package contents leading to significantly increased package numbers.

Pyrophoric materials
Metallic uranium is known to have the potential to form pyrophoric uranium hydride (UH_3). Work on encapsulation of metallic uranium has been able to identify conditions capable of avoiding hydride formation and this has been used in support of encapsulation of uranium residues in plants such as MEP. For uranium hydride already present in wastes, progress has been made in a number of areas. BNFL are identifying conditions where UH_3 can be passivated, such as during drying of sludges in SDP. UKAEA are developing proposals for retrieval and packaging of potentially corroded uranium fuel wastes from Windscale Pile 1, which include facilities for identification of hydride and where necessary its passivation. This is a similar approach to that adopted for wastes contaminated with sodium metal referred to above.

High Fissile Wastes
A number of wastestreams contain potentially high inventories of fissile materials and therefore have the potential for more reactive configurations if any neutron absorbers within the packages are removed or extensive degradation of arrays of packages occur. (This results in an increased potential for a criticality event).

A number of plants (such as MEP, WEP and WTC) are controlling the inventories of fissile materials within packages to meet both short-term criticality constraints and additional constraints that may apply due to longer term processes such as loss of neutron absorption or reconfiguration. Such wastes represent 38,000 m^3. Although Nirex has considered the robustness of packages to long-term degradation from its perspective, the view and requirements of the regulators on this key aspect are a matter of on-going discussion and development.

Plants being designed need to be capable of achieving the necessary precision and accuracy in determining fissile inventories and significant work is ongoing involving waste producers and Nirex. This is most challenging on those plants which process wastes of different fuel types and enrichments and is further exacerbated where the fissile materials are intimately mixed with a wide range of other materials.

(iv) Materials which enhance radionuclide mobility
Discussion of particular wastes and derived wasteforms that fall into this category is summarised below.

Superplasticisers
Superplasticisers have been proposed in some cases as additions to existing immobilisation grouts to improve workability and to facilitate infiltration of waste items without needing to apply mechanical energy (vibration). Such additives have been found to be detrimental to longer-term waste management as they can provide a source of complexants that can enhance radionuclide mobility in a disposal environment. Superplasticised grouts have been proposed for Sellafield BEP (6,700 m^3), Trawsfynydd fuel element debris and WAGR decommissioning.

Nirex has advised that alternative methods for aiding grout infiltration should be capable of satisfying short-term processing needs without compromising long-term waste management needs. One option is to apply vibration during processing (such as adopted in MEP and WEP). Studies into developing vibratory systems for large packages are on-going. Alternatives such as non-superplasticised grouts, or identifying superplasticisers with limited complexing ability have also been advised and are now being researched. For example in the case of Trawsfynydd MAC, this now uses a non-plasticised grout (which required the formulation to be revised) and various plants are now using alternative supplies of materials for producing grouts which have been shown to be more fluid and penetrating. Investigations into other approaches such as changing particle size distribution of cement powders and identification of either non-complexing or non-persistent superplasticising chemicals is on-going.

Tc-99 Abatement Proposals

Nirex have advised on BNFL proposals for Tc-99 abatement including electrodeposition, reductants, routing to HLW as well as utilising TPP to trap the technetium. In the case of TPP, the Tc-TPP complex is part of the EARP floc wastestream and would be routed to the WPEP packaging plant for packaging. This process leads to Tc-99 in the mobile VII oxidation state associated with the complex TPP. Both these factors give uncertain long term effects on radionuclide mobility. Nirex has advised that a major research programme will be required to establish the behaviour and demonstrate the acceptability of proposed Tc-99 - TPP complex under disposal conditions. This has been accepted by the regulators who have stated that the TPP process should not be instigated without the appropriate R&D and have now required BNFL to undertake the first phase of such a programme to establish the feasibility or otherwise of the TPP option. (Adoption of he TPP process would affect about 400 m^3 of MAC floc which in turn would be mixed with more than 8,000 m^3 of other flocs). Nirex has also advised that the option of the routing of Tc-99 to HLW should also be supported by data to establish that the Tc-99 arising from this wasteform is also not likely to compromise the future disposability of resultant packages.

Conclusion

Information has been provided on the “challenging” wastes and waste types reported in the UK radioactive waste inventory and for which Nirex is assisting the industry to find suitable packaging solutions. The descriptions used to define the waste types (historic mixtures with divergent properties, materials where effective immobilisation is difficult, materials with inherent hazards, materials which enhance radionuclide mobility) are not mutually exclusive so particular waste streams may feature in more than one of these waste type descriptions **(see Table 1)**.

Overall, where these issues have been identified and recognised early, then significant progress is being made. The task is not impossible. Strategies are being developed, and in some cases implemented, that are capable of addressing the above issues. Many of these strategies also recognise the remaining uncertainties about the nature and characteristics of many of these wastes and are building in flexibility so these can be addressed. The challenges presented by these wastes are not to be under-estimated by Nirex. We believe there is a strong need for those charged with the safe retrieval and processing these wastes to work closely with Nirex to ensure any decisions being made can consider all relevant factors including the needs of the long-term. This will enable packages to be developed consistent with concepts for their safe long-term management and concepts to be developed that are consistent with the packages being produced. We therefore believe early and sustained interaction is necessary to ensure coherent solutions for the management of the UK’s waste are developed.

Table 1 – Potentially adverse properties of materials for a number of example waste groupings

	Waste facility/grouping					
	B41	B38	Dounreay shaft and silo	Windscale Pile 1 graphite	BNFL Sellafield Miscellaneous βγ waste	UKAEA Harwell B462 wastes
Divergent materials	✓	Some	✓	x	✓	✓
Materials that are difficult to infiltrate	Some	Some	Some	✓	✓	✓
Materials with inherent hazards	Some	Some	Some	✓	x	Some
Materials that enhance radionuclide mobility	Some	x	x	x	x	x
Concept addressing these properties?	No	Yes	Yes	Yes	No	Yes
Total conditioned volume (m^3)	4,700	12,100	1,500	1,800	4,500	5,600
Nirex's judgement of the fraction of total volume that may require additional processes	~50%	<10%	<15%	100%	100%	~15%
Comments	Little information on proportion of differing wastes	Waste is segregated into 'undersize' (sludge) and 'oversize' (larger items)	Waste is identified and sorted as it is removed	Hazard associated with stored Wigner Energy	Waste stored unconditioned in boxes at purpose built facility on-site	Waste is sorted and re-packed into containers awaiting grouting

Notes: **Data are based on the 1998 UK Inventory.**

Up to the end of March 2001, Nirex issued advice and/or Letters of Comfort covering about 40% of the total ILW conditioned volume of 215,000 m^3 declared in the 1998 UK Inventory.

Question 2

Can any more information be given concerning the specific types, quantities and locations of wastes that fall into the categories of: (a) having caveated LoCs; (b) being allowed to be sorted and packaged, but with the expectation of repackaging prior to disposal; and posing "lock-in" problems.

The key question is, having identified such wastes, what is the scale and distribution of the "challenging waste" likely to be?

The attached paper *"Use of Letters of Comfort in Liability and Risk Management and the Role of Caveats"* answers part of this question. **Appendix 1** provides more information on volumes and locations of materials covered by such endorsements.

Appendix 1

Data on Wastes Covered by Letters of Comfort

The tables in this Appendix provide information on wastes covered by Letters of Comfort. The tables list a description of the waste, the stage (conceptual, project pre-commitment, or pre-operational), the date of issue of the Letter of Comfort, and an estimate of the conditioned volume of waste covered by the Letter of Comfort.

Table A1
Wastes covered by Letters of Comfort (LoCs) up to the end of FY 2000/01

Waste	Stage of LoC	Date of issue of LoC	Conditioned volume (m³)
Cemented Sludge from AEEW	Conceptual	11-Mar-86	500
MTR Liquors in Dounreay Cementation Plant	Conceptual	11-Jun-90	-
Cemented DFR Raffinate	Conceptual	22-Jun-92	600
ICI Thoria Waste	Conceptual	06-Dec-94	-
Windscale Pile 1 B2 Water Duct Waste	Conceptual	23-Nov-95	1,800
Encapsulation of B241 Floc Waste	Conceptual	01-Dec-95	-
Berkeley Power Station Operational Wastes	Conceptual	23-Feb-96	-
Sellafield DRYPAC Plant (formerly SSSF)	Conceptual	22-Feb-96	19,000
Encapsulation of waste from Solvent Treatment Plant	Conceptual	21-Mar-96	-
Windscale Pile 1 Undamaged Graphite Waste	Conceptual	25-Oct-96	-
Trawsfynydd Fuel Element Debris Wastes	Conceptual	06-May-97	-
WAGR Decommissioning ILW	Conceptual	28-Apr-97	-
TRIGA	Conceptual	30-May-97	-
Trawsfynydd Pond Skips	Conceptual	21-Aug-97	-
Trawsfynydd MAC, MCI and Desiccant	Conceptual	19-Aug-97	300
Dounreay Shaft	Conceptual	23-Sep-97	1,200
Dounreay Silo	Conceptual	16-Feb-98	1,200
Harwell Stored Low Level Sludge Wastes	Conceptual	20-Apr-98	-
RIPPLE Generators	Conceptual	23-Jul-98	-
Harwell Stored Intermediate Level Liquor Wastes	Conceptual	16-Jul-98	-
UKAEA Depleted Uranium	Conceptual	24-Jul-98	-
DFR Raffinate	Conceptual	19-Apr-99	600
Trawsfynydd Sludges	Conceptual	27-Jul-99	-
SGHWR Sludge	Conceptual	02-Sep-99	500
PFR Boron Carbide Absorber Pins	Conceptual	14-Jan-00	300
Ionium Sludge	Conceptual	02-Feb-00	-
FINGAL Vessel Waste	Conceptual	17-Aug-00	-
Submersible Caesium Removal Units	Conceptual	31-Jan-01	100
EARP Floc Encapsulation	Stage 2	28-Aug-87	-
Waste from Winfrith Radwaste Treatment Plant	Stage 2	11-Jan-89	-
Type 1803 Packages in Dow Polymer	Stage 2	24-Oct-91	800
ILW arisings from Sizewell B Power Station	Stage 2	29-Nov-91	300
Encapsulation in WTC of Supercompacted PCM	Stage 2	04-Nov-93	-
Tank 1 MTR Raffinate Liquors in DCP	Stage 2	25-Nov-93	-
Dounreay Supercompacted PCM	Stage 2	01-Dec-94	500
AWE RALETP	Stage 2	16-Apr-97	100
RHILW	Stage 2	19-May-97	-
Trawsfynydd Pond Fuel Element Debris	Stage 2	22-Jun-98	400
Trawsfynydd MAC	Stage 2	01-Oct-99	-
Harwell LL Sludges	Stage 2	17-Dec-99	100
Harwell ILW Liquor	Stage 2	17-Mar-00	-
Encapsulation of FHP Swarf in EP1	Final	23-May-90	9,500
Disposal of Magnox Swarf from B38 comp.19-22	Final	02-Feb-93	2,100
Radionuclide Recording of Magnox Swarf from B38	Final	02-Feb-93	-
Encapsulation in WPEP of Bulk & MAC EARP Flocs	Final	28-May-93	8,800
THORP Hulls, Centrifuge Cake, BaCO3/MEB Crud	Final	20-Aug-93	8,600

Waste	Stage of LoC	Date of issue of LoC	Conditioned volume (m^3)
Encapsulation in EP2 of scrap from THORP and EP2	Final	22-Dec-93	-
Encapsulation in WPEP of Scrap from Nine Acre Site	Final	09-May-94	-
Rotary Skip Wash Debris in MEP	Final	16-Jun-94	-
SETP Hydrocyclone Solids in WPEP	Final	07-Oct-94	-
Encapsulation of Tokai Mura End Crops in MEP	Final	25-Oct-95	-
WAGR Loop Tubes and Operational Waste	Final	21-Feb-96	-
Encapsulation of SEC Floc - Tank 1	Final	27-Mar-96	500
Encapsulation of Dounreay MTR Raffinate (Tanks 1, 3, 7) in the DCP	Final	23-Aug-96	2,600
Trawsfynydd IEX Resins (Vaults 1-3)	Final	18-Nov-96	3,200
Supercompacted PCM in WTC	Final	13-Dec-96	7,900
SEC Floc Tank 2	Final	19-Aug-97	500
WAGR Decommissioning ILW	Final	01-Jul-98	1,500
Flocs from STP Effluents	Final	22-Mar-00	-
WAGR Fuel Element Guide Tubes	Final	07-Apr-00	-
‘Co-Treat’ in barium carbonate/MEB crud	Final	25-Sep-00	-
Trawsfynydd MAC (Flux flattening bars only)	Final	21-Dec-00	-
Harwell RHILW (first 60 drums only)	Final	22-Dec-00	400
WAGR Refrasil and Hot-box side plate	Final	22-Feb-01	-
Trawsfynydd MAC (Extension to pantograph rods)	Final	08-Mar-01	-
Trawsfynydd MAC (Extension to all MAC)	Final	29-Mar-01	100

Notes:

Volumes have been rounded to the nearest hundred.

Where no volumes are provided this is because either the amount is relatively insignificant (<100 m^3) or, in order to avoid double-counting, the volume is omitted because it is already included in the volumes for another Letter of Comfort.

Table A2

Wastes for which caveated Letters of Comfort have been issued

Waste	Conditioned volume (m^3)
FHP swarf in EP1 (MEP) Magnox Swarf from B38 compartments 19-22. Rotary Skip Wash Debris in MEP.(2D35, 2D35/C, 2D38, 2D38/C, 2D45)	12,000
BTC Fuel Element Debris waste, (9A31, 9A32, 9A33, 9A34, 9A35, 9A39, 9A40, 9A41, 9A42, 9A43)	1,000
MTR Liquors (5B04, 5B04/C)	3,000
Windscale Advanced Gas-Cooled Reactor (WAGR) Wastes, (5F308, 5F310, 5F312)	2,000
Total	**18,000**

Note:

The volumes have, in general, been rounded up.

Table A3

Wastes for which conditional Letters of Comfort have been issued

Waste	Conditioned volume (m^3)
Harwell RHILW, (5C30, 5C33, 5C34,etc)	2,000
Trawsfynydd Ion Exchange Resins, (9G18, 9G19, 9G20)	3,000
Submersible Caesium Removal Units.	100
Dounreay Silo and Dounreay Shaft Wastes Requiring Additional Treatment, (5B02, 5B25)	2,000
Totals	**7,000**

Note:

The volumes have, in general, been rounded up.

NCTM(01)31

Use of Letters of Comfort in Liability and Risk Management and the Role of Caveats

Prepared by J Palmer

30 August 2001

Summary

This paper provides a Nirex perspective on what is represented by Nirex endorsement by issue of a ‘Letter of Comfort’. It gives an overview as to how Letters of Comfort have been and are being used by different waste producers in managing their risks and explains the role of caveats which are sometimes applied.

A summary is provided of how Letters of Comfort have been used by waste producers during the past 10 years or so to support their various waste packaging strategies. Examples are provided where waste producers have chosen to:-

- package wastes in a manner that is fully consistent with anticipated future management phases, including potential disposal;
- package wastes in a manner potentially consistent with future management, but due to residual uncertainties, the potential need to rework the packages with known technologies to produce fully consistent packages is recognised; and
- package wastes for interim storage in a manner that will enable future treatments to be carried out using known processes, to produce packages fully consistent with anticipated future management.

The paper illustrates the flexibility inherent within the existing LoC process to support a range of different waste management strategies.

1. Introduction

This paper provides a Nirex perspective on what is represented by Nirex endorsement by issue of a 'Letter of Comfort'. It gives an overview as to how Letters of Comfort have been and are being used by different waste producers in managing their risks and explains the role of caveats which are sometimes applied.

2. Background

The Letter of Comfort process was established in the late1980s in order to provide a mechanism whereby producers of radioactive waste could be appraised of issues relating to the future safe management of their wastes, by the organisation set up to develop long-term management solutions.

The provision of Letters of Advice (LoA) and Letters of Comfort (LoC) by Nirex is a key input to the waste producers' waste management decision making process as envisaged by the White Paper Command 2919, para 113[1]. In making packaging decisions, producers have access to Nirex advice and endorsements, meaning that decisions taken today can take due account of the potential consequences and burden being imposed on future generations.

In response to specific requests, Nirex provides formal advice in the form of a 'Letter of Advice' (LoA), on the consistency of a waste producer's packaging proposal against anticipated requirements for future transport, handling, storage and disposal. These requirements are based upon Nirex's experience and knowledge obtained during its research and development of the 'Phased Disposal Concept' [2] (which includes detailed consideration on storage, transport, handling and disposal). The requirements for packaging wastes to meet anticipated long-term needs are communicated to waste producers by the provision of standards and specifications (as summarised in [3]) and an over-arching set of principles which have been set down to provide a transparent understanding of the conditions under which Nirex can provide endorsement (the Packaging Principles in [4]).

Where Nirex has found a specific packaging proposal to be consistent with the phased disposal concept, its principles and the Waste Package Specifications, then Nirex provides endorsement through the issuance of a 'Letter of Comfort' (LoC). It should be stressed that this is **endorsement** and not acceptance or guarantee of future acceptability. All LoCs are based on information presently available and "best beliefs" and make it clear that should any of the requirements change, then it is the waste producer that would be liable for any associated costs. The standard form of wording used in a Letter of Comfort, is reproduced in Annex 1.

The Nirex advice and endorsement is an important management tool that can be used by producers to identify and understand the extent of future risks within their waste management programmes.

3. Basis of Nirex Endorsement through Letters of Comfort

The LoC signifies that, providing the packages will be stored in suitable conditions by the waste producer, then from Nirex's perspective:

- the packages will not require any further treatment to meet the needs for long-term management, or;
- the packaging proposals may require further treatment to remediate **limited deficiencies** and these are possible using **known** technologies; or;

- the proposed packages will **definitely** require further treatment, **and** are capable of being further worked to produce final disposal packages using **known** technologies **(and this need has been explicitly recognised).**

In the first situation Nirex is able to issue an **uncaveated** Letter of Comfort.

In the second situation Nirex is only able to issue a **caveated** Letter of Comfort. This identifies where an additional process may be necessary to mitigate the potential problem, should this be shown to be necessary.

In the third situation Nirex is able to issue an **uncaveated** Letter of Comfort for that initial process step. This is conditional on a future action being taken to convert these interim packages into final disposal packages.

Nirex does not provide endorsement where major issues and uncertainties remain and where to mitigate the problem would require a major rework, involving a complete reversal of the proposed packaging step, or would involve unknown or yet to be developed technologies. In such cases Nirex will provide a “Letter of Advice” to inform the developer of where actions will be required to mitigate the issues.

In addition Nirex is only able to provide uncaveated Letters of Comfort where the waste is clearly within its remit.

4. Use of Caveated and Uncaveated Letters of Comfort

Since 1986 Nirex has been approached by waste producers to provide over 200 pieces of advice. This advice has covered over 40% of the conditioned volume of intermediate level wastes declared by waste producers in the 1998 UK Waste Inventory. As at April 2001 Nirex has been able to issue 69 Letters of Comfort endorsing packaging plans for over 35% of the volume of the nation’s declared inventory of intermediate level wastes.

<u>Uncaveated Letters of Comfort</u>

Of these 69 letters of comfort, 56 have covered proposals for producing a disposal package where no further action or remediation is foreseen. These LoCs have been largely uncaveated, but see later discussion on waste classification.

<u>Caveated Letters of Comfort</u>

Eight of the proposals cover packages for which there are residual uncertainties in package long-term performance but for which the issue is well defined and the technologies for remediating the issue are readily available should they prove necessary. Caveated LoCs have been issued in these cases.

Examples of these are given in the following table:-

Waste	Uncertainty	Technical Mitigation
FHP swarf in EP1 (MEP). Magnox Swarf from B38 compartments 19-22. Rotary Skip Wash Debris in MEP. BTC Fuel Element Debris waste.	Uncertainties in the long-term corrosion performance of the waste, potentially leading to disruptive forces following resaturation in the disposal environment	Overpacking may be necessary to restrict ingress of water and/or accommodate expansive forces without causing disruption.
WAGR boxes containing caesium contaminated wastes.	Uncertainties in the long-term containment and corrosion behaviour of the containers may lead to inadequate performance and/or retrievability being compromised.	Overpacking into standard Nirex containers.
Original MTR Conceptual LoC. WAGR boxes for Loop Tubes, operational wastes and decommissioning waste.	Non-standard packages may not be able to be handled in a cost-effective manner or may adversely affect safety.	Special handling measures or overpacking.

There have also been a number of requests for endorsement of the packaging of wastes which could be viewed as satisfying the definitions of either ILW or HLW depending on interpretation of waste classification. Such wastes include raffinates from MTR, DFR and TRIGA fuel reprocessing, fuel samples retrieved from Harwell RHILW and Dounreay Silo, and Fingal Vessel Waste. Although the proposed waste packages have been found to be consistent with the foreseen requirements for safe future management, and endorsement via a LoC has been given, this has had to be caveated. This caveat advises waste producers of the risk that if these wastes were judged to be outwith the remit of Nirex, then a future Nirex facility would not be in a position to accept them.

<u>Uncaveated but Conditional Letters of Comfort</u>

Five of the Letters of Comfort have endorsed proposals for retrieval and packing of waste in a form that will enable future treatment to produce suitable packages for future management including potential disposal, by applying known technologies. These include processes where there is a period of passive safe storage before future treatment and where there is the need for further characterisation before the most appropriate process can be chosen.

These are summarised below:

Waste	Operation	Future Processing
Harwell RHILW	Sorting, monitoring and repacking wastes into standard Nirex containers.	Grouting of wastes within the existing drums.
Trawsfynydd Ion Exchange Resins	Immobilisation of resin into shielded "type 1803 drums".	Grouting of type 1803 drums into standard 4m box.
Submersible Caesium Removal Units.	Production of ionsiv columns with known inventories.	Immobilisation of ionsiv and grouting of packages in standard Nirex containers.
Dounreay Silo and Dounreay Shaft Wastes Requiring Additional Treatment.	Retrieval, sorting, monitoring and characterisation of wastes.	Chemical treatment and immobilisation of materials outside existing formulation or process envelopes.

This had led to Letters of Comfort being issued conditionally upon future actions being undertaken.

5. Conclusion

The Letter of Comfort process has been used to inform/support waste producers' waste management strategies for more than 10 years. A variety of strategies have been pursued by individual waste producers including:-

- packaging in a manner that should be suitable for future storage, transport, handling and potential disposal;
- packaging in a manner which may require rework using known technologies to make packages that should be suitable for future storage, transport, handling and potential disposal;
- packaging wastes in a manner that allows safe storage and should enable future packaging to enable safe transport, storage, handling and potential disposal.

The provision of LoAs and LoCs by Nirex is a key input to the waste producers' waste management decision making process as envisaged by the White Paper Command 2919. In making packaging decisions, producers have access to Nirex advice and endorsements, meaning that decisions taken today can take due account of the potential consequences and burden being imposed on future generations. The Nirex advice and LoC is an important management tool that can be used by producers to identify and understand the extent of future risks within their waste management programmes.

The LoC/LoA system has inherent flexibility and does not dictate any particular strategy as to how waste producers should move towards achieving the safe long-term management of their wastes. A "caveat" may be applied to a LoC in order to give added emphasis to areas of uncertainty and to risk items where uncertainties may necessitate future actions.

References

(1) HM Government. Review of Radioactive Waste Management Policy - Final Conclusions. Command 2919, 1995.

(2) Nirex, Generic Disposal Studies; the Nirex Phased Disposal Concept. Nirex Report N/025, March 2001.

(3) Nirex, Waste Package Specification for Intermediate Level Waste, Nirex Report N/007, May 2000.

(4) Nirex, The Packaging of Waste for Safe Long-term Management, Nirex Report N/006, May 2000.

Annex 1

Standard Form of wording used in Letter of Comfort

The following is the standard form of wording used in a Nirex Letter of Comfort. The wording is designed to reflect the stage of the submission i.e. whether Conceptual, Interim or Final stage.

(Conceptual/Interim/Final) **Stage Letter of Comfort**

Thank you for your submission of *(date)* covering proposals for *(description of wastes/ packaging proposal).*

You have asked Nirex to confirm that these proposals will meet the requirements which we foresee as being necessary for storage, transport, handling and potential disposal.

We have carefully considered your proposals as described in the submission and in the supporting documentation provided. On the basis that *(describe any conditions)* then, on the basis of our current understanding, as recorded in our advice, we can confirm that your proposed concept for *(describe waste packaging concept)* is compatible with the requirements we see as necessary for storage, transport, handling and potential disposal.

Thus, based upon our best beliefs today, which are founded upon the information at present available to us, UK Nirex Ltd endorses your proposals to *(describe proposal)* and is therefore pleased to provide you with this *(conceptual/interim/final as appropriate)* stage 'Letter of Comfort'.

However, if the requirements currently foreseen as being necessary for waste storage, transport, handling and disposal should change for any reason whatsoever, then any costs associated with such a change would be the responsibility of the Waste Producer.