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Harwell Laboratory: *Southern England's New Radioactive Waste Repository?*

Introduction

This report has been compiled in response to the official opening of the 'new' intermediate level radioactive waste store at Harwell Laboratory.

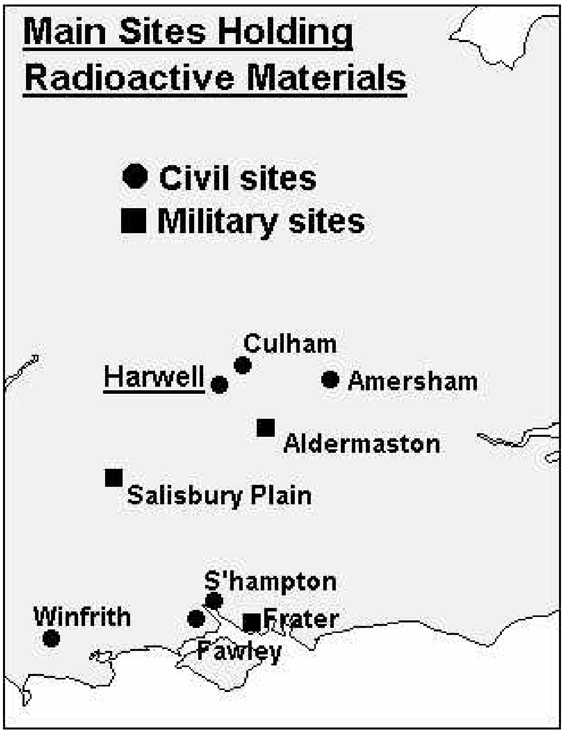
Since 1987 I have been investigating the activities of the Atomic energy Authority at Harwell and Culham, initially as a result of my own concerns about the site and the operation of the defective nuclear research reactors. I am an independent 'environmental investigator' based in Banbury, Oxfordshire. I have been an active environmentalist for many years. I trained in the engineering industry before setting up my current business in early 1992. Since then I have been working across the UK as a consultant to community groups and small businesses in the fields of planning, waste management, sustainable development, pollution and risk assessment.

The recent developments at Harwell are of great concern. This is because at the official level - that is in the official reports produced by government and regulatory agencies - it is obvious that in future Harwell will be a national repository for radioactive wastes. However the United Kingdom Atomic Energy Authority (UKAEA) Government Division, who are responsible for Britain's civil radioactive waste produced before 1996, and the privatised arm of UKAEA - AEA Technology plc - who operate many of the facilities on the Harwell site, are masquerading the changes in operations on the site as 'high tech' development or waste facilities for 'hospitals and universities'. While this is factually correct, the real reality is that Harwell is increasingly becoming a centre for the management of radioactive wastes from a large part of England and Wales. The nearby Culham Laboratory (also run by AEA Technology) is also looking more towards waste management activities as a means of diversifying away from pure research.

One of the most disturbing factors in this change is the complicity of the local authorities - Vale of the White Horse District Council and Oxfordshire County Council. Harwell Laboratory lost many of its immunities to planning and environmental regulation between 1991 and 1997. However it is my view that many of the activities on the site which should be subject to planning and environmental control are not subject to inspection. This failure is compounded by the fact that the other statutory regulators - the Environment Agency, the National Radiological Protection Board (NRPB) and the Health and Safety Executive's Nuclear Installations Inspectorate (HSE-NII) - have become increasing partial in their dealings with AEA/UKAEA. There is a clear problem regarding the enforcement of the law and the protection of the environment and public safety on this site.

Radioactive Materials in Southern England

Harwell Laboratory



Harwell is the birthplace of the UK nuclear industry. It began work on the development of nuclear reactors for civil and military use, and the development of nuclear weapons, in the early 1950s. Aldermaston, Burghfield and Amersham were all at one time part of the UKAEA, but the military operations were split off in 1971, and the lucrative radioisotopes work was privatised to form Amersham International in the early 1980s.

Harwell had two large (Dido and Pluto), and one small (Gleep), nuclear reactors operating up until 1991. Until 1991 UKAEA had regulated their own safety, and consequently the safety of the reactors and other nuclear plants were compromised. This was the subject of a report I wrote for the House of Commons Energy Select committee in 1990. Shortly after the publication of that report UKAEA announced that the reactors were closing, although they denied any link with my investigations.

Much of the nuclear plant on site is now being decommissioned - which in itself is causing higher levels of radioactivity to be discharged into the air. The excessive speed with which the UKAEA are trying to decommission the site has also caused accidents, resulting in the contamination of workers and the prosecution of the UKAEA by the Health and Safety Executive. Significant quantities of radioactive waste have been buried around the site in shallow pits. The main burial site is the '*Meashill Trenches*' at the rear of the site, but significant quantities of radioactive materials were also buried at the '*Southern Storage Site*' (adjacent to Chilton School) and the '*Western Storage Site*' (to the rear of the site, near the new vault store.

Since the closure of the reactors, much of the nuclear role of Harwell has been lost, and the non-nuclear parts of the business are beginning to take over. Harwell is home to the Energy Technology Support Unit (ETSU) - the Government's renewable energy experts. Harwell Laboratory also houses other organisations such as:

- the National Radiological Protection Board (NRPB) - who are in charge of radiological protection;
- UK Nirex - the Government's radioactive waste management authority;
- the Medical Research Council (MRC) - the work at Harwell involves experiments on animals using radiation; and
- the National Physical Laboratory's Rutherford Appleton research laboratory.

As well as nuclear problems, Harwell also has some significant non-nuclear problems. Because of the UKAEA's cavalier attitude to safety, for many years waste chemicals were dumped at the back of the site. This has now caused massive groundwater pollution beneath the site, and the pollution has caused the public water supply at the nearby village of Blewbury to be contaminated with chlorinated solvents.

There have been investigations of cancer levels around Harwell[1], but these studies contain significant flaws. As a result of the studies funded by Newbury District Council around Greenham Common it came to light that there were significant radiation readings emanating from Harwell. A subsequent study of the Harwell site[2] found radiation levels significantly in excess of those previously disclosed by UKAEA.

The future for Harwell at the moment is as a site for the storage of low and intermediate level radioactive waste. The UKAEA was given a 'Special Development Order' (SDO) in 1954, which allows them to build anything in the pursuit of nuclear energy. To this end they have built more and more radioactive waste handling and storage facilities on the site. However the SDO was revoked in 1997, and therefore UKAEA/AEA Technology should be applying for planning permission for much of the development around the site. The removal of immunity from pollution licensing also means that the sites should be licensed for its waste and air polluting activities. However at the moment the information available from the regulatory bodies on this is patchy, which leads those involved in monitoring activities at Harwell to suspect that there is a failure to properly regulate development and polluting activities on the site.

Harwell is accepting radioactive waste for storage from Aldermaston and Amersham International, and the AEA Technology has recently taken control of a company - Safeguard International - who to handle most of the UKs commercial/medical radioactive waste. From 1995, they will also begin 'waste conditioning' - that is processing radioactive wastes to concentrate the activity and prepare it for storage in any future underground facility. In terms of the national stock, Harwell is amassing a significant quantity of radioactive waste - all with no public consultation.

Harwell, as well as discharging substantial quantities of activity to the air, discharges liquid waste into the River Thames in the middle of the village of Sutton Courtenay. According to the UKAEA's own monitoring reports, detectable levels of plutonium and fission products have been found in the riverbed downstream. The UKAEA also has a water treatment works in Sutton Courtenay - in 1992-93 I discovered that the UKAEA were illegally dumping waste - some of it radioactive - in a gravel pit behind the works. This led to Oxfordshire County Council, after much pressure, forcing UKAEA to undertake costly (c.£1,000,000) clean-up operations.

The radioactive emissions from Harwell were last authorised by the Environment Agency in 1996[3]. However this authorisation was rushed, and some of the procedures in the authorisation do not provide effective regulation of the site. It is also possible that some of the emissions from the site are not authorised, but it has not been possible to obtain data to demonstrate this because of obfuscation by AEA and the Agency. The agency has recently announced that it is undertaking a review of the authorisation during 1999/2000 to produce a new updated authorisation[4].

Other sites

Aldermaston is the UKs atomic bomb factory. The plutonium and other nuclear materials to make the bombs comes from the Ministry of Defence's reactors at Calder Hall (Cumbria) and Chapelcross (Dumfries). This is processed at what was the 'Windscale' part of BNFL Sellafield works, and this is then moved by road to Aldermaston. Other radioactive parts for the weapons are made in Cardiff. Like Sellafield, there are higher than normal rates of cancer and leukaemia around the Aldermaston site. This was a matter of much debate at the 'community inquiry'[5] held by Reading Borough Council a few years ago. There is currently dispute between the health authority and the government committee - COMARE[6] - who monitor health effect, ands independent doctors and scientists who interpret the data differently[7]. Aldermaston discharges liquid radioactive wastes into the River Thames just south of Pangbourne.. Significant groundwater contamination has just been discovered at Aldermaston too. Nuclear warheads are transported from Aldermaston to 'special munitions' depots across the country. In Southern England there is only one such depot - RNAD Frater near Portsmouth. This site holds the nuclear depth charges used by the Royal Navy.

Culham is mainly an administrative centre for AEA Technology, with a few workshops and laboratories. The major part of the site is taken up the Joint European Taurus (JET) project - the European fusion research programmes' experimental reactor. Fusion power is often portrayed as clean, since it only involves fusing hydrogen to make helium. The truth is rather different. Because of problems getting the reactor working JET has recently been using tritium (a radioactive isotope of hydrogen) in experiments. This has increased radioactive discharges from the site. The use of tritium in fusion experiments also creates more contamination within the reactor due to the 'activation' of the reactor vessel; this may pose some problems during the decommissioning of the plant when it closes in a few years time. Culham has also houses the UKs main radioactive waste transfer station receiving radioactive waste from across the country, sorting, processing and packaging it, before sending it on for final disposal. However the buildings they are carrying out this work in are 35 year old garages and vehicle workshops[8]. There is also significant doubt about the safety of the facility in the event of a fire, particularly as it is close to the European School at Culham.

Winfrith is another UKAEA site, and the reactor was unique in Europe. It was known as the 'steam generating heavy water reactor'. It had various problems over its lifetime, but was mainly kept running as the UKAEA's only source of power generation revenue. Today, the laboratory at Winfrith is slowly running down. It is mainly used now for research into the transport of radioactive waste, and is used as a centre for processing radioactive waste, for example super-compacting low and intermediate wastes before long-term storage (to reduce its volume). Rechem International run a chemical waste incinerator - also licensed to burn significant quantities of low-level radioactive waste - at ***Fawley*** on the Solent. They receive waste from hospitals, universities and industry, as well as wastes from the Harwell, Culham, Aldermaston and Winfrith sites.

Amersham International are one of Europe's main manufacturers of radiochemicals and radioisotopes. Some of the sources are very small, and have insignificant effects, but others can cause serious damage should they ever get loose from their transport containers - an example would be the large sources used in hospitals to treat cancer.

Southampton container terminal is a major port, and part of the trade is carries out involves radioactive materials. Most of the spent fuel brought into the UK for reprocessing at Sellafield comes in via other ports such as Dover, Immingham, Barrow or Heysham. Southampton is mainly involved in the movement of radioactive materials of a 'low specific activity'. This includes the uranium ore (called yellowcake), or uranium hexafluoride, which are used to make nuclear fuel rods. Uranium does not pose a great radioactive hazard, as compared to radioactive waste, but it has a number of toxic effects on the body. Uranium hexafluoride actually poses a greater chemical hazard than a radiological one should a mishap occur.

Other sites: There was one landfill site in the area used for the large scale disposal of radioactive waste - Stanford in-the Vale in Oxfordshire. This site closed due to water and contamination problems. The nearest landfill used for radioactive waste dumping is Beddingham Quarry near Lewes.

One further site to note is Salisbury Plain. There has been a switch in recent years in the materials used in armour piercing shells. Many munitions now incorporate depleted uranium as, because of its greater mass, it is more effective at making holes in steel plate. The downside of this is that fragments of uranium are scattered over the firing ranges. Some of the uranium also vaporises/burns on impact, so spreading it even further. Although the military will not admit any ill-effects from the use of depleted uranium, its use in munitions has been implicated as one of the possible causes of 'Gulf War Syndrome'.

The sites which have not been mentioned so far, because they are too numerous, are hospitals and universities. Radioactive sources are used in certain medical treatments, and modern chemistry and physics uses many radioactive materials either as an essential part of experiments or as a tracer/indicator. Many of the materials used are of low activity, and are commonly - on the advice of the Government - either dumped in with the normal rubbish or tipped down the sink. Only the higher activity material is collected. If you wish to find out where these sites are you should ask the Environment Agency. However I have put the Environment Agency's list of licensed sites on my Internet website at:

http://www.gn.apc.org/pmhp/dc/radwaste/

The Future role for Harwell - *A Radioactive Waste Repository*

The assumption that has underlain all radioactive waste management planning for the past ten years is that waste would be deposited in a 'deep repository' at Sellafield. When the appeal over the grant of planning permission was dismissed on safety grounds it created a crisis in radioactive waste management. This was primarily for four reasons:

1. Until that date very little work was done to reprocess or package wastes because it was not certain what form the waste would have to be in to go in the repository. This meant that, for example, the old sea-dump drums, some of which were leaking, were not repacked to ensure their safety on the grounds that it would be done a few years later when the waste went to the repository.
2. There had been little attention paid to minimising the waste arisings - for example through better operation practices or better segregation of waste of different activity, since it was assumed the repository would take bulk quantities of waste.
3. There was little concern about the increasingly dilapidated state of some of the radioactive waste stores - the older intermediate waste stores at Harwell are an example - and so waste was being stored in increasingly unsuitable and unsafe conditions.
4. Given that the fate of the waste was sealed - it would go to the repository - Nirex, and other government bodies responsible for handling waste, did not enter into any public debate on the future of radioactive waste management. This meant that at Harwell waste has continued to amass at ever greater levels - for possibly the next 60 to 100 years - with no public consultation.

Information on how much radioactive waste is generated and stored at sites in the area is provided in the UK Radioactive Waste Inventory 1994[9]. Extracts of this are provided in Appendix 1 of this report. I have also place information from the Inventory, covering all sites in the UK, on my Internet website at:

http://www.gn.apc.org/pmhp/dc/radwaste

The government and the nuclear industry must now begin again to find a strategy to manage the ever increasing levels of radioactive waste. The problem will become particularly urgent in the early years of the next decade as more nuclear power stations begin to shut down. For these reasons a report was produced[10] by the HSE-NII on the future management of intermediate level waste (ILW). This is perhaps the document which gives the most detailed guide as to the future of waste storage at the Harwell site.

The NII report begins by outlining the immediate issues to be dealt with: '*Although the situation is generally under control at the present time, there is a considerable legacy from the past.* ***Many of the facilities that have been used to store ILW do not meet modern standards.*** *Some areas are of immediate concern and are being dealt with by licensees… We have assumed, possibly conservatively, that the typical life of a modern waste store is 50 years. The lives of stores built to previous standards may be shorter.*'

On the existing ILW facilities at Harwell and Winfrith it states: '*Harwell and Winfrith each have unused ILW stores which will be used for solid ILW and cemented sludges.* ***A new store for solid ILW from the re-working of the sea-disposal drums at Harwell and Winfrith will be needed, and UKAEA plans to construct this at Harwell. If the UKAEA's plan to transfer its plutonium contaminated material (PCM) to BNFL at Sellafield is not realised, then the Authority will, in our view, need to construct conditioning plants and stores for PCM at one or more of its own sites.'***

On the facilities at Aldermaston, the report is more critical: '*Hunting-Brae needs to develop its plans to condition and reduce the volume of its solid wastes. More waste stores will be needed by 2005 if volume reduction is not carried out. Sludges are stored in unsuitable facilities of uncertain structural condition.*'

In conclusion the report states: '*The delay in providing a final disposal repository will not cause any* *immediate safety problems for ILW storage.* ***However, up to 20 stores will be required for the wastes currently accumulated on all major licensed sites if an operating repository is not available within the next 15-20 years****. Waste Management strategies which defer the retrieval and conditioning of raw wastes pending the early availability of a repository need to be reconsidered as they may no longer be tenable.*'

The report then considers facilities at each of the sites holding ILW. On Harwell it notes: '*There are some ILW liquids and sludges stored in old but inspectable tanks. UKAEA is to condition these wastes by encapsulation and store them in the new vault store (B462.27)…* ***Solid ILW is stored in three stores in the B462 complex. This waste is in cans in a series of vertical tubes in a concrete slab. Two of the stores are nearly 40 years old (although they were refurbished in 1993) and some of the older waste cans may be wet and deteriorating with age.*** *The third store is relatively modern. UKAEA intends to start the retrieval of this waste in the near future but it could take 15 years to empty these stores.* ***The waste is to be sorted in B462.27, and the solid ILW will be stored in that building's vault store. UKAEA needs to grout this waste for long term storage, and hence will have to construct a cementation plant.*** *There is also some solid ILW in two buffer stores which UKAEA intends to transfer to B462.27 for processing and long-term storage… PCM is stored in a modern engineered facility, B462.23. Loose waste is stored in drums (mostly galvanised) on racks. There is also some PCM in two buffer stores, and PCM arising from post operation clean out of the chemistry building, B220, is to be stored in that building. We consider these storage arrangements are acceptable in the short term.* ***UKAEA plans to transfer this waste to Sellafield but will have to make alternative arrangements if this is not possible****… There are over 3000 sea disposal packages at Harwell. They are in a conventional agricultural-style open-sided building, but as the packages themselves are robust, we believe the storage arrangements are adequate in the short term.* ***UKAEA intends to sort this waste, and encapsulate and store the ILW component, in a facility which has yet to be constructed, by 2010****.*'

On the facilities at Winfrith the report states: '***Solid ILW is stored in three buildings. This waste is to be transferred to the B462.27 facility at Harwell in the near future. Sea disposal drums (289) are stored in similar fashion to those at Harwell, and it is UKAEA's intention to process these, with the Harwell drums, by 2010. PCM is stored in the Fissile Materials Store. UKAEA hopes to transfer this waste to Sellafield if this can be agreed, although some interim storage at Harwell may be necessary.***'

So - what main changes can we deduce from this report about waste storage at Harwell:

1. The new 'vault store' being opened by UKAEA at Harwell will not provide any additional capacity - it is to replace the existing sub-standard facilities on site. Therefore, contrary to the UKAEA's press release[11], it **will not** handle all of Harwell's ILW and significant time into the next Century (this is, after all, a misleading statement given that the next century is only 10½ months away).
2. A new store will be built at Harwell, by 2010, to handle the waste reprocessed from the sea-dump drums from Harwell and Winfrith. This also contradicts the UKAEA press release which infers that the newly opened vault store will be the 'cornerstone' of future waste management at Harwell. Clearly this cannot be the case if a new facility will be required.
3. If UKAEA cannot send its plutonium contaminated material to Sellafield, then another store - made to even higher specifications because of the need to handle fissile materials - will have to be created. There has been some indications that Harwell will receive plutonium contaminated waste from Aldermaston, for example PCM contaminated mercury and oils, for long term storage. It is not clear if this will add to the problem.
4. As part of the reconditioning of waste held in the other two ILW stores - which contrary to the view given in the UKAEA press release are considered to be unsuitable by the NII because of the possibility of waster seepage damaging the drums - a cementation plant will have to be constructed.
5. Finally, there is the issue of the ILW arising from other sites - for example decommissioned power stations. As noted in the report up to 20 new stores will be needed, but the facilities that will be

constructed as part of power station decommissioning have not yet been decided upon. We therefore face the possibility that some of the more intractable intermediate level waste - for example waste contaminated with fissile materials or long-lived radionucleides (as opposed to contamination with more shorter lived activation products) may be stored at the three main ILW centres in Britain - Sellafield, Dounreay and Harwell.

Therefore we can safely say that at least one or two more stores will be needed to handle Harwell's ILW, plus at least one more processing facility (the cementation plant). However should Harwell receive more waste from Winfrith, and as seems to be the case from Aldermaston, then perhaps more stores will be required as part of the contribution to the national requirement of 15 to 20 new stores. This is a rather different perspective than that communicated in the UKAEA's clearly misleading press release on the opening of the new vault store.

In conclusion

I welcome the opening of the new vault store because it provides a much safer alternative to the dilapidated stores in which this highly dangerous waste is kept today. However there are clearly issues which have to be resolved about the future development of facilities at Harwell:

1. There is a disparity between the UKAEA's statements and the position of the Nuclear Installations Inspectorate. Either the NII are wrong, or UKAEA have provided misleading information in their press releases. Given my twelve years experience I would suspect the latter since there have been many occasions in the past when the public relations staff at Harwell have deliberate mislead the media in order to deflect attention to embarrassing problems on site.
2. There will be new facilities at Harwell, and these will need proper assessment prior to construction. However I have doubts whether the officers of Vale of the White Horse District Council, Oxfordshire County Council have the will or ability to give appropriate attention to these applications. In my experience these applications will be approved with very little public debate.
3. Given the above, there needs to be an open public debate about the future of waste disposal at Harwell. There is a moral responsibility, in terms of the philosophy of sustainable development, to accept the wastes that have already been generated at Harwell - with of course appropriate support and compensation from the Government. However the greater debate is whether or not Harwell should continue to receive waste imported from other sites. There needs to be an open discussion between the authorities involved and the people of Oxfordshire and West Berkshire about the risks of storage at Harwell versus the risks of storage at other sites, and the long-term future of the Harwell site. Nothing that takes place on this site has ever been subject to proper public consultation in order to provide public assent for these development.
4. There needs to be a much more open policy in UKAEA and AEA Technology, and the three main regulators (the local authorities, HSE NII and the Environment Agency) regarding operations at the site and the historic legacy from 50 years of nuclear research.

In my view this will not happen unless local people and community groups begin to apply pressure for greater involvement in the running of the site. Such reforms, in terms of transparency of decision making and open access to information, are highlighted as a priority in the recent White Paper on Local Government[12].

Paul Mobbs

10.2.99

Appendix 1: Extracts from the UK Radioactive Waste Inventory 1994

The UK Radioactive Waste Inventory consists of four reports:

- The 1994 United Kingdom Radioactive Waste Inventory - UK Nirex Ltd. report number 695 DOE/RAS/96.001 **(the 'Main' report)**
- The Physical and Chemical Characteristics of UK Radioactive Wastes - UK Nirex Ltd. report number 696 DOE/RAS/96.002
- The Radionuclide Content of UK Radioactive Wastes - UK Nirex Ltd. report number 697 DOE/RAS/96.003
- A Review of the Processes Contributing to Radioactive Waste in the UK - UK Nirex Ltd. report number 699 DOE/RAS/96.005

Extracts from the 'Main' Report

2.4.1.2 Intermediate Level Waste (ILW)

Wastes are classified as ILW if their radioactive content exceeds the upper limits for LLW, but their radioactivity and heat output are lower than that of HLW.

ILW consists principally of materials that have been irradiated in a nuclear reactor (e.g. fuel cladding and reactor components), and equipment and materials that have been used in the processing of radioactive materials (e.g. ion exchange resins and filters). ILW requires radiation shielding and/or containment to protect the operator.

No disposal route is currently available for ILW, and at present most of these wastes are stored at the producing sites - some minor waste producers make use of the UKAEA's ILW store at Harwell. Nirex has the task of providing facilities for deep underground disposal of ILW and some LLW, and is undertaking further investigations at the preferred repository site near Sellafield in Cumbria. ILW will be conditioned in a form suitable for disposal. It will be packaged in steel or concrete containers and either stored prior to disposal or sent directly for disposal to a deep repository. Conditioning of some ILW streams commenced in 1990.

There are a small number of unclassified waste streams in the inventory. These are fuel wastes and uranic residues. Their total volume prior to conditioning is 135 m^3. Whilst these wastes have broadly similar characteristics to other intermediate level wastes, they cannot be readily accommodated within the present UK system of waste classification. Consequently they have not been formally allocated to a specific class of waste; however for the purposes of the inventory they are included with intermediate level wastes when summing volumes and activities. The UK waste classification system is currently under review.

2.4.1.3 Low Level Waste (LLW)

LLW is waste with a radioactive content that does not exceed 4 GBq/t of alpha or 12 GBq/t of beta/gamma activity.

LLW consists of general rubbish (such as used paper towels and discarded laboratory clothing) and other lightly contaminated plant items and equipment, as well as some materials that have been irradiated, arising predominantly from the operation of nuclear facilities. Building materials and larger items of plant and equipment are also produced from the decommissioning of facilities. LLW requires containment to protect the operator but does not normally require radiation shielding.

Since 1959 most of the UK arisings of solid LLW have been disposed of at the site operated by BNFL at Drigg in Cumbria. UKAEA also operates a LLW disposal facility at Dounreay. The scope of Nirex's proposed deep repository includes the disposal of some LLW. LLW is now to be conditioned prior to final disposal, but this was not always the case in the past. For much LLW the conditioning process includes supercompaction to reduce its volume.

Details of LLW that has been disposed of (e.g. to Drigg) are not recorded in the inventory, although total volumes disposed during the last few years are summarised in Section 5.3.

2.4.1.4 Very Low Level Waste (VLLW)

Wastes with very low concentrations of radioactivity arise from a variety of sources, including hospitals and the non-nuclear industry. They contain little total radioactivity and may be disposed of by various means such as with domestic refuse, at landfill sites or by incineration. The method depends upon the nature and quantity of the material to be handled.

Within certain limits and provided that special precautions are observed, solid VLLW which is too radioactive for dustbin disposals may be disposed of at suitable landfill sites. Demolition wastes and other high volume wastes having a low specific activity or light contamination can also be authorised for burial at a landfill site.

Incineration is more expensive than landfill disposal and is usually reserved for wastes that are noxious or biologically toxic. Authorisations for incineration take account of the quantity and nature of the radionuclides in the waste and any resulting ash.

Wastes that may be disposed of in any of the above ways are not disposed of in national radioactive waste disposal facilities and are not recorded in the UK Radioactive Waste Inventory.

2.4.2 State of wastes

For each type of waste recorded in the inventory (HLW, ILW, LLW) as defined above, the report presents information for two different physical states: as stored and conditioned.

'Conditioning' refers to the processes used to prepare the wastes for long-term storage or disposal, for example vitrification, or encapsulation in cement or polymer. Wastes that have not yet been conditioned may already have had some form of treatment before being stored, such as the evaporation of aqueous HLW, the sorting and drumming of miscellaneous contaminated solid ILW, and the sorting and in-drum compaction of soft LLW. The volumes of wastes recorded in the inventory in the 'as stored' state reflect any such treatment that has already been carried out. Thus for current wastes, the as stored data refer to the actual volumes of wastes in store, some of which will be untreated, some treated and some conditioned. The conditioned data refer to the volumes that these same wastes would occupy after conditioning. For future arisings, both the as stored and the conditioned volumes assume a continuation of current and planned treatment and conditioning practices.

The 1991 inventory (Ref. 2.1) used the terms as stored, conditioned and supercompacted. In this report supercompaction is simply regarded as a method of waste treatment that may form part of the conditioning process.

Conditioning of HLW and ILW commenced on the BNFL Sellafield site during 1990 with the start-up of the Waste Vitrification Plant (WVP) for HLW and the Magnox Encapsulation Plant (MEP) for ILW. In early 1994 conditioning of floc from the treatment of liquid effluents started in the Waste Packaging and Encapsulation Plant (WPEP). Stocks of conditioned wastes existing on 1 April 1994 produced from these plants are recorded in the inventory. Conditioning of some forms of solid ILW may include supercompaction prior to packaging and encapsulation to minimise volumes for disposal.

Wastes that were prepared for disposal at sea, and subsequently stored at sites following the suspension of sea disposal operations, are included in this inventory. They are not considered to be conditioned since they may require further treatment prior to disposal to a deep repository.

Much LLW is routinely treated as it arises, by one or more processes such as sorting, size reduction, incineration, in-drum (or box) compaction and whole-drum (or box) supercompaction. Supercompaction has been introduced by the UK nuclear industry as the preferred treatment for LLW whenever appropriate, either at the site of waste arising or at central locations. A proportion of LLW, principally from decommissioning, will be too bulky to allow supercompaction without prior size reduction. For these wastes, waste producers must evaluate whether they should be disposed of without volume reduction.

Conditioned LLW is the form that will be disposed of in the existing disposal sites at Drigg and Dounreay, and to a future deep repository. Conditioning typically involves overpacking the wastes and filling the interstitial voidage with cement grout.

The conventions used in reporting volumes of radioactive wastes in as stored and conditioned forms are described in Section 2.4.6.

2.4.3 Committed and uncommitted wastes

Predicted future waste arisings are categorised as committed or uncommitted. Committed wastes arise from the operation and decommissioning of plants and facilities that exist now, or are under construction, or for which there is a commitment to start construction. Uncommitted wastes are those which may arise from plants or facilities that are proposed or projected, or from present facilities (e.g. laboratories) or processes if they continue beyond their currently committed operational lifetimes.

2.4.4 Origins of wastes

In general, the wastes that are produced in a nuclear power station or other facility during its operating lifetime are different in nature and radioactivity content from those wastes that remain after the facility is shut down. The report presents information separately for these two categories of waste, which are termed operational waste and decommissioning waste respectively. Another reason to report these wastes separately is that the timing of decommissioning can be scheduled to coincide with the availability of waste disposal routes. Consequently, the dates of arisings are not as predetermined as those for operational wastes.

Operational wastes arise during the normal day-to-day operations of a plant or facility, from its start-up to its final shutdown. Examples of operational wastes are paper towels, scrap metal, filters, laboratory equipment, ion exchange resins and solidified sludges from the treatment of liquid effluents.

Wastes from any post-operational clean out (POCO) activities are treated as operational wastes.

Decommissioning wastes arise after shutdown of a facility. They consist mainly of building materials and larger items of plant and equipment. The decommissioning of reactors is conventionally planned in three stages.

Stage 1 The fuel is removed from the reactor.

Stage 2 All plant and structures are removed other than the reactor and the surrounding biological shield.

Stage 3 All the remaining structures are dismantled and the site is cleared and restored.

The precise timetables for decommissioning will be dictated by the strategy of the reactor operators. Nuclear Electric and Scottish Nuclear have evolved a “Safestore Strategy” for gas-cooled power reactors which although planned in three stages differs from the conventional strategy described above (see Chapter 3).

2.4.5 Waste stream identification

A waste stream is usually confined to a particular facility. It is distinguished by its radionuclide composition and in many cases also by its physical and chemical characteristics. Examples of waste streams include graphite from the dismantling of AGR fuel at BNFL Sellafield, ion exchange material from the treatment of spent fuel cooling pond water at a nuclear power station, and miscellaneous laboratory hardware from radiochemical preparations at Amersham International.

Each waste stream in the inventory is allocated a unique identifier. This consists of a digit indicating the producer of the waste, followed by a letter indicating the site of arising, followed by a two- or three-digit number. Operational wastes are identified by numbers in the range 01 to 99; decommissioning wastes are allocated a three-digit number. For example:

Waste stream 3B01:
- **3** (Producer = Nuclear Electric)
- **B** (Site = Bradwell)
- **01** (Waste stream; operational)

Waste stream identifiers are generally carried over from one inventory to the next. New waste streams are allocated an identifier in sequence with existing numbers. Identifiers of waste streams are not re-used if the streams cease to exist, for example because the waste has been disposed of. Thus the waste stream identifiers at any one site of arising do not necessarily form a complete numerical sequence.

LLW streams in the Inventory may be designated as one of the following.

- **LLW/R** LLW that currently arises and is routinely disposed of to an authorised disposal site such as Drigg in Cumbria.
- **LLW/SD** LLW that currently arises and is stored pending disposal to an authorised disposal site.
- **LLW/UDG** LLW that is unsuitable for disposal to an authorised disposal site. These wastes do not meet current conditions for acceptance for disposal.

Waste streams in the Inventory may be further categorised as follows.

- **SPD1** Stored pending Stage 1 decommissioning.
- **SPD2** Stored pending Stage 2 decommissioning.
- **SPD3** Stored pending Stage 3 decommissioning.
- **PFSD** Prepared for sea disposal (but currently stored because of the bar on this disposal route).

2.4.6 Volumes of wastes

The Inventory gives volumes of radioactive wastes in stock on 1 April 1994 and in predicted arisings, in as stored and conditioned forms.

The volume of as stored waste in stock on 1 April 1994 is the amount of space that the waste occupies in storage following its generation and any subsequent treatment that may have been carried out. For example, aqueous HLW volumes refer to the amount of liquor stored pending vitrification, and not to the liquor arising directly from the first stage of separation prior to evaporation.

For arisings, the as stored volume refers to the volume that the waste would occupy if it were in stock on 1 April 1994, assuming current waste treatment practices.

The conditioned waste volume is equivalent to the as stored waste volume multiplied by a numerical quantity called the conditioning factor. A conditioning factor of 0.5 for example implies a halving of the volume on waste conditioning. The conditioning factor is an overall conversion factor reflecting the net effect of all treatment processes. For example, where waste has undergone supercompaction before encapsulation the conditioning factor is the net factor resulting from both supercompaction and encapsulation.

The conditioning factor takes account of the change in waste volume on conditioning, but does not account for the extra volume of the waste container in which the waste is conditioned, container voids or any capping material.

The volume of conditioned waste in any given time period is the predicted arising in that period expressed as a conditioned volume, based on the continuing use of current and planned conditioning practices. It is not the volume of waste that would be produced from conditioning plants operating in that period; the inventory makes no forecast of these volumes.

In most conditioning processes waste is mixed with, or embedded in, other material (e.g. cement, polymer) and hence there is no general relationship between as stored density, conditioning factor and conditioned density. Estimates of volumes of conditioned waste are indicative only, and should be used with appropriate care.

Throughout the report the volumes of waste arisings are given for financial years, not calendar years, although for medium and longer-term forecasts this distinction is unlikely to matter. For simplicity in presentation and discussion of volumes, the financial year "1995/96", for example, is referred to as "1995".

7.3.5 UKAEA

7.3.5.1 Operational wastes

On 1 April 1994 the stocks of operational waste held by UKAEA totalled 6,001 m^3, consisting of 163 m^3 of HLW, 5,474 m^3 of ILW and 364 m^3 of LLW. Most of the waste stocks are held at Dounreay and Harwell. Suitable LLW is being conditioned at the Dounreay, Harwell and Winfrith sites; about 40 m^3 is in stock awaiting disposal.

The corresponding volume in stocks from the 1991 Inventory was 8,873 m^3 (271 m^3 of HLW; 5,157 m^3 of ILW; 3,445 m^3 of LLW). There is a lower stock of HLW in the 1994 Inventory because the volume of the highly active liquor at Dounreay has been reduced by evaporation.

UKAEA stocks of ILW have increased by 317 m^3 since the 1991 Inventory. This increase is smaller than forecast, principally because of lower arisings at Dounreay and reclassification of some ILW as LLW. A large decrease in stocks of LLW is shown; this is largely due to wastes at Dounreay, previously recovered for supercompaction, being sent for disposal.

The projected total conditioned operational waste volumes for UKAEA are 23 m^3 of HLW, 11,363 m^3 of ILW and 10,313 m^3 of LLW. These volumes compare with corresponding forecasts from the 1991 Inventory of 161 m^3 of HLW, 11,336 m^3 of ILW and 17,399 m^3 of LLW.

The decrease in HLW is because the liquors will be more highly concentrated when conditioned. Reductions in work programmes at Dounreay, Harwell and Windscale, and improvements in waste minimisation due to better waste management practices, have led to decreases in the volumes of ILW and LLW produced. However, for ILW this has been off-set by an upwards re-evaluation of conditioning factors for certain wastes.

Total conditioned operational waste volumes from individual UKAEA sites and the changes in volumes from the 1991 Inventory are presented below. Active operations at the Risley and Springfields sites have ceased since the issue of the 1991 Inventory, so no operational radioactive wastes are reported.

Harwell

The predicted total volume of ILW is about 7% lower, and now expected to be 4,788 m^3 compared with the forecast of 5,159 m^3 in the 1991 Inventory. Most wastes are in stock, but remain to be conditioned. Future arisings are now predicted to be only 52 m^3. The change is attributed to the reductions in active work programmes.

The estimated total volume of LLW is also lower than forecast in the 1991 Inventory. The current volume reported is 4,129 m^3 compared with the previous estimate of 4,611 m^3. This reduction also reflects the scaling down of research programmes, and would have been much greater but for increased conditioning factors adopted for all LLW streams.

Winfrith

The total volume of ILW is 901 m^3. This is similar to the 1991 Inventory prediction of 835 m^3 when account is taken of uranic wastes not previously identified. The predicted total volume of LLW (1,397 m^3) has also changed little when recent disposals are considered.

Culham

No ILW has yet arisen. The total predicted future arisings are 153 m^3, a reduction of 40 m^3 from that in the 1991 Inventory. Total LLW volumes have fallen from 96 m^3 in the 1991 Inventory to 44 m^3: this is due largely to LLW disposals in the interim period.

7.3.5.2 Decommissioning wastes

UKAEA decommissioning strategies have evolved since the publication of the 1991 Inventory. This has resulted in changes to decommissioning timescales and hence to the wastes predicted to arise at certain times. Furthermore, the volumes of waste generated during decommissioning have been reassessed. Total conditioned volumes of decommissioning wastes from all UKAEA sites are now forecast to be 10,258 m^3 of ILW and 141,960 m^3 of LLW. The corresponding volumes given in the 1991 Inventory are 10,150 m^3 of ILW and 111,900 m^3 of LLW.

A direct comparison of volumes at each site is difficult because the 1991 Inventory included a pair of ILW and LLW streams (5Z301 and 5Z302) that were not site-specific. These streams were made up of substantial volumes of wastes from miscellaneous facilities at a number of sites; wastes which in the 1994 Inventory are explicitly identified with the appropriate site. However, a number of significant changes are apparent:

- The total LLW volume from Harwell has risen from 6,974 m^3 to 12,751 m^3. The difference is due largely to wastes from the decommissioning of miscellaneous facilities, not identified in the 1991 Inventory with the Harwell site;
- The total LLW volume from Winfrith has risen from 8,040 m^3 to 14,104 m^3. LLW from the decommissioning of the Steam Generating Heavy Water Reactor (SGHWR) has been revised from 6,720 m^3 to about 9,841 m^3: this, together with wastes from the decommissioning of miscellaneous facilities on the site and explicitly identified for the first time in the 1994 Inventory, accounts for the difference.

7.3.6 Minor Waste Producers

7.3.6.1 Operational wastes

ILW from minor waste producers is stored at Harwell: stocks on 1 April 1994 were 127 m^3. These are less than that interpolated from the 1991 Inventory owing to lower than expected arisings over the past two years and the reclassification of certain waste as LLW. The estimated total conditioned volume of ILW is 62 m^3: this is a downwards revision as 45% lower arisings are now expected.

The rate of LLW arising for routine disposal remains unchanged from that in the 1991 Inventory. The total forecast conditioned volume is 6,193 m^3.

7.3.6.2 Decommissioning wastes

Minor waste producers generate no decommissioning wastes.

7.3.7 Ministry of Defence

7.3.7.1 Operational wastes

On 1 April 1994 the total stocks of operational waste held by MOD were 3,825 m^3, consisting of 2,319 m^3 of ILW and 1,506 m^3 of LLW. Over 90% of all waste stocks are held at Aldermaston.

Stocks of ILW have increased from 1,946 m^3 on 1 January 1991. The increase is in good agreement with the interpolation from the 1991 Inventory of what would be in stock on 1 April 1994. Volumes of LLW in stocks are not comparable since these vary as consignments are routinely disposed of at Drigg.

The predicted total conditioned operational waste volumes for MOD are 5,490 m^3 of ILW and 32,164 m^3 of LLW. These volumes compare with corresponding forecasts from the 1991 Inventory of 7,882 m^3 of ILW and 28,572 m^3 of LLW. Waste volumes are dominated by the contribution from Aldermaston, estimated to be 5,190 m^3 of ILW and 27,167 m^3 of LLW.

Aldermaston

Waste volumes from Aldermaston dominate the total volumes produced by MOD.
The predicted total volume of ILW has fallen from 7,468 m^3 to 5,190 m^3, mainly due to a re-evaluation for PCM of the potential volume reduction on conditioning. Total LLW volume has risen from 25,160 m^3 to 27,167 m^3: this is the net effect of a re-evaluation of disposal volumes and a forecast decrease in the rate of future arising as older facilities are replaced.

7.3.7.2 Decommissioning wastes

Estimates of MOD decommissioning waste arisings have been revised following a reassessment of liabilities. This includes for the first time submarine wastes beyond 2030. Total conditioned waste volumes are now forecast to be 7,209 m^3 of ILW and 16,376 m^3 of LLW. The corresponding volumes given in the 1991 Inventory are 5,007 m^3 of ILW and 54,130 m^3 of LLW. The increase in the volume of ILW is due principally to submarine decommissioning beyond 2030. The substantial difference for LLW is due largely to a reduction in estimates of waste from Aldermaston, down from 54,010 m^3 to 11,196 m^3.

Tables from Annex 4F of the Main Report

Table A4.5.2c Comments. UKAEA : operational waste at Harwell

Table A4.5.2a Specific activity, bulk density and conditioning factor. UKAEA : operational waste at Harwell

Stream Identifier	Title	Waste type	Stock activity Alpha (TBq/m³)	Stock activity Beta/gamma (TBq/m³)	Arisings activity Alpha (TBq/m³)	Arisings activity Beta/gamma (TBq/m³)	Bulk density (t/m³)	Conditioning factor
5C02	ALPHA BETA/GAMMA LLW SLUDGE	LLW/SD	1.40E-03	3.20E-02	0	0	1.02	4.800
5C08	SEA DISPOSAL PACKAGES	ILW;PFSD	6.00E-02	1.50E+ 00	0	0	1.60	2.500
5C18	ALPHA BETA/GAMMA ILW LIQUOR	ILW	1.50E-02	2.00E-01	0	0	1.00	1.500
5C30	HARWELL SOLID (ALPHA) BETA/GAMMA ILW	ILW	7.30E-02	2.40E-01	8.80E-01	6.40E-01	0.78	0.700
5C33	HARWELL SOLID LOW FISSILE ALPHA ILW	ILW	1.90E-01	1.10E+ 00	2.90E-01	9.60E-01	0.50	0.240
5C34	HARWELL SOLID HIGH FISSILE ALPHA ILW	ILW	6.70E-01	1.20E+ 00	1.20E+ 01	5.40E+ 00	0.54	0.210
5C38	BUILDING 220 OPERATIONAL LLW	LLW/R	4.50E-05	1.40E-04	1.20E-05	1.60E-04	0.49	0.670
5C39	TRACE CONTAMINATED LABORATORY AND PROCESS LLW	LLW/R	4.00E-06	4.90E-04	1.90E-05	1.90E-04	0.25	0.900
5C40	INCINERATOR ASH	LLW/R	8.80E-05	1.80E-03	9.00E-05	1.80E-03	0.49	1.430
5C41/C	CEMENTED SLUDGE	LLW/R	5.30E-05	2.80E-04	6.70E-05	3.60E-04	1.52	1.000
5C43	ISOTOPE PRODUCTION UNIT LLW	LLW/R	1.00E-03	4.50E-04	3.00E-10	2.20E-04	0.67	0.590
5C44	ALPHA BETA/GAMMA LLW LIQUOR	LLW/SD	4.60E-05	3.10E-03	0	0	1.00	0.380
5C45	GLEEP FUEL		6.20E-02	8.30E-01	6.20E-02	8.30E-01	4.51	2.300
5C46	URANIC RESIDUES	ILW	5.00E-01	NE	0	0	1.69	3.000
5C47	OILS AND SOLVENTS	LLW/R	1.30E-06	9.80E-04	8.40E-04	8.30E-04	0.46	* 1.000
5C48	ICI THORIA CATALYST	ILW	7.00E-02	6.00E-02	7.00E-02	6.00E-02	3.40	1.950

Table A4.5.2b Stocks and arisings volumes (m3). UKAEA : operational waste at Harwell

Stream Identifier	Waste type	Stocks at 1.4.1994	Arisings as stored 1994	1995-1999	2000-2009	2010-2019	2020-2029	2030-2059	Post-2060	Total As stored	Total Conditioned
5C02	LLW/SD	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	78.0	374.4
5C08	ILW;PFSD	1784.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1784.0	4460.0
5C18	ILW	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	21.0
5C30	ILW	233.4	1.5	7.4	9.3	8.7	2.8	0.0	0.0	263.1	184.2
5C33	ILW	141.6	3.8	19.2	1.9	1.7	1.6	0.0	0.0	169.8	40.8
5C34	ILW	7.9	0.6	2.8	0.0	0.0	0.0	0.0	0.0	11.3	2.4
5C38	LLW/R	13.4	13.7	68.4	27.4	27.5	27.5	0.0	0.0	177.9	119.2
5C39	LLW/R	137.3	58.6	292.8	415.3	376.2	270.8	0.0	0.0	1551.0	1395.9
5C40	LLW/R	1.0	< 1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.9
5C41/C	LLW/R	8.4	59.0	295.1	590.2	590.2	590.2	0.0	0.0	2133.1	2133.1
5C43	LLW/R	1.9	5.3	26.3	52.6	52.7	0.0	0.0	0.0	138.8	81.9
5C44	LLW/SD	33.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.0	12.5
5C45		1.6	6.2	0.0	0.0	0.0	0.0	0.0	0.0	7.8	17.9
5C46	ILW	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	32.9
5C47	LLW/R	2.7	1.1	1.1	1.6	1.6	1.3	0.0	0.0	9.4	9.4
5C48	ILW	10.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	15.0	29.3
Total ILW		2203.5	12.1	34.4	11.2	10.4	4.4	0.0	0.0	2276.0	4788.4
Total LLW		275.7	138.7	683.7	1087.1	1048.2	889.8	0.0	0.0	4123.2	4129.3

Note : 5C45 is an unclassified waste stream, but is included in total ILW volumes**.**

5C02 No more arisings are expected.

5C08 Amersham waste which arose prior to 1984 has been transferred to Harwell. Arisings of waste from Amersham stopped in 1990. Wastes arose prior to 1984 due to the suspension of sea disposal operations.

5C18 No significant arisings are expected.

5C30 Future arisings volumes have decreased due to reductions in active work programmes and the closure of buildings on the Harwell site for decommissioning.

5C33 Future arisings volumes decrease due to reductions in active work programmes and the closure of buildings on the Harwell site for decommissioning.

5C34 Future arisings volumes decrease due to reductions in active work programmes and closure of buildings on the Harwell site for decommissioning.

5C38 Future arisings include combustible LLW which will arise with non-combustible LLW from June 1994. Operational work in B220 is expected to decrease substantially by 2000 as more of the building is decommissioned.

5C39 Future arisings include combustible LLW which will arise with non-combustible LLW from June 1994. Arisings rate gradually decreases due to closure of buildings on site for decommissioning.

5C40 Harwell LLW incinerator closed on 31 May 1994 and therefore no more incinerator ash will be generated. Combustible waste will arise with and be processed with non-combustible waste.

5C41/C -

5C43 Future arisings include combustible LLW which will arise with non-combustible LLW from June 1994. Arisings rate gradually decreases due to closure of buildings on site for decommissioning.

5C44 No more arisings are expected.

5C45 All remaining GLEEP fuel received 1994/95. No more arisings expected.

5C46 A further 0.56m^3 of waste may arise. Material is currently used as shielding.

5C47 Arisings decrease due to reduction in active work on Harwell site and closure of buildings for decommissioning.

5C48 -

Table A4.5.7c Comments. UKAEA : decommissioning waste at Harwell

Table A4.5.7a Specific activity, bulk density and conditioning factor. UKAEA : decommissioning waste at Harwell

Stream Identifier	Title	Waste type	Stock activity Alpha (TBq/m^3)	Stock activity Beta/gamma (TBq/m^3)	Arisings activity Alpha (TBq/m^3)	Arisings activity Beta/gamma (TBq/m^3)	Bulk density (t/m^3)	Conditioning factor
5C301	BEPO RESEARCH REACTOR	LLW/R	6.60E-13	1.10E-05	2.20E-05	1.45E-02	3.43	* 1.000
5C302	BEPO RESEARCH REACTOR	ILW	0	0	NE	4.20E-02	1.64	1.300
5C303	DEVELOPMENT LABORATORY	LLW/R	1.80E-06	1.10E-05	NE	NE	~ 3.00	* 0.900
5C304	DEVELOPMENT LABORATORY	ILW	2.20E-01	5.20E-01	NE	NE	~ 3.00	* 1.000
5C305	DIDO REACTOR	LLW/R	NE	3.50E-04	1.20E-06	1.20E-04	~ 0.80	* 1.000
5C306	DIDO REACTOR	ILW	NE	1.10E+ 00	9.26E-06	9.09E+ 00	~ 1.00	1.000
5C307	PLUTO REACTOR	LLW/R	NE	4.50E-05	1.20E-06	1.20E-04	0.60	* 1.000
5C308	PLUTO REACTOR	ILW	NE	3.20E+ 01	8.73E-06	1.10E+ 01	1.00	1.000
5C309	DECOMMISSIONING: OTHER FACILITIES LLW	LLW/R	2.90E-05	3.90E-05	NE	NE	2.17	1.000
5C310	DECOMMISSIONING: OTHER FACILITIES ILW	ILW	6.20E-01	2.00E+ 01	NE	NE	2.53	1.000

Table A4.5.7b Stocks and arisings volumes (m^3). UKAEA : decommissioning waste at Harwell

Stream Identifier	Waste type	Stocks at 1.4.1994	Arisings as stored 1994	1995-1999	2000-2009	2010-2019	2020-2029	2030-2059	Post-2060	Total As stored	Total Conditioned
5C301	LLW/R	34.1	0.0	0.0	0.0	156.0	0.0	0.0	157.0	347.1	347.1
5C302	ILW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	526.0	526.0	683.8
5C303	LLW/R	12.2	0.0	449.0	711.0	1003.0	0.0	0.0	0.0	2175.2	1957.7
5C304	ILW	66.9	0.0	162.0	22.5	14.0	0.0	0.0	0.0	265.4	265.4
5C305	LLW/R	9.5	0.0	5.0	5.0	375.0	375.0	0.0	0.0	769.5	769.5
5C306	ILW	0.2	0.0	0.0	0.0	82.0	48.0	0.0	0.0	130.2	130.2
5C307	LLW/R	4.1	0.0	5.0	5.0	360.0	360.0	0.0	0.0	734.1	734.1
5C308	ILW	0.5	0.0	0.0	0.0	80.0	46.0	0.0	0.0	126.5	126.5
5C309	LLW/R	49.7	0.0	1922.0	2690.0	0.0	2030.0	2251.0	0.0	8942.7	8942.7
5C310	ILW	29.2	0.0	155.0	78.0	0.0	19.0	11.4	0.0	292.6	292.6
Total ILW		96.8	0.0	317.0	100.5	176.0	113.0	11.4	526.0	1340.7	1498.5
Total LLW		109.6	0.0	2381.0	3411.0	1894.0	2765.0	2251.0	157.0	12968.6	12751.1

5C301 Future waste arisings are given in terms of conditioned volume. BEPO has already been decommissioned to stage 2 after shutdown in 1968. Stage 3 Phase 1 planned for 1994, Phase 2 for 2015 and Phase 3 for 2060-2065.

5C302 Waste arisings are given in terms of conditioned volume. BEPO has already been decommissioned to Stage 2 after shutdown in 1968. Stage 3 Phase 1 is planned for 1994, Stage 2 for 2015 and Phase 3 for 2060-2065.

5C303 Reference strategy considers complete decommissioning with Stage 1 1995-1996, Stage 2 1999-2005 and Stage 3 2014-2018.

5C304 Reference strategy considers complete decommissioning with Stage 1 1995-1996, Stage 2 1999-2005 and Stage 3 2014-2018.

5C305 Stage 1 1990-1994, Stage 2 2014-2015 and Stage 3 2014-2024.

5C306 Stage 1 1990-1994, Stage 2 2014-2015, Stage 3 2014-2024.

5C307 Reference Strategy is Stage 1 completed 1994 then further decommissioning delayed for 20 years. Stages 2 and 3 then undertaken sequentially. Stage 2 2014-2016 and Stage 3 2016-2024.

5C308 Stage 1 started in 1990 and finishes at the end of 1994, Stage 2 is 2014-2015 and Stage 3 2014-2024.

5C309 -

5C310 -

Table A4.5.4c Comments. UKAEA : operational waste at Winfrith

Table A4.5.4a Specific activity, bulk density and conditioning factor. UKAEA : operational waste at Winfrith

Stream Identifier	Title	Waste type	Stock activity Alpha (TBq/m^3)	Stock activity Beta/gamma (TBq/m^3)	Arisings activity Alpha (TBq/m^3)	Arisings activity Beta/gamma (TBq/m^3)	Bulk density (t/m^3)	Conditioning factor
5G01	MISCELLANEOUS REACTOR HARDWARE, UPPER INTERMEDIATE BETA/GAMMA	ILW;SPD2	0	* 1.00E+ 01	0	0	* 1.00	1.000
5G02	LOW BETA/GAMMA ACTIVITY PCM SOLIDS	ILW	* 1.00E-01	2.30E+ 00	0	0	* 1.00	1.000
5G03	ION EXCHANGE RESIN, SLUDGES	ILW/LLW	7.10E-05	1.00E-01	7.10E-05	2.00E-01	1.10	1.600
5G04	MISCELLANEOUS UPPER INTERMEDIATE LEVEL WASTE	ILW	2.00E-01	4.00E+ 01	* 2.00E-01	* 2.00E+ 02	* 2.00	* 1.000
5G05	LOW INTERMEDIATE LEVEL SOLID BETA/GAMMA WASTE	ILW/LLW	2.30E-03	1.60E-01	2.30E-03	1.60E-01	0.25	1.700
5G10	SEA DUMP PACKAGES MIXED BETA/GAMMA	ILW;PFSD	2.60E-04	2.00E-02	0	0	1.80	1.000
5G11	PCM IN SEA DUMP PACKAGES	ILW;PFSD	* 5.00E-02	* 5.00E-01	0	0	1.36	* 1.000
5G14	PIE LLW	LLW/R	6.30E-05	1.50E-02	6.30E-05	1.50E-02	~ 1.60	0.970
5G15/C	SUPERCOMPACTED PIE LLW	LLW/R	3.00E-06	4.80E-04	3.00E-06	4.80E-04	0.70	1.000
5G16	GENERAL LABORATORY, RIG AND REACTOR WASTE	LLW/R	1.00E-07	1.20E-04	1.00E-07	1.20E-04	~ 1.00	0.750
5G17/C	SUPERCOMPACTED GENERAL LABORATORY, RIG AND REACTOR WASTE	LLW/R	2.20E-07	2.70E-04	2.20E-07	2.70E-04	0.66	1.000
5G18/C	SUPERCOMPACTED ALPHA ACTIVE LABORATORY LLW	LLW/R	4.90E-06	1.50E-04	4.90E-06	1.50E-04	~ 0.70	1.000
5G19	URANIFEROUS LLW	LLW/R	2.00E-03	0	0	0	0.35	0.280
5G20	DRAGON FUEL WASTE		5.70E-01	1.63E+ 03	0	0	1.80	4.500
5G21	URANIC RESIDUES	ILW	4.70E-02	NE	0	0	5.70	~ 5.000

Table A4.5.4b Stocks and arisings volumes (m^3). UKAEA : operational waste at Winfrith

Stream Identifier	Waste type	Stocks at 1.4.1994	Arisings as stored 1994	1995-1999	2000-2009	2010-2019	2020-2029	2030-2059	Post-2060	Total As stored	Total Conditioned
5G01	ILW;SPD2	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.0
5G02	ILW	149.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	149.2	149.2
5G03	ILW/LLW	~ 300.0	0.5	2.5	0.0	0.0	0.0	0.0	0.0	303.0	484.8
5G04	ILW	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8
5G05	ILW/LLW	26.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	26.8	45.6
5G10	ILW;PFSD	84.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.4	84.4
5G11	ILW;PFSD	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	50.0
5G14	LLW/R	~ 10.0	~ 130.0	0.0	0.0	0.0	0.0	0.0	0.0	140.0	135.8
5G15/C	LLW/R	~ 14.0	~ 71.0	0.0	0.0	0.0	0.0	0.0	0.0	85.0	85.0
5G16	LLW/R	~ 10.0	~ 15.0	75.0	150.0	150.0	150.0	0.0	0.0	550.0	412.5
5G17/C	LLW/R	~ 14.0	~ 21.0	103.0	206.0	206.0	206.0	0.0	0.0	756.0	756.0
5G18/C	LLW/R	~ 5.0	~ 1.4	0.0	0.0	0.0	0.0	0.0	0.0	6.4	6.4
5G19	LLW/R	~ 4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	1.2
5G20	ILW	12.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	54.0
5G21	ILW	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	22.0
Total ILW		636.7	1.4	2.5	0.0	0.0	0.0	0.0	0.0	640.6	900.7
Total LLW		57.3	238.4	178.0	356.0	356.0	356.0	0.0	0.0	1541.7	1396.9

Note : 5G20 is an unclassified waste stream, but is included in total ILW volumes**.**

5G01 The SGHWR ceased operations in 1990.

5G02 The Alpha Materials Laboratory, A52, is now in care and custody.

5G03 Fuel Pond to be emptied by early 1996. No further arisings.

5G04 PIE operations have now ceased. There are no further committed wastes expected in this stream. Lower end ILW repackaging is now being carried out in A59, together with some post-operation clean out work.

5G05 PIE work has finished. Waste repackaging/resentencing work is being carried out, with the waste being disposed of to Drigg. It is anticipated that active work may continue at Winfrith post-1994 which may generate some ILW, but at present this is uncommitted and cannot be estimated.

5G10 No more sea dump drums are being produced.

5G11 No more sea dump packages are being produced.

5G14 PIE has ended. Bertha waste repackaging is being carried out (see waste stream 5G05).

5G15/C PIE work has finished.

5G16 -

5G17/C -

5G18/C The Alpha Materials Laboratory, A52, is now in care and custody.
5G19 Work associated with this waste stream has now finished.
5G20 Repacking in smaller containers will increase gross volume by about 10%.
5G21 No further arisings expected.

Table A4.5.10c Comments. UKAEA : decommissioning waste at Winfrith

Table A4.5.10a Specific activity, bulk density and conditioning factor. UKAEA : decommissioning waste at Winfrith

Stream Identifier	Title	Waste type	Stock activity Alpha (TBq/m^3)	Stock activity Beta/gamma (TBq/m^3)	Arisings activity Alpha (TBq/m^3)	Arisings activity Beta/gamma (TBq/m^3)	Bulk density (t/m^3)	Conditioning factor
5G301	SGHWR DECOMMISSIONING LLW	LLW	0	0	< 4.80E-12	2.03E-04	* 1.00	~ 0.470
5G302	SGHWR DECOMMISSIONING ILW	ILW	0	0	9.14E-09	1.84E+ 02	* 1.00	2.000
5G303	DRAGON REACTOR DECOMMISSIONING LLW	LLW	0	0	NE	9.80E-04	0.76	0.710
5G304	DRAGON REACTOR DECOMMISSIONING ILW	ILW	0	0	3.10E-02	2.07E+ 00	0.72	1.000
5G305	SGHWR STAGE 1 DECOMMISSIONING LLW	LLW/R	NE	6.80E-05	NE	6.80E-05	~ 1.00	* 1.000
5G306/C	SUPERCOMPACTED SGHWR STAGE 1 DECOMMISSIONING LLW	LLW/R	NE	1.50E-04	NE	1.50E-04	0.84	1.000
5G307	OTHER FACILITIES DECOMMISSIONING LLW	LLW	0	0	NE	NE	1.68	1.000
5G308	OTHER FACILITIES DECOMMISSIONING ILW	ILW	0	0	NE	NE	0.58	1.000

Table A4.5.10b Stocks and arisings volumes (m^3). UKAEA : decommissioning waste at Winfrith

Stream Identifier	Waste type	Stocks at 1.4.1994	Arisings as stored 1994	1995-1999	2000-2009	2010-2019	2020-2029	2030-2059	Post-2060	Total As stored	Total Conditioned
5G301	LLW	0.0	0.0	2120.0	250.0	250.0	6900.0	* 11418.0	* 0.0	20938.0	9840.9
5G302	ILW	0.0	0.0	19.0	0.0	0.0	0.0	* 126.5	* 0.0	145.5	291.0
5G303	LLW	0.0	0.0	0.0	0.0	0.0	1678.0	0.0	0.0	1678.0	1191.4
5G304	ILW	0.0	0.0	0.0	0.0	0.0	58.0	0.0	0.0	58.0	58.0
5G305	LLW/R	~ 5.0	~ 50.0	~ 40.0	0.0	0.0	0.0	0.0	0.0	95.0	95.0
5G306/C	LLW/R	~ 51.0	~ 93.0	~ 71.0	0.0	0.0	0.0	0.0	0.0	215.0	215.0
5G307	LLW	0.0	0.0	205.0	92.0	1220.0	1171.0	74.0	0.0	2762.0	2762.0
5G308	ILW	0.0	0.0	33.0	46.0	0.0	107.0	0.0	0.0	186.0	186.0
Total ILW		0.0	0.0	52.0	46.0	0.0	165.0	126.5	0.0	389.5	535.0
Total LLW		56.0	143.0	2436.0	342.0	1470.0	9749.0	11492.0	0.0	25688.0	14104.2

5G301 Volumes are given for raw waste from stages 1, 2 and 3 decommissioning. Stage 1 started in 1990, care and maintenance 2000-2024, Stage 2 2025-2027. Stage 3 wastes will arise after 2030.

5G302 Volumes given are for raw waste from Stages 1, 2 and 3 decommissioning. Stage 1 started in 1990, care and maintenance 2000-2024, Stage 2 2025-2027. Stage 3 wastes will arise after 2030.

5G303 Volumes given are for raw waste. Stage 1 completed, Stage 2 starts 2020, Stage 3 continues immediately after Stage 3 and is intended to be completed by 2029.

5G304 Volumes given are for raw waste. Stage 1 completed, Stage 2 starts 2020, Stage 3 continues immediately after Stage 2 and is intended to be completed by 2029.

5G305 Current arisings will cease in 1996 as SGHWR goes into care and maintenance.

5G306/C Current arisings will cease in 1996 as SGHWR goes into care and maintenance.

5G307 -

5G308 -

Table A4.5.5c Comments. UKAEA : operational waste at Culham (JET)

Table A4.5.5a Specific activity, bulk density and conditioning factor. UKAEA : operational waste at Culham (JET)

Stream Identifier	Title	Waste type	Stock activity Alpha (TBq/m^3)	Stock activity Beta/gamma (TBq/m^3)	Arisings activity Alpha (TBq/m^3)	Arisings activity Beta/gamma (TBq/m^3)	Bulk density (t/m^3)	Conditioning factor
5H01	ILW REDUNDANT COMPONENTS FROM D-D OPERATIONS	ILW	0	0	0	NE	1.00	1.000
5H02	SOFT TRASH FROM D-D OPERATIONS	LLW/R	0	* < 1.20E-04	0	* < 1.20E-04	~ 0.50	0.480
5H03	ILW WASTE FROM D-T OPERATIONS	ILW	0	0	0	NE	< 1.00	1.000
5H04	SOFT LLW WASTE FROM D-T OPERATIONS	LLW/R	0	0	0	* < 1.20E-04	~ 0.50	0.480
5H05	LLW REDUNDANT COMPONENTS FROM D-D OPERATIONS	LLW/R	0	* < 2.00E-03	0	* < 2.00E-03	1.08	1.000

Table A4.5.5b Stocks and arisings volumes (m^3).UKAEA : operational waste at Culham (JET)

Stream Identifier	Waste type	Stocks at 1.4.1994	Arisings as stored 1994	1995-1999	2000-2009	2010-2019	2020-2029	2030-2059	Post-2060	Total As stored	Total Conditioned
5H01	ILW	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0
5H02	LLW/R	~ 17.0	~ 20.0	3.0	0.0	0.0	0.0	0.0	0.0	40.0	19.2
5H03	ILW	0.0	0.0	< 150.0	0.0	0.0	0.0	0.0	0.0	150.0	150.0
5H04	LLW/R	0.0	0.0	< 3.0	0.0	0.0	0.0	0.0	0.0	3.0	1.4
5H05	LLW/R	14.3	2.0	7.0	0.0	0.0	0.0	0.0	0.0	23.3	23.3
Total ILW		0.0	0.0	153.0	0.0	0.0	0.0	0.0	0.0	153.0	153.0
Total LLW		31.3	22.0	13.0	0.0	0.0	0.0	0.0	0.0	66.3	43.9

5H01 Arisings based upon phases of JET experiment. Highest arisings occur during shutdowns.

5H02 Arisings based on phases of JET experiment. Highest arisings occur during shutdowns. Volumes are for compacted waste.

5H03 -

5H04 -

5H05 Arisings based upon phases of JET experiment. Highest arisings occur during shutdowns.

Table A4.5.11c Comments. UKAEA : decommissioning waste at Culham (JET)

Table A4.5.11a Specific activity, bulk density and conditioning factor. UKAEA : decommissioning waste at Culham (JET)

Stream Identifier	Title	Waste type	Stock activity Alpha (TBq/m^3)	Stock activity Beta/gamma (TBq/m^3)	Arisings activity Alpha (TBq/m^3)	Arisings activity Beta/gamma (TBq/m^3)	Bulk density (t/m^3)	Conditioning factor
5H301	JET DECOMMISSIONING TRITIATED ILW	ILW	0	0	NE	~ 9.80E+ 02	2.80	~ 1.000
5H302	JET DECOMMISSIONING TRITIATED LLW	LLW/UDG	0	0	NE	1.20E-04	1.00	1.000
5H303	JET DECOMMISSIONING NON-TRITIATED ILW	ILW	0	0	NE	3.60E+ 00	3.00	1.000
5H304	JET DECOMMISSIONING NON-TRITIATED LLW	LLW	0	0	0	3.20E-02	4.00	1.000
5H305	JET DECOMMISSIONING LLW CONCRETE	LLW	0	0	NE	1.47E-04	1.92	* 1.000

Table A4.5.11b Stocks and arisings volumes (m^3). UKAEA : decommissioning waste at Culham (JET)

Stream Identifier	Waste type	Stocks at 1.4.1994	Arisings as stored 1994	1995-1999	2000-2009	2010-2019	2020-2029	2030-2059	Post-2060	Total As stored	Total Conditioned
5H301	ILW	0.0	0.0	0.0	400.0	0.0	0.0	0.0	0.0	400.0	400.0
5H302	LLW/UDG	0.0	0.0	0.0	~ 400.0	0.0	0.0	0.0	0.0	400.0	400.0
5H303	ILW	0.0	0.0	0.0	250.0	0.0	0.0	0.0	0.0	250.0	250.0
5H304	LLW	0.0	0.0	0.0	6000.0	0.0	0.0	0.0	0.0	6000.0	6000.0
5H305	LLW	0.0	0.0	0.0	0.0	10000.0	0.0	0.0	0.0	10000.0	10000.0
Total ILW		0.0	0.0	0.0	1300.0	0.0	0.0	0.0	0.0	1300.0	1300.0
Total LLW		0.0	0.0	0.0	6400.0	10000.0	0.0	0.0	0.0	16400.0	16400.0

5H301 Decommissioning starts either 2005 or 2008, depending on handover date of JET, 1996 or 1999.
5H302 Decommissioning starts either 2005 or 2008, depending on handover date of JET; 1996 or 1999.
5H303 Waste arisings from decommissioning starting in 2005 or 2008 depending on handover date of JET; 1996 or 1999.
5H304 Waste arisings from decommissioning starting in 2005 or 2008 depending on handover date of JET; 1996 or 1999.
5H305 Waste arisings from decommissioning starting in 2013 or 2015 depending on handover date of JET; 1996 or 1999.

Appendix 2: Extracts from the NII's Report on ILW Storage

INTERMEDIATE LEVEL RADIOACTIVE WASTE STORAGE IN THE UK:

A review by HM Nuclear Installations Inspectorate

November 1998

INTRODUCTION

This review was initiated by HSE following the Secretary of State's decision to uphold Cumbria County Council's refusal to grant planning permission for an underground rock characterisation facility near Sellafield. That decision effectively delayed the availability of any future disposal facility for intermediate level radioactive waste (ILW). HSE needed to have a clear understanding of the effect of such a delay on the safety of stored ILW.

Over the years we have been increasingly concerned about the storage conditions of ILW on many nuclear licensed sites. Current arrangements were accepted on the assumption that a disposal facility would be available by 2012. The past policy (up to 1995) of not foreclosing options (unless there were strong safety reasons for doing so) has meant that large quantities of ILW have been stored in a raw (unconditioned) form. Whilst the problem mostly affects the nuclear chemical plant sites such as Sellafield, nuclear power stations also store substantial quantities of raw ILW. In raw form, much of this ILW is potentially mobile and hence presents a greater hazard than when it is conditioned to provide passive storage. The purpose of waste conditioning is to immobilise radioactivity so that only minimal human intervention is required to ensure safety during the storage period. The oldest ILW, often labelled "legacy waste", was produced when the defence related pressures of production meant that ILW was simply accumulated as it arose with little attention paid to segregation or retrieval; this philosophy and practice continued into the civil nuclear power programme. We would like to see all licensees conditioning radioactive waste for passive storage and moving away from the storage of potentially mobile waste. We have been pressing them to do this, and have consulted the environment agencies to ensure that all aspects of government policy relating to radioactive waste management are satisfied.

Although the situation is generally under control at the present time, there is a considerable legacy from the past. Many of the facilities that have been used to store ILW do not meet modern standards. Some areas are of immediate concern and are being dealt with by licensees. This report identifies the critical areas where the storage of raw ILW needs improvement and comments upon the new facilities that will be required if a disposal route continues to be delayed.

SCOPE OF THE REVIEW

This review considers ILW stored on licensed nuclear sites from all operations to date, and that predicted to be generated in the future. Any reference to waste in this report means intermediate level radioactive waste. This report does not consider High Level (heat generating) Waste arising from reprocessing of spent fuel, which has a separate management programme, those wastes generated during the later stages of deferred decommissioning programmes, nor Low Level Waste which has a current disposal route.

We have assumed, possibly conservatively, that the typical life of a modern waste store is 50 years. The lives of stores built to previous standards may be shorter. Stores on licensed nuclear sites are subject to periodic review to justify their continued use and should there be a deterioration safety will give sufficient time for replacement stores to be constructed. We believe it is unlikely that even the most modern store would remain usable for as long as 100 years without considerable maintenance or refurbishment.

Prior to the delay in the provision of a repository, most licensees' radioactive waste management strategies were based, at least in part, on raw waste storage followed by waste conditioning and direct disposal to avoid the need for additional surface stores. This review has considered how such strategies are affected by the now inevitable delay in providing a repository. Where we consider that as a consequence of the delay additional surface storage is required, we have detailed our expectations under the annexes dealing with individual licensees. We have made the working assumption that for major radioactive waste producers, new stores will be built at the site where the ILW originates, though this does not preclude other options.

MAIN FINDINGS

The detailed annexes that follow contain discussions on the current position and safety priorities for each major licensee and their sites. The tables at the end of each annexe present details of ILW volumes, types, locations, processing routes and likely dates. Our main findings for each licensee are summarised below:-

United Kingdom Atomic Energy Authority (UKAEA)

Virtually all the ILW stored on UKAEA sites is in raw form; the exception is some waste at Dounreay where UKAEA has recently started to encapsulate Materials Test Reactor (MTR) raffinates.

For Dounreay a new store for solid ILW, including waste retrieved from the Silo and Shaft will be required. Harwell and Winfrith each have unused ILW stores which will be used for solid ILW and cemented sludges. A new store for solid ILW from the reworking of the sea-disposal drums at Harwell and Winfrith will be needed, and UKAEA plans to construct this at Harwell. If the UKAEA's plan to transfer its plutonium contaminated material (PCM) to BNFL at Sellafield is not realised, then the Authority will, in our view, need to construct conditioning plants and stores for PCM at one or more of its own sites.

Atomic Weapons Establishment (Hunting Brae).

Solids and sludges are stored at Aldermaston. The solid ILW store structures may be suitable for a further 25 years. However, the ILW has not been conditioned for long term storage. Hunting-Brae needs to develop its plans to condition and reduce the volume of its solid wastes. More waste stores will be needed by 2005 if volume reduction is not carried out. Sludges are stored in unsuitable facilities of uncertain structural condition. Hunting-Brae need to ensure that a sludge treatment facility is fully operational by the end of 2002 and that a new store provided for this waste.

Other sites.
The Dockyard sites and Nycomed Amersham plc have only small amounts of ILW to consider and have appropriate facilities and strategies, including waste conditioning where appropriate, for dealing with it. Other UK licensed sites which are not detailed in this summary do not hold significant quantities of ILW and would, we expect, deal with any ILW through the facilities of larger operators.

CONCLUSIONS

The delay in providing a final disposal repository will not cause any immediate safety problems for ILW storage. However, up to 20 stores will be required for the wastes currently accumulated on all major licensed sites if an operating repository is not available within the next 15-20 years.

A delay extending beyond 50 years will require a programme of store replacements or refurbishments in addition to the 20 referred to above. There may also be a need for additional handling and repackaging of wastes which would be avoided if a repository were available.

Waste Management strategies which defer the retrieval and conditioning of raw wastes pending the early availability of a repository need to be reconsidered as they may no longer be tenable. There are now safety benefits to be gained from retrieving and conditioning these wastes into a passive safe form using standardised packaging suitable for long term storage and eventual disposal (The Inspectorate, in agreement with the major licensees, is anxious to avoid the proliferation of non-standard designs of waste packages which would complicate the solution of designing a suitable disposal route).

ANNEXE 4, UNITED KINGDOM ATOMIC ENERGY AUTHORITY (UKAEA)

UKAEA stores ILW at four sites in the United Kingdom. These wastes consist of a wide range of materials. Table 4 provides a summary of the wastes and waste stores. Two additional stores will be required as a result of the delay to the disposal facility for Intermediate Level Radioactive Waste, one at Dounreay and the other at Harwell.

Dounreay

Liquid ILW wastes are stored in building D1208 and comprise acidic raffinates (by far the largest volume), floc slurries and solvents arising from the reprocessing of fuel. The raffinates are in 15 stainless steel tanks, some dating back to the 1950s, and although inspection of these tanks is not easy, recent measurements of the tank wall thickness indicate they are still in good condition. There are, however, signs of deterioration in the wall of one of the cells housing the tanks. The ILW raffinates are being encapsulated and stored in the Dounreay Cementation Plant (DCP), and UKAEA estimates that this will take until 2012 to complete. We consider that the position with the raffinates is adequate provided there are no delays in the cementation programme, and no further deterioration of the storage facilities. The flocs are stored in three tanks. One of the older tanks has developed a small leak. The UKAEA is reviewing the options for processing the floc. The current plan is to convert it to a form suitable for encapsulation in the DCP when the raffinate campaign is completed, although a delay to 2012 may not be acceptable. The UKAEA's strategy for solvents is incineration; a new plant and discharge authorisation from SEPA will be needed for this.

PCM is stored loose in drums (mostly galvanised) in an engineered store, D9867. We consider these storage arrangements are adequate in the short term. UKAEA is planning to send this waste to BNFL, Sellafield for processing and long term storage, although no contract has been agreed. If this route does not become available, the UKAEA may have to construct its own encapsulation plant and store.

Solid ILW is stored under water in the Shaft and Wet Silo. UKAEA accepts that these facilities are not adequate and is planning to retrieve, condition and store the waste. The Authority intends the Waste Treatment Plant and store to be available for Shaft wastes in 2014, Wet Silo wastes in 2019, and other wastes in 2024. We consider that UKAEA should construct this plant and empty the Shaft and Silo as soon as is reasonably practicable. We note that UKAEA is reviewing these dates in response to our audit of Dounreay and believes that the forecast dates are likely to be brought forward. Solid ILW is stored in drums in D9875 and the Dounreay Cementation Plant. These arrangements are satisfactory in the short term. UKAEA intends to process and store these wastes in the proposed Waste Treatment Plant.

A significant amount of operational ILW has accumulated in temporary 'storage' across the site. While the UKAEA is developing improved waste handling facilities to support post operational clean out (POCO) and decommissioning of the site, it should be able to transfer much of this operational waste to existing suitable stores. We consider that UKAEA should carry out this work as soon as is reasonably practicable.

Harwell

There are some ILW liquids and sludges stored in old but inspectable tanks. UKAEA is to condition these wastes by encapsulation and store them in the new vault store (B462.27).

Solid ILW is stored in three stores in the B462 complex. This waste is in cans in a series of vertical tubes in a concrete slab. Two of the stores are nearly 40 years old (although they were refurbished in 1993) and some of the older waste cans may be wet and deteriorating with age. The third store is relatively modern. UKAEA intends to start the retrieval of this waste in the near future but it could take 15 years to empty these stores. The waste is to be sorted in B462.27, and the solid ILW will be stored in that building's vault store. UKAEA needs to grout this waste for long term storage, and hence will have to construct a cementation plant. There is also some solid ILW in two buffer stores which UKAEA intends to transfer to B462.27 for processing and long-term storage.

PCM is stored in a modern engineered facility, B462.23. Loose waste is stored in drums (mostly galvanised) on racks. There is also some PCM in two buffer stores, and PCM arising from post operation clean out of the chemistry building, B220, is to be stored in that building. We consider these storage arrangements are acceptable in the short term. UKAEA plans to transfer this waste to Sellafield but will have to make alternative arrangements if this is not possible.

There are over 3000 sea disposal packages at Harwell. They are in a conventional agricultural- style open-sided building, but as the packages themselves are robust, we believe the storage arrangements are adequate in the short term. UKAEA intends to sort this waste, and encapsulate and store the ILW component, in a facility which has yet to be constructed, by 2010.

Winfrith

Sludges from the Steam Generating Heavy Water Reactor (SGHWR) are stored in three tanks (plus one held as a spare). UKAEA intends to condition these sludges by encapsulation within 10 years, and store the product in an existing but unused ILW store. Reactor hardware waste is stored in mortuary holes in SGHWR. UKAEA proposes leaving it there until later stages of decommissioning, but as with the power reactor sites, a robust safety case will be required to justify any deferral in the recovery and conditioning of these wastes.

(at Winfrith) Solid ILW is stored in three buildings. This waste is to be transferred to the B462.27 facility at Harwell in the near future. Sea disposal drums (289) are stored in similar fashion to those at Harwell, and it is UKAEA's intention to process these, with the Harwell drums, by 2010. PCM is stored in the Fissile Materials Store. UKAEA hopes to transfer this waste to Sellafield if this can be agreed, although some interim storage at Harwell may be necessary. The storage arrangements for these three types of waste are therefore only needed for the short-term and are generally adequate.

TABLE 4, UKAEA

Waste type	Facility	Type code	Is waste suitable for long-term storage ?	Conditioning facility required ?	New store required ?	Date store required (UKAEA planning)
HARWELL						
Liquid, sludges	B336.10A	F	No	Yes	No, B462.27	available
Solid	B462.2, B462.9, B462.26	G	No	Yes	No, B462.27	available

Waste type	Facility	Type code	Is waste suitable for long-term storage ?	Conditioning facility required ?	New store required ?	Date store required (UKAEA planning)
Solid	B462.20, B528.4	H	No	Yes	No, B462.27	available
PCM	B462.23	B	No	UKAEA plans to move this waste to BNFL starting 2005 but route is not certain		
PCM	B220, B462.20, B528.4	C, H	No	UKAEA plans to move this waste to BNFL starting 2005 but route is not certain		
Sea-disposal packages	B462.19	A	No	Yes	Yes	2010
WINFRITH						
Sludges	SGHWR	F	No	Yes	No, unused store available	2006
Solid	SGHWR	G	No	To be processed with SGHWR Stage 2 decommissioning waste, starting 2025		
Solid	A59 Active Handling Building	H	No	To be transferred to B462.27, Harwell		
Solid	A58.1	A	No	To be repacked in A59 before transfer to Harwell		
Solid	A58.4	B	No	To be transferred to B462.27, Harwell		
Sea-disposal packages	A58.1	A	No	To be stored at Harwell, following sorting/ conditioning, starting 2002		
PCM	Fissile materials store	B	No	UKAEA plans to move this waste to BNFL starting 2005 but route is not certain		
KEY TO STORE TYPE CODE: A: Non-engineered facilities, B: Engineered Stores (box and/or drums), C: Non-engineered drum storage, D: Pond storage,			E: Vaults and silos, F: ILW tanks, G: Mortuary Stores, H: Miscellaneous Stores			

ANNEXE 5 HUNTING BRAE (AWE)

Hunting-Brae Ltd has operated the sites at Aldermaston, Burghfield, on behalf of the Ministry of Defence since 1993. In July 1997 HSE licensed the Aldermaston and Burghfield sites under the Nuclear Installations Act 1965 (as amended). Operational ILW does not arise at Burghfield. The remainder of this annexe therefore refers exclusively to waste management at Aldermaston. The waste stores are summarised in Table 5. Although a new store is required at Aldermaston, this arises for operational safety reasons and not as a result of the delayed availability of a disposal facility for ILW.

Intermediate level waste

A number of different types of ILW arise from Hunting-Brae's operations. The main sources are:

- drummed ILW (PCM, tritium contaminated waste, etc);
- sludges recovered from liquid effluent cleanup operations;
- sea dump packages;
- crated gloveboxes; and,
- decommissioning wastes.

Solid waste storage

We accept that the stores built at Aldermaston since the mid 1980s were designed with a minimum life of 25 years, and consider that with appropriate inspection and maintenance this lifetime could be extended (subject to periodic safety review) by 15-25 years.

Sludge storage

We are concerned at the uncertain structural condition of the sludge tanks. The waste is not stored in a passive safe state and is potentially highly mobile. The tanks were not designed for their current function. Hunting-Brae has been told of our concerns and we expect it to prepare plans, as a matter of urgency, to retrieve the stored sludge and process it to a passive state.

Specific comments on waste storage facilities

Aldermaston has six modern stores built since the mid 1980s, of factory unit style construction, which are considered suitable for continued storage of the site's ILW. They have a design life of 25 years and, subject to appropriate maintenance and periodic reviews of their safety cases, could have their lives extended for up to an additional 25 years. The stores contain: drummed PCM materials; sea dump packages; crated glove boxes and small quantities of other miscellaneous waste. The majority of these wastes are eventually going to be conditioned for disposal.

Two stores, of brick construction, have been converted from 1950s vintage laboratories. These are not considered suitable for the long term storage of ILW. They are planned to be emptied by the end of 1999 into the existing modern stores. They contain drummed PCM.

One store, of brick construction, that was purpose built in the 1970s, is not considered suitable for the long term storage of ILW. This is planned to be emptied by the end of 2002 into the existing modern stores. This store contains drummed PCM.

Sludges are held above ground in the open in a number of rubber lined steel tanks. They are surrounded by bunds so any leakage would be contained. They are not considered suitable for the storage of ILW. Hunting-Brae's current plan is to complete a dedicated treatment plant for conditioning these sludges by the end of 2002. The sludges will then be converted to a solid form.

TABLE 5, HUNTING-BRAE (AWE)

Store	Waste type and current waste volumes	Is waste conditioned for long term storage?	Is a conditioning facility required?	Is a new store required?	Dates for conditioning and provision of store
Modern purpose-built store	41 gloveboxes of various sizes	No	Yes. The gloveboxes may be returned to the on-site producers.	Depends if the existing store could be used for conditioned waste.	No date has been set for conditioning these gloveboxes
Storage tanks	761 cubic metres of sludge in steel tanks.	No	Yes. Programme is to provide an operational facility by 2002.	Yes for the conditioned waste.	Needed for start of conditioning in 2002.
Waste Management Complex	25 large wrapped items. 10 Acitainers 8 Mercury packages	No	Small quantities of waste / could be conditioned individually	Depends if an existing store could be used for conditioned waste.	No date has been set for conditioning these items
Two converted laboratories of 1950's origin.	A total of 1511 100 litre drums containing PCM	No.	Yes. This is required for all PCM drums.	No in short term. Waste to be moved to modern stores. See comments on modern stores.	Waste to be moved to a modern store by the end of 1999
	A total of 251 200 litre drums containing PCM				
One old purpose-built store	A total of 2162 100 litre drums containing PCM	No.	Yes. This is required for all PCM drums.		Waste to be moved to a modern store by the end of 2002
	6 miscellaneous items	No	Small quantity of waste that could be conditioned individually		Waste to be moved to a modern store by the end of 2002
Five modern purpose- built stores	A total of 7616 200 litre drums containing PCM	No.	Yes. This is required for all PCM drums.	Depends if the existing store could be used for conditioned waste. However, without conditioning more waste stores will be needed in the next 5-10 years.	Conditioning will need to start if more stores for raw waste are not to be built.

Store	Waste type and current waste volumes	Is waste conditioned for long term storage?	Is a conditioning facility required?	Is a new store required?	Dates for conditioning and provision of store
	A total of 396 400 litre drums containing PCM	No.	Yes. This is required for all PCM drums.		
	A total of 732 sea dump packages containing 200 litre drums	No.	Yes. Packages need to be emptied & contents re-packaged		
	225 filters 7 miscellaneous items 49 containers of oil 4 Source containers 3 containing mercury packages				

References

[1] The main one, which continues to be referenced, is '*Radiation Doses to Members of the Public around AWRE Aldermaston, ROF Burghfield and AERE Harwell*', NRPB-R202, National Radiological Protection Board 1987.

[2] '*An Investigation of Off-Site Radiation Levels at Harwell and Rutherford Appleton Laboratory Following Air-borne Gamma Spectrometry in 1996 - Final Report*', Scottish Universities Research and reactor Centre, January 1998.

[3] '*Radioactive Substances Act 1993: Decision on Applications by AEA Technology plc to Dispose of Radioactive Wastes From… Premises on the Harwell Site, Didcot, Oxfordshire*', Environment Agency 1996.

[4] '*Environment Agency Receives Applications From UK Atomic Energy Authority*', Environment Agency News Release 12/99, 29th Jan. 1999

[5] This took place in March 1994, chaired by Helena Kennedy QC. The report of the proceeding is available from Reading Borough Council.

[6] COMARE - Committee on the Medical Aspects of Radiation in the Environment

[7] See '*Childhood Leukaemia and Radioactive Pollution from the Atomic Weapons Facilities at Aldermaston and Burghfield in West Berkshire*', Chris Busby PhD, Green audit Occasional Papers 98/1, January 1998.

[8] I prepared a detailed report - '*Response to Safeguard International's Environmental Statement on the Culham Radioactive Waste Transfer Station*' (Nov. '95) - on the development proposal, considering the safety aspects and the legal basis for permitting the development, on behalf of Culham, Clifton Hampden, Dorchester, Kennington, Long Wittenham, Nuneham Courtenay, Radley and Sutton Courtenay

[9] The UK Radioactive Waste Inventory is compiled by Electrowatt Ltd on behalf of UK Nirex. The latest edition, compiled to the year 1994, was produced in 1997. For more details contact: EWI, Electrowatt House, North Street, Horsham, West Sussex, RH12 1RF

[10] '*Intermediate Level Radioactive Waste Storage In The UK: A review by HM Nuclear Installations Inspectorate*', Health and Safety Executive Nuclear Safety Division, November 1998

[11] '*Safe Store for Nuclear Waste*', UKAEA News Release 99/05, 10th February 1999.

[12] '*Modern Local Government In Touch with the People*', Department of the Environment, Transport and the Regions, July 1998

