

**Dounreay Solid Low Level Radioactive Waste
OVERALL STRATEGY**

**UKAEA, Dounreay
Thurso, Caithness, UK.
KW14 7TZ**

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Author	Endorsed	Approved
David Broughton Manager, LLW Strategy – Dounreay <i>Senior Project Manager</i>	Doug Graham Dounreay Strategy Manager	Simon Middlemas New Build Group Manager <i>Project Sponsor</i>
Signature David Broughton	Signature Doug Graham	Signature Simon Middlemas
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Context

- C1. This top level document sets out UKAEA's proposed overall strategy for managing Dounreay's solid low level radioactive waste. It describes both short and long term strategies and the ways in which to implement them. All the relevant issues are brought together to produce an overall balanced strategy.
- C2. The audience for this document is the group of UKAEA managers, regulators, government sponsors and stakeholders who have been involved during the past few years in this strategy development and the Best Practicable Environmental Option study that was carried out for the long term solutions.
- C3. From 1st April 2005 the Nuclear Decommissioning Authority (NDA) will be responsible for managing the UK nuclear decommissioning programme. From 1st April 2005 UKAEA will carry out an agreed programme of work at Dounreay under contract to NDA. The early stages to implement this overall strategy for managing Dounreay's solid low level radioactive waste are anticipated to be included in the contract. All material produced by UKAEA in implementing the strategy will be owned by NDA.
- C4. This Overall Strategy is *the* key overarching document. It is supported by a Best Practicable Environmental Option (BPEO) Study which was carried out by UKAEA and its consultants. It is fully documented in the Best Practicable Environmental Option Study Final Report [GNGL(04)TR75 April 2004]. All the material produced in the BPEO Study is available to NDA, the regulators and the general public.

The BPEO Study was carried out from 2000 to 2003 during which period the site restoration programme stretched until 2060. The Overall Strategy has been developed in the period when the site restoration programme has been restructured to be complete in 2036. This has not affected the conclusions but BPEO Study dates and timescales, although now superceded, have been left unchanged so that the BPEO Study report and its supporting technical studies' reports are consistent and correctly represent the situation as at April 2004.

Executive Summary

- E1. During the next thirty years the Dounreay nuclear site is being decommissioned and its environment restored. This work could produce between 64,000m³ and 109,000m³ of new arisings of solid low level radioactive waste in addition to the 33,000m³ that is already disposed of in an existing authorised disposal facility on the site, and which is now full.
- E2. UKAEA proposes to dispose of the solid low level radioactive waste (LLW) arising from site restoration at Dounreay at BNFL's LLW disposal facility at Drigg in Cumbria, if an authorisation is granted by SEPA, until a new LLW disposal facility is available at Dounreay. In the long term construction and operation of a new LLW disposal facility at Dounreay for Dounreay LLW has been identified through a comprehensive study to be the Best Practicable Environmental Option (BPEO).
- E3. UKAEA proposes to store the low active / high volume demolition solid radioactive waste (LA/HV) at Dounreay until a new LA/HV disposal facility is available at Dounreay. Construction and operation of a new LA/HV disposal facility at Dounreay for Dounreay LA/HV has also been identified to be the Best Practicable Environmental Option. Any disposal of this category of waste, even in the short term, at BNFL's LLW disposal facility at Drigg is not considered to be an efficient use of that important resource.

- E4. There are reviews in progress at UK national level of current and future radioactive waste management arrangements and disposal facilities. The outcomes from these could affect the strategy for Dounreay's solid low level radioactive waste. Also if an authorisation to dispose of LLW at Drigg is granted by SEPA it may include conditions which influence the strategy. For these reasons a staged decision making process and programme is necessary for implementing and adjusting the strategy.
- E5. The staged decision making process and programme are supported by NDA and the regulators. Hold points for NDA to review both national and Dounreay strategy developments have been identified. Decisions can be taken by NDA at these points with advice from regulators and Scottish Executive. This creates sufficient flexibility for NDA to allow UKAEA to progress with the first stages of the long term solutions.
- E6. The long term management arrangements for Dounreay's existing authorised LLW disposal facility, which is now full, will be determined by building on the work carried out in the BPEO Study and completing a Post Closure Safety Case (PCSC). The PCSC will be assessed by SEPA. Whether the waste already disposed of can remain there safely and indefinitely, or whether it requires retrieval and re-disposal could have an impact on the long term strategy decisions.
- E7. The proposed programme is to produce comprehensive planning applications, safety and environmental submissions by the end March 2006. During the period April 2006 to March 2008 NDA will be able to decide on the actual scope of the submission it considers is required and ultimately the scope of the actual facilities to be constructed. It is anticipated that construction of the first disposal vaults would be started in 2008 and completed in 2011.
- E8. After site restoration is completed and all disposals finished the LLW and LA/HV disposal facilities would be permanently capped off around 2035. Assessments carried out in the BPEO Study indicate that the closed facilities would present no danger to future generations or the environment. The possible yearly radiological exposure to a member of a critical group¹ was assessed to be around one five hundredth of natural background radiation or one quarter of the level associated with a "one in a million risk".

¹ A group of people assumed to be most affected by the facility by reason of the its habitat and lifestyle.

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Introduction

1. UKAEA is carrying out an environmental site restoration programme at its Dounreay nuclear licensed site in Caithness in the north of Scotland. Dounreay was the UK's former Fast Reactor experimental facilities site. This programme could take around thirty years to complete during which around 150,000m³ of treated and packaged solid low level radioactive waste could be produced. This waste must be managed within UK National and Scottish radioactive waste policy and in accordance with safety and environmental regulations. This document sets out UKAEA's overall strategy for managing the solid radioactive low level waste that has already been produced, and that which will arise in the future at Dounreay.
2. The strategy has evolved from technical investigation by UKAEA and its consultants², and discussions with regulators and stakeholders. An overall perspective is presented which sets out the relationship between the short and long term elements of strategy.
3. Throughout this document solid radioactive low level waste is considered in two categories:
 - i. the UKAEA defined category of low activity / high volume demolition waste (LA/HV) in which the radioactivity content is > 0.4Bq/gm total manmade radioactivity, <40Bq/gm beta,gamma and < 1Bq/gm alpha.
in this document the abbreviation LA/HV is used for non putrescent radioactive concrete, rubble, steelwork and soil waste arising from demolition of nuclear facilities and which contains very low levels of radioactivity. It presents a very low risk and can be managed in ways similar to ordinary industrial and waste management practices.
 - ii. the UK national category of normal operational and decommissioning low level waste (LLW) defined in Cm 2919 in which the radioactivity content is >0.4Bq/gm total manmade radioactivity, <12GBq/tonne beta/gamma and <4GBq/tonne alpha
in this document the abbreviation LLW is used for radioactive operational and decommissioning waste above the LA/HV limit but within the UK national limit³. It presents a low risk and is easily managed through controlled and contained manual and automated processes.
4. UKAEA estimates that between 38,000m³ and 64,000m³ (*packaged volume*) of LLW, and between 26,000m³ and 45,000m³ (*packaged volume*) of LA/HV will be produced during site restoration in addition to the 33,000m³ that has already been disposed of in the existing authorised facility. A description of the size of these waste volumes and possible facilities is given in Appendix 1.

² Galson Sciences Ltd., Enviros, Quintessa Ltd., Babbie Group, NNC, Morton Fraser

³ To be strictly correct the nationally accepted term "LLW" covers the whole range including LA/HV but for clarity in this document the abbreviations LLW and LA/HV are treated as separate waste categories

Background

5. Unlike most other nuclear sites, which dispose of their LLW at BNFL's disposal facility at Drigg in Cumbria, Dounreay has always operated its own authorised LLW disposal facility. The facility, consisting of six shallow trenches, has been used over the past forty years to dispose of around 33,000m³ of Dounreay's LLW. This facility is now full. The facility with its covers and temporary caps is shown in Figure 1. Also shown are two buildings on top of pits 3 and 4 that are used for temporary storage of LLW prior to processing and disposal.



Figure 1. The existing Dounreay LLW disposal facility

6. During the early 1990s UKAEA obtained planning permission from Highland Council for a small extension to the existing disposal facility but decided not to implement this development as it would not provide a long term solution. UKAEA felt that further work on long term planning and environmental issues was required. At that time, DTI did not wish UKAEA to investigate the feasibility of sending Dounreay LLW to Drigg, although inter-site transfer authorisations were in place⁴.
7. Consequently it was recognised that interim arrangements were needed to deal with the continuous arisings of LLW. An interim LLW store was created by modifying an existing warehouse building DN016, locally known as Whatling's Hangar. At present Whatling's Hangar remains as UKAEA's principal facility at Dounreay for storing LLW on an interim basis. This is shown in Figure 2.



Figure 2. Whatling's Hangar

The 1998 Safety Audit

8. During June 1998 NII and SEPA carried out a joint safety audit of Dounreay [1]. The recommendations on the management of low level radioactive waste were:

⁴ from 1972 until 1999

- i. R78 – UKAEA, as a matter of urgency, should institute effective waste minimisation and volume reduction measures for low level waste.
 - ii. R79 – UKAEA, as a matter of urgency should either install a new incinerator for combustible low level waste or find alternative methods for treatment, storage, and disposal of these wastes.
 - iii. R80 – UKAEA, as a matter of urgency should review its capabilities and options for the storage and disposal of low level waste
 - iv. R81 – UKAEA should develop and implement a strategy for the treatment and disposal of “very low radioactive material”.
9. UKAEA responded in November 1998 [2]. The actions directly relevant to LLW strategy in the response were:
- i. R78 – Consideration to be given to physical changes to the controlled areas at Dounreay to minimise the generation of unnecessary LLW.
 - ii. R79 – Options are to construct a new incinerator or manage combustible waste via the non-combustible route.
 - iii. R80 – A new LLW facility for all Dounreay’s LLW will be progressed. In the meantime interim suitable storage will be provided. Drigg LLW conditions for acceptance will be adopted at Dounreay to keep open the option of an alternative route if required.
 - iv. R81 - VLRM⁵ will be disposed in the new facility and stored in the interim in an existing facility. UKAEA will submit a definition of VLRM to the regulators.

Development of the overall management strategy

10. The development of the overall management strategy was progressed in four principal areas:
- i. Waste minimisation
 - ii. Disposal of Dounreay LLW at Drigg
 - iii. Interim arrangements for LLW and LA/HV management
 - iv. Options for long term LLW and LA/HV management

Waste minimisation

11. Waste minimisation is the top priority in the overall management strategy. It is a UK national principle and leads to efficiencies and cost reductions through the whole of the waste management operations. The necessity to pursue a waste management hierarchy⁶ (seeking beneficial use of materials rather than disposal) and improve waste minimisation will be continuous management activities throughout all phases of site restoration.
12. UKAEA policy at Dounreay is to:
- i. reduce the overall volume of waste produced to the lowest practicable
 - ii. minimise the volume of waste that must be managed as radioactive waste

⁵ Very Low Radioactive Material – An obsolete UKAEA term, waste in this category is now referred to as low activity/ high volume demolition waste (LA/HV)

⁶ SEPA website <http://www.sepa.org.uk/wastemin/yourown/whatis.htm>

- iii. ensure that radioactive waste is appropriately managed within the lowest radiological category possible
13. A facility (DN060), originally used solely for oil industry related decontamination work, is being modified and upgraded to undertake a wider range of decontamination work. Decontamination processes assist in achieving the aims stated above. The other factor taken into account when assessing a decontamination operation is of course cost. The decontamination costs likely to be incurred must be justified by the gain to be achieved by subsequent lower waste management costs and environmental impact.
14. Waste minimisation predictions have been used to assess the possible range in volume of solid low level radioactive waste that will ultimately require management. The minimum volume could be 64,000m³ (maximum waste minimisation and no action on the already disposed waste). The maximum volume could be 175,000m³ (minimum waste minimisation and retrieval of already disposed waste). A table detailing the range is given in Appendix 2. A visual representation is given in Figure 3.

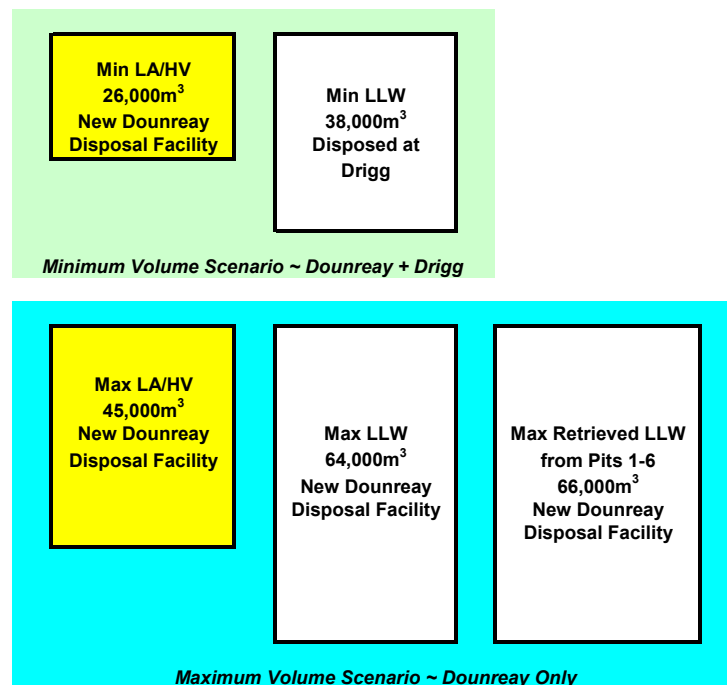


Figure 3. Maximum and minimum volumes

15. There is no economic justification to install a new solid LLW incinerator.⁷ The category of combustible solid LLW has been discontinued and all suitable solid LLW is supercompacted. This decision was actually made before the Safety Audit during the DTI's DRAWMOPS programme in the mid 1990s. Studies carried out then indicated that supercompaction and landfill disposal were more economic and the probability of achieving planning permission for a "nuclear" incinerator were very low.

Disposal of Downreay LLW at Drigg

16. UK national policy [3] is to safely dispose of LLW at appropriate times and in appropriate ways. NII, which regulates the UKAEA's Downreay site, interprets this as LLW should be disposed of as soon as practicable to authorised disposal facilities[4]. As Downreay's

⁷ For liquid low level waste oils and solvents UKAEA proposes building a new incinerator.

disposal facility is now full, NII expects current arisings of LLW to be now disposed of at Drigg. LLW at Dounreay is now categorised and quality assured to be compliant with the current Drigg Conditions for Acceptance (CFA) [5].

17. An application for disposal of Dounreay's LLW at Drigg was made to SEPA in May 2002. The application does not include LA/HV waste. If an authorisation is granted, disposal of LLW at Drigg may eventually become a permanent solution, or other authorised arrangements may be put in place. This is discussed later under long term strategy. The immediate site restoration programme will be severely restricted unless the route to dispose of Dounreay LLW at Drigg is authorised during 2005. Only about eighteen months' temporary storage capacity remains for LLW. If LLW cannot be disposed of at Drigg the storage space it is currently occupying cannot be made available for storing new arisings of LA/HV.
18. If an authorisation is granted UKAEA would begin disposing of operational and decommissioning LLW which conforms to the CFA within two months of receiving the authorisation. This is a condition in NII Consent 63. UKAEA has passed the final audit by BNFL of the current LLW waste management arrangements.
19. The shipments for the first few years will be by road transport. The frequency is estimated to be around one lorry per week. The LLW disposed of at Drigg will be either bulk decommissioning waste in BNFL specification half height ISO transport containers (HHISO) or supercompacted drums of operational or decommissioning waste in HHISOs. Neither form will be grouted at Dounreay, this will be undertaken by BNFL at Drigg. The HHISOs of LLW will be either new arisings or historic waste at present stored in Whatling's Hangar. The amount and origin of the LLW disposed of at Drigg each year will depend on operational programmes at Dounreay and the conditions of the overall contract for disposal that UKAEA has with BNFL.⁸ After the experience of early transfers by road to BNFL the possible use of rail or sea will be reassessed [6]. The latter two transport methods would require marshalling of HHISOs of LLW at Dounreay rather than immediate despatch of individual ones.
20. Although strategy details given later in this paper need to be considered to get a full appreciation of Figure 6, this figure can be useful at this point in setting the Drigg and interim issues in context.

Interim LLW Management arrangements

21. There are two categories of low level radioactive waste that are not normally disposed of at Drigg and these will have to be stored on an interim basis at Dounreay.
22. The first category is the LLW that does not conform to the current Drigg CFA. This is mostly historical waste from oil industry related descaling work and from early fast reactor reprocessing experiments. This will be stored until it can be managed in the longer term. It may be able to be disposed of at Drigg under special arrangements with BNFL⁹. It may also be able to be disposed of in a new Dounreay facility. If it cannot be disposed of in either of these it will be stored pending Ministers' decisions on the recommendations of the Committee on Radioactive Waste Management (CoRWM) for this category of waste.

⁸ There are not individual site contracts with BNFL for the use of Drigg

⁹ BNFL can authorise disposal of LLW outside the CFA after special consideration of the composition of the waste with respect to the total and annual Drigg inventories

23. The second category is the LA/HV. Although this waste is technically within the CFA the UK nuclear industry and BNFL do not consider it is an efficient use of Drigg to dispose of this waste there. UKAEA will store this LA/HV until it can be disposed of in a new LA/HV disposal facility at Dounreay. The historic arisings of this category of waste will remain in Whatling's Hangar and D9935. New arisings can be stored in the space vacated by transfers of LLW to Drigg, if this route is authorised, and in the temporary buildings on top of Pits 3 and 4 (see Figure 1). However more capacity than this is required. UKAEA will expand the capacity of the existing LA/HV store D9935 during late 2005 when the other functions this building performs are transferred elsewhere. This additional capacity will have a number of purposes:
- i. to maximise the available space in Whatling's hangar
 - ii. to prepare containers for transport for disposal at Drigg
 - iii. to segregate and repack historical waste to minimise the amount of radioactive waste
 - iv. to store LA/HV on a temporary basis if necessary
 - v. to store empty HHISOs

Long term strategy

The BPEO Study

24. The planning permission and authorisation processes associated with long term solutions require a "no preconceptions" approach and the involvement of stakeholders. Immediate development of a new LLW facility, as stated simply in the audit recommendations and UKAEA's response, was not considered a viable way to proceed. The planning authority would not consider that an appropriate review of options required by the Environmental Impact Assessment Regulations had been undertaken with stakeholder input. Instead, as a first step, an objective review of options was undertaken. This was carried out through a "Best Practicable Environmental Option (BPEO) Study" which is accepted UK best practice [5]. The scope and depth of the BPEO Study was such that it was able to inform the other areas of strategy development. For instance, a major study of the Drigg option [4] aided both short and long term assessments.
25. The BPEO study has been completed and is fully documented in the "Final BPEO Study Report – April 2004" [6]. The BPEO study is supported by around sixty individual technical assessments and reports. Three stakeholder panels were held to review the options and expose the features and issues that were considered important by stakeholders. These were followed by a three month public consultation by correspondence and through the use of the UKAEA internet website.
26. Although the BPEO report is comprehensive and a major reference for technical and stakeholder information, it is an underpinning document to the overall Dounreay low level radioactive waste strategy. The BPEO report has provided a substantial input to the decision making process to determine the way forward but it has not been the only input. The regulators, Scottish Executive and the Nuclear Decommissioning Authority (NDA)¹⁰ have all made an input.

¹⁰ At this time it has actually been the NDA's precursor, the Liabilities Management Unit (LMU)

27. The BPEO study is also contributes to the overall Dounreay site restoration strategy. It is aligned with the current strategies for other waste streams and the views on the possible end state for the site at completion of restoration.

Staged decision making

28. There are UK wide reviews¹¹ of radioactive waste issues underway at present and it is unrealistic to assume that a Dounreay long term solution for its low level radioactive waste can be chosen in isolation. Nevertheless, there is a pressing need for a solution for Dounreay and the land use planning and authorisation processes are long and thorough.
29. Preparation of design and authorisation submissions will start in 2005 on a “working assumption long term option”. Hold points for decision making are programmed in 2006 and 2008. At these times strategic direction and decision making are required. Starting on the working assumption, but building in hold points, will allow efficient progress to be maintained if that option is to come to fruition. At the hold points account can be taken of UK national and Scottish radioactive waste management developments and will give NDA, with advice from the regulators, the opportunity to decide on the direction of the project.

Working assumption long term option

30. The BPEO that has been identified for the long term management of Dounreay’s LLW and LA/HV is to be used as the working assumption. There are no current additional factors to those considered in the BPEO study to suggest another basis should be used.
31. In summary all Dounreay LLW and LA/HV would be disposed of in new below surface shallow disposal facilities constructed on UKAEA owned land to the south east of the present Dounreay licensed site. An impression of what the facilities might look like is given in Figure 4.



Figure 4. New below surface LLW and LA/HV disposal facilities at Dounreay

32. Summary details are given below. Further detailed environmental and engineering explanations and justifications can be obtained from the references.
33. LA/HV and LLW would be disposed of in separate facilities which may be part of an integrated disposal complex as shown in Figure 3. All Dounreay’s LA/HV and LLW could be disposed of safely in the new facilities [9,10]. The Dounreay LLW that does not meet the current Drigg CFA and that might only be acceptable for disposal at Drigg under

¹¹ CoRWM reports in 2006, the NDA review of LLW reports in mid 2005, a review of Drigg is with the EA

special arrangements (because of the existing radioactive inventory of Drigg and BNFL's management plan for future UK disposals at Drigg) is low level radioactive waste and is suitable for shallow disposal in a new Dounreay facility in accordance with UK national definitions for LLW [3].

34. Where appropriate, LLW would be collected, as now, in 200 litre mild steel drums and treated in the Dounreay WRACS¹² facility. The resulting supercompacted drums, "pucks", would be placed in a carbon steel container similar to the half height ISO freight container (HHISO) used throughout the UK nuclear industry¹³, and transferred to the new disposal facility. Here the containers would be filled with a cement grout and placed in concrete floored and walled vaults. A drum before supercompaction and the resulting "puck" after supercompaction are shown in Figure 5.



Figure 5. Drum and Puck

35. Steelwork, pipework and equipment decommissioning LLW, and operational LLW that is more effectively packed in bulk, would not be supercompacted and instead would be put directly into the HHISO type containers and disposed of in the same LLW vaults. Again the containers would be filled with a cement grout before emplacement.
36. The LA/HV waste consisting of concrete, steel, rubble and soil can be disposed of safely in bulk [11,12,13]. Further packaging would depend on the form of the waste and on operational considerations. This waste would be disposed of in vaults that could be of a simpler design than the LLW vaults as the waste poses insignificant risk.
37. The LLW and LA/HV vaults are anticipated to have roofs during the operational period.¹⁴ There would not be the intention to retrieve the emplaced containers of LLW or the bulk LA/HV, though this would always be possible. Overall monitoring of the waste will be possible. Any rainwater or groundwater will be intercepted before entering the facilities and monitored before discharge. At the end of decommissioning at Dounreay the facilities would be permanently capped off. There would be no requirement for specific institutional control but it is thought that successive generations may provide institutional control for perhaps 150 years.

Long term strategy for the existing disposal facility (Pits 1-6)

38. A decision on the long term management arrangements for the already disposed LLW in the existing Dounreay facility will be made after further work has been completed. From the BPEO study the identified BPEO for the already disposed LLW was to retrieve the waste, repackage it, and re-dispose of it in the new LLW facility. This was based on the

¹² Waste Receipt Assay Characterisation and Supercompaction

¹³ As only internal transport is required some features of the standard may not be necessary

¹⁴ These are detail design issues that will be determined during the planning application stage

perceived difficulty in making a Post Closure Safety Case (PCSC) for leaving the waste where it is, and the majority view of stakeholders for that option.

39. However the facility is safe and creates an insignificant impact on humans and the environment. Assessments indicate that the possible yearly radiological exposure to a member of the public would be around one quarter of the level associated with a “one in a million risk”. This is at a level which is below regulatory concern¹⁵. This is likely to remain so for centuries. Performance Assessments [14] already carried out suggest a PCSC might be able to be sustained. The cost to the taxpayer of retrieval and redisposal is so high (around £65M) that it is prudent to undertake the PCSC evaluation before making a decision. This approach is supported by SEPA which will require UKAEA to produce a plan of how it envisages undertaking the study. Also whether retrieval takes place or not, and where the LLW is redispoused¹⁶, has an impact on the size and scope of operations of any new Dounreay disposal facilities. The solutions for the existing and new arisings of LLW are therefore interlinked and this underlines the necessity of taking a staged decision path.
40. An issue to deal with in the PCSC is the possibility of cliff erosion creating a breach where waste might fall uncontrolled onto the foreshore. This may or may not happen in the timeframe of 2400 to 3000. The waste, at that point in time, would present an insignificant risk but it would be uncontrolled and unsightly if falling out of a breach. Such a breach would not be unforeseen or occur without many years of prior warning so counter measures are possible.
41. Where appropriate, the long term management plans for Pits 1-6 will be considered and compared with BNFL’s and NDA’s plans for the long term management of similar disposal facilities at Drigg.

The way forward for preliminary work and decision making

42. In April 2005 UKAEA would wish to start on the next stage of the working assumption long term option. The objective will be to produce, by March 2006, the formal submission documents for seeking authorisation to proceed with both LLW and LA/HV disposal facilities. The submission documents will include:
- i. Planning Application
 - ii. Safety and Environmental Overall Report (SEOR)
 - iii. Environmental Impact Assessment (EIA)
 - iv. Environmental Statement (ES)
 - v. Radioactive Substances Act 1993, (Disposal facilities on land for low and intermediate level radioactive wastes: Guidance on Requirements for Authorisation)
 - vi. Preliminary Safety Case
 - vii. Site Licence application
43. Also in 2005/6 UKAEA will carry out a comprehensive PCSC study of the existing Pits 1-6 disposal facility. The PCSC report will be submitted to regulators and NDA in April

¹⁵ “A public consultation on modernising the policy for decommissioning the UK’s nuclear facilities”-DTI, Nov.03; also EU Basic Safety Standards Council Directive 96/29 EURATOM

¹⁶ BNFL has stated it would not accept retrieved LLW from Pits 1-6 for re-disposal at Drigg. The NDA may wish to review this.

2006. The PCSC report will demonstrate whether a justification for leaving the waste in place is robust, or show that it is difficult to argue that long term safety and environmental standards can be maintained with the waste left in-situ.

44. In April 2006 NDA should have sufficient information to decide whether UKAEA should submit applications to construct both LLW and LA/HV facilities or just a LA/HV facility. A robust PCSC for the existing Pits 1-6 facility coupled with routine Dounreay LLW disposals to Drigg, if the route has been authorised, may point to only a LA/HV facility application. On the other hand; a PCSC indicating that retrieval of the waste in Pits 1-6 was desirable, and possible wider UK National and Scottish considerations concerning the Drigg route, could suggest an application for both facilities should be made.
45. After applications have been submitted to Highland Council and the regulators UKAEA is assuming that determination will be completed by March 2008. This period of assessment and decision making may involve a planning inquiry.
46. If the submission in April 2006 was for permission to construct both LLW and LA/HV facilities and permission is granted in 2008 then another decision point is reached. Once again NDA will be in a position to decide whether UKAEA should now construct both LLW and LA/HV facilities or just a LA/HV facility. By this stage some additional operating experience of the Drigg route might have been gained if the route has been authorised.¹⁷
47. At this decision point it will be desirable that SEPA has determined its position on the Pits 1-6 PCSC report. This will be particularly important if the PCSC report suggested retrieving the waste was necessary, but that there was a indication that only a LA/HV disposal facility would be constructed at Dounreay. So, at this decision point NDA will need to have resolved whether LLW from Pits 1-6, if it is to be retrieved, can be disposed of at Drigg or whether it must remain at Dounreay.
48. These alternatives and the decision making process are shown in Figure 6.

Construction concepts (working assumption option)

49. The concept is to build the new disposal facilities in phases. The first phase would be constructed from end 2008/early 2009 until 2011 after which the vaults would be available for receipt of waste. This phase would accommodate 2500 containers of LLW in two vaults and 30,000m³ of LA/HV in a separated facility. For the LA/HV, simpler containers than the HHISO containers used for LLW could be used. These could be designed as a range to cater for the various forms of LA/HV likely to be encountered in site restoration. The first phase would also include the cement grouting plant. Phase 1 would occupy about 3.5 hectares.
50. If retrieval of Pits 1-6 LLW was undertaken and was to be re-disposed of at Dounreay two additional vaults for 3000 containers of LLW would require construction from 2023 to 2026. This second phase would occupy about 1.5 hectares.
51. An indicative programme is given in Figure 7.
52. The facilities would be full and ready for permanently capping off at the end of the site restoration period, from 2033 to 2035. Technical assessments [7,8] indicate that over very long timescales the possible yearly radiological exposure to a member of a critical group¹⁸

¹⁷ Scottish Executive may put conditions on the scope of the authorisation

¹⁸ A group of people assumed to be most affected by the facility by reason of the its habitat and lifestyle.

from these closed off facilities would be around one five hundredth of natural background radiation or one quarter of the level associated with a “one in a million risk”.

Contingencies

53. If an authorisation to dispose of LLW at Drigg is not granted by SEPA then the new, or converted, building for LLW operations can be utilised to allow some site restoration to proceed until long term disposal facilities at Dounreay are available.
54. If the long term disposal facilities project is held up during the approval process, but the Drigg route is authorised and operating, site restoration work can proceed as long as sufficient storage capacity for LA/HV waste is constructed to meet production rates.

Concluding remarks

55. UKAEA has undertaken a comprehensive assessment to identify an overall low level radioactive waste management strategy for Dounreay. This has been carried out during a period of considerable change in the UK’s national approach to the management of the nuclear legacy. UKAEA’s strategy plan is made within its present remit and with its understanding of UK national and Scottish current policies.

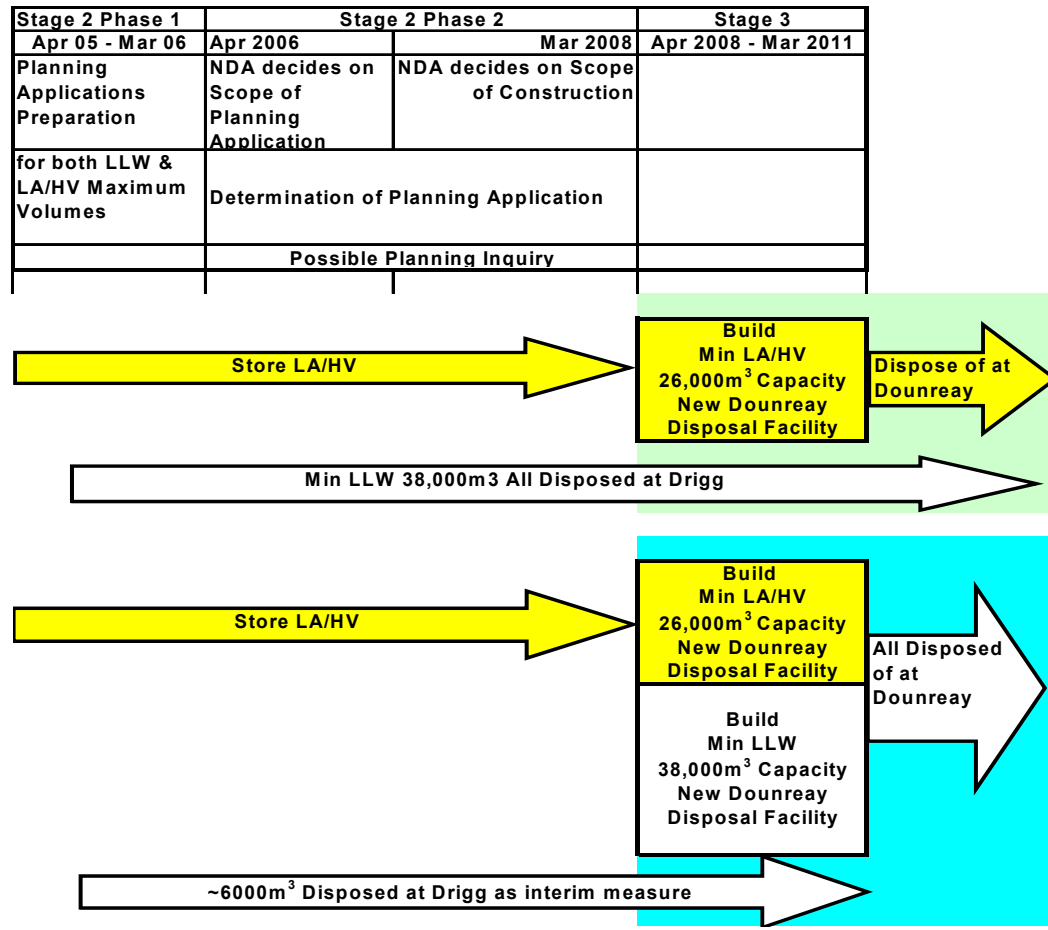


Figure 6. Decision making programme and options

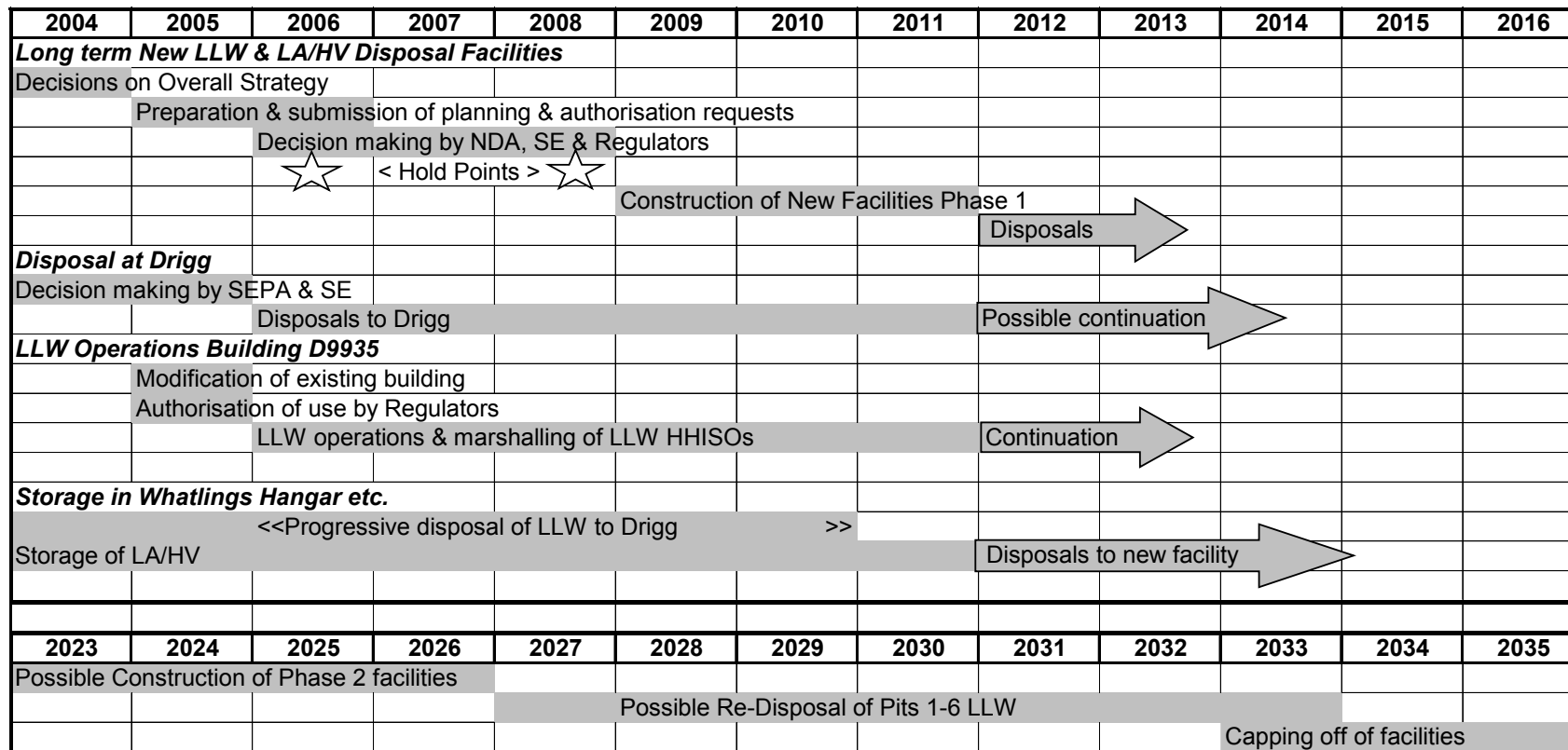


Figure 7. LLW management programme

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Appendix 1.

LLW and LA/HV visualisation information

Metrics LLW

A1 The minimum volume of packaged LLW arising from the decommissioning of Dounreay facilities (excluding any action with the disposed LLW in Pits1-6) is of the order of $38,000\text{m}^3$. For comparison this is around the volume of Dounreay's DFR sphere



A2 This volume would be disposed of in 1900 HHISOs which would create stack of
9 HHISOs wide by 4 HHISOs high by 53 HHISOs long.

54m (180ft) 5.5m (18ft) 127m (424ft)

A3 This would require an area of 1 hectare (2.5 acres)

A4 To compare with Drigg; Vault 8 is 175m by ~230m, 4 hectares (10 acres) and can contain $180,000\text{m}^3$ of packaged waste.

A5 The maximum volume of packaged LLW arising from the decommissioning of Dounreay facilities (excluding any action with the disposed LLW in Pits1-6) is of the order of $64,000\text{m}^3$. For comparison this is just under two of Dounreay's DFR spheres. This maximum volume would require a 1.7 hectare (4.2 acres) facility.

Metrics LA/HV

A6 The minimum volume of bulk LA/HV arising from the decommissioning of Dounreay facilities is of the order of $26,000\text{m}^3$.

A7 This should be disposed of in bulk, taking up the same volume. If it has to be stored it would require 2600 HHISO. If it was disposed of in these containers the disposed volume would be $52,000\text{m}^3$.

A8 A simply engineered facility for disposing of the minimum volume of LA/HV in bulk would require an area of 1.5 hectares (3.7 acres)

A9 The maximum volume of bulk LA/HV arising from the decommissioning of Dounreay facilities is of the order of $45,000\text{m}^3$. This would require a facility area of 2.2 hectares (5.5 acres).

Appendix 2.
Summary of waste volume estimates

Type of LLW	Raw Volume Minimum	Raw Volume Maximum	Raw Volume Mean	Packaged Volume Minimum	Packaged Volume Maximum	Packaged Volume Mean
	m ³	m ³	m ³	m ³	m ³	m ³
Disposed in existing facility Pits 1-6	33000	33000	33000	60000	66000	63000
Stored LA/HV	2000	2000	2000	4000	4000	4000
New arisings of LA/HV	22000	41000	31500	22000	41000	31500
Total LA/HV	24000	43000	33500	26000	45000	35500
Stored LLW	5000	5000	5000	4000	4000	4000
New arisings of LLW	20000	31000	25500	34000	60000	47000
Total LLW	25000	36000	30500	38000	64000	51000
Totals (stored & new)	49000	79000	64000	64000	109000	86500
Totals (stored & new & Pits1-6)	82000	112000	97000	124000	175000	149500