Dounreay Site Restoration Ltd

Site Decommissioning: Waste & Characterisation Unit	Reference:	WSU/Strategy/P033(08)
	Issue:	Issue 6
	Date:	March 2010

DOUNREAY 'INTERIM' INTEGRATED WASTE STRATEGY

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Revision Record Sheet		
Issue	Date	Changes from Previous Issue
1	March 2005	Issued with Lifetime Plan 2005.
2	February 2006	Issued with Lifetime Plan 2006. It should be noted that DSRS Volume 4 was never formally issued as an approved document.
3	February 2007	Amended to take account of the new NDA Specification for the Content and Format of a Site Integrated Waste Strategy (ENG01, Rev 2, August 2006). Issued to Site Programme Office for LTP07 following UKAEA Peer review.
4	February 2008	Issued with Lifetime Plan 2008 following internal UKAEA Peer Review.
5	March 2009	Issued with Lifetime Plan 2008 Rev D.
5.1	August 2009	Minor Update of Section 6 to align with RSA Submission.
6	March 2010	Issued with Lifetime Plan 2010

* When Annexes 3 and 4 are included – the Document will become RESTRICTED.

1 EXECUTIVE SUMMARY

1) Dounreay Site Restoration Ltd (DSRL), a company owned by Babcock International Group, manages and operates Dounreay on behalf of the Nuclear Decommissioning Authority (NDA). Babcock International purchased the previous incumbent, UKAEA Ltd, during 2009.

2) Dounreay Integrated Waste Strategy (IWS) document describes the strategy for managing wastes on the Dounreay site. It provides the justification for the waste strategy in the Dounreay Lifetime Plan, (LTP). Issue 6 is being submitted to the NDA with the LTP10.

3) The Dounreay IWS addresses the management of all forms of waste, both radioactive and non-radioactive, and of material which may become waste in the future. It includes waste creation and its avoidance and minimisation, what requires storage and what is disposed of to the environment. There is also recognition that some wastes may require pre-treatment or conditioning to make them acceptable to a waste route. It is supported by the Dounreay Radioactive Waste Inventory (DRWI), which provides information on both radioactive and non-radioactive wastes on the Dounreay Site.

4) An IWS can be considered to be optimised when it is the outcome of a systematic and consultative decision making process that has considered a range of options and their practicability. All relevant factors including safety, environment and security should be seen to be appropriately balanced. This process is currently at various stages dependant on the waste, the project or the facility being considered. Therefore, the overall strategy still has 'Interim' status.

5) During 2009/10, DSRL issued its Site Waste Best Practicable Environmental Option (BPEO) for all its wastes and the report which benchmarked its current strategies against national and international waste minimisation best practice. The DSRL strategies were confirmed as aligning well with best practice.

6) This past year has seen the ongoing development of strategies for Contact Handleable Intermediate Level Waste (CHILW), Thorium High Temperature Reactor (THTR) graphite and thorium nitrate whilst Letters of Compliance (LoC) were received for the packaging of Dounreay Fast Reactor (DFR) decommissioning reactor metals in $3m^3$ boxes, DFR decommissioning graphite in 4m boxes and also THTR graphite powder in 500 litre drums.

7) Work was also undertaken to draft a new Conditions for Acceptance (CfA) for Low Level Waste (LLW) to compliment the Waste Acceptance Criteria (WAC) being prepared for the new LLW Disposal Facility at Dounreay.

8) The key elements in developing the Dounreay IWS are:

- Characterisation to allow improved understanding of materials and the future waste treatment requirements.
- Implementing the waste hierarchy, primarily for new arisings but, where practical, for existing material.
- Radioactive wastes (LLW and Intermediate Level Waste (ILW)) from past operations and decommissioning are being progressively treated into a passively safe form suitable for long term storage or disposal as appropriate.
- Provision of facilities to treat ILW into a passively safe form.
- Defining the End State for the Dounreay Site to allow clear planning to reach that end point.

- Provision of a new facility for the disposal of solid LLW at Dounreay.
- Reviewing disposition strategies for other materials, such as fuels, to ascertain if they are appropriate to be consigned against current specifications for either an ILW or High Level Waste (HLW)/Spent Fuel facility.
- Developing routes for the reuse or disposal of non-radioactive wastes and the provision of facilities to achieve that aim.
- Interacting with other Site Licence Companies (SLCs) to share information and experience on similar waste streams including participation in NDA or industry working groups and seminars.
- Demonstrate Best Practicable Means (BPM) for all liquid and gaseous discharges from the Dounreay Site.

9) The Dounreay LTP10 contains a number of key and major milestones. These are detailed in section 2.2. These cover important points in the lifetime of the Site and relate to the completion of collective waste actions e.g. all ILW conditioned. The key phases identified in the Dounreay LTP are:

- 1st Phase – Decommissioning – Present day to 2025 (Interim End Point (IEP))
- 2nd Phase – Interim Storage – 2025 to 2050
- 3rd Phase – Off-Site Transfer and Final Demolition – 2050 to 2078
- 4th Phase – Care, Surveillance and Site Closure – 2078 to ~2300 (Final End Point (FEP))

10) The main challenges to underpin the Dounreay IWS during LTP10 are:

- Reviewing the Site Intermediate Level Waste Strategy in light of the NDA Assured Funding limit of up to £150M per year. Immediate impact is a delay to the New Build facilities and a decision to look at alternative, more affordable solutions.

- Reviewing other Waste Strategies impacted by the funding issue including decommissioning operations.

- Continuing implementing the fuels strategy and assessing the impact of associated waste arisings on the Waste Strategy.

- Continuing initiatives to improve facility and waste characterisation and hence better define treatment, packaging and disposal strategies.

- Alignment of DSRL strategies with the NDA Strategy Management System.

- Awaiting the issue of the Scottish Government Policy on Higher Activity Waste (HAW) and instruction from NDA on implementation.

- Further work is still required in implementing the non-radioactive waste strategy at Dounreay in order to maximise the opportunities for re-use and recycling of waste.

- Work is also required to better understand the capacity of non-radioactive waste routes and facilities and demonstrate BPM.

- Opportunities for the transfer of materials off-site will continue to be investigated as waste strategies are developed.

- Agreeing clean up levels for the remediation and restoration of the site, along with the management of clean and exempt decommissioning rubble and its use in the capping and landscaping the site.

11) External constraints and dependencies influencing the IWS include:

a. NDA Funding: The NDA has provided an Assured Funding Letter which states that up to £150M per year will be available to DSRL. This statement was made as part of the Competition process for Dounreay. Such a funding level will impact on the timescales to construct new build waste treatment facilities BUT does potentially offer any Bidders for Dounreay the opportunity to innovate and influence future strategic direction for the Site.

b. Regulatory constraints have the potential to impact either through the introduction of new legislation or requirements, unclear specification of those requirements, delays in consultation or approval of project documentation.

c. Scottish Government policy on Higher Activity Waste (HAW) has been undergoing consultation. Dependant on the exact policy which is issued, it may potentially impact on the DSRL strategy in a number of ways:

   - Indefinite storage on site of HAW;
   - Option of near site, near surface disposal for some types of waste;
   - Option of consignment to off-site facilities for treatment of HAW.

12) Potential opportunities for improving waste management for consideration by the NDA include:

- NDA led consultation, strategy management where one or more SLCs are investigating waste management opportunities IF timescales permit;
- Improved communication and information sharing between SLCs in areas such as:
   - Direct Research Portfolio – visibility of work packages ahead of release and then ability to review reports as it is not clear how they may address cross site issues.
   - Waste package design to offer potential savings
   - Waste packaging plant design and equipment
   - Availability of historical development work
   - Sharing of LoCs
   - Sharing of Lessons Learned
   - Early notification of Facility or Process Plant visits to allow other SLCs a chance to express an interest or influence specification of potential work
   - Clarity on the capabilities of the National Nuclear Laboratory
   - Decommissioning techniques
   - Publishing a list of key SLC contacts in areas of expertise
   - Visibility of NDA schedule of "national" waste management strategy programmes such as graphite managment.
   - Ensuring that Dounreay gets the best out of NDA-led groups such as the Nuclear Waste Research Forum (NWRF) which coordinates most of the above
   - Highlighting of Best Practice by NDA and Regulators

.... Simon Middlemas, Managing Director, DSRL

2 INTRODUCTION

2.1 Purpose and Scope

13) In support of the delivery of the NDA strategy, all NDA sites are required to produce and implement an optimised IWS. This requirement and the expected content of the IWS document are outlined in NDA documents “Specification for the Content and Format of a Site Integrated Waste Strategy Document” (1) and “Companion Document to Integrated Waste Strategy” (2).

14) The overall objective of the IWS is to demonstrate how Dounreay will assess and manage all wastes, both radioactive and non-radioactive (including those in solid, liquid or gaseous form) arising from the site's past, present and future operations. This may also include any other waste transferred from other non-NDA sites for management and disposal. For Dounreay, this is specifically the management of Low Level solid and liquid wastes from the Ministry of Defence (MoD) facility at Vulcan.

15) The IWS demonstrates how all waste related activities on the site are integrated and includes a demonstration that the waste can be appropriately managed in accordance with BPEO and BPM, at the time and rate at which it will arise. It is submitted to the NDA as part of the LTP review process and will enable Dounreay to demonstrate to its regulators and stakeholders that it is complying with legislation and standards.

2.2 Background

16) The 140 acre Dounreay nuclear licensed site was developed on the site of an old military airfield, dating from the Second World War, and is situated on the north coast of Caithness in Scotland. Dounreay’s mission from the 1950s onward was to develop the United Kingdom’s (UK’s) fast reactor technology programme. This was achieved through the establishment of a Dounreay Materials Test Reactor (DMTR), two fast reactors (DFR and Prototype Fast Reactor (PFR)), a Fuel Cycle Area (FCA) comprising plants for the manufacture, recovery and processing of fuel, and associated laboratories and support infrastructure. With the closure of PFR in 1994 and the subsequent government decision to discontinue investment in fuel reprocessing at Dounreay, the emphasis is now fully focused towards decommissioning and site restoration as an NDA designated site.

17) The facilities on the Dounreay site supported the full nuclear fuel cycle from the manufacturing of materials test reactor fuels through reprocessing and post irradiation examination of fuel. Waste generated from the operations and now the decommissioning of those facilities are the key inputs into defining the IWS for Dounreay.

18) Historically, Dounreay has stored a significant proportion of its intermediate level radioactive wastes (both solid and liquid) untreated on site. The immobilisation of MTR raffinate liquors through the Dounreay Cementation Plant (DCP) is the only operational ILW conditioning process in operation at this time.

19) In order to deliver an integrated ILW strategy, the provision of new facilities is required, such as the Remote Handleable Intermediate Level Waste Immobilisation and Encapsulation Plant (RHILW-IEP), which will treat and package the most active liquor and solid ILW streams on the Dounreay site. A new Waste Treatment Plant (WTP) is also planned for wastes retrieved from the Shaft and Silo and the packaging of drummed CHILW.

20) Since operations started at Dounreay back in 1959, the Site has been authorised to dispose of its solid LLW on Site. Dounreay undertook a BPEO consultation exercise on how best to manage future LLW arisings (3). The outcome of that consultation was the requirement to build a new disposal facility to meet the future decommissioning needs of the site. The planning application for the construction of that facility has been approved and the project to deliver it has commenced. Meanwhile solid LLW continues to be packaged and stored on the site.

21) The site has a number of key facilities relevant to the delivery of its waste strategy. These facilities are a mixture of raw and conditioned waste stores, waste treatment and packaging facilities as well as waste discharge/disposal facilities for both radioactive and non-radioactive materials.

22) The treatment, conditioning and packaging facilities required to implement the waste strategy include:

- Currently Available:
  - DCP for immobilisation of ILW Materials Test Reactor (MTR) liquors
  - Waste Posting Cell (WPC) for the repacking of solid ILW from small waste consignors into standard ILW drums for interim storage
  - Low Level Liquid Effluent Treatment Plant (LLLETP)
  - Low Level Waste Receipt, Assay, Characterisation and Supercompaction facility (WRACS)
  - “In Facility” packaging of Half Height ISOs (HHISOs) for bulk LLW
  - Abatement and monitoring of gaseous discharges via stacks and vents

- Future:
  - RHILW-IEP for liquid and solid ILW
  - WTP for retrieved solid and sludge ILW from Shaft and Silo and also CHILW
  - Reactor waste packaging plants for ILW and some LLW
  - Decommissioning waste packaging plant for liquid ILW storage facility
  - Incinerator for ILW and LLW solvents and oils (requirement currently under review)
  - Clean/Exempt waste facility
  - New gaseous discharge stacks to support decommissioning

23) In terms of waste storage at Dounreay, the following facilities are integral in implementing the IWS. These are a combination of both existing and future facilities and include:

- Existing:
  - Unconditioned solid Remote Handleable Intermediate Level Waste (RHILW) 200 litre Drum Store
  - Unconditioned solid CHILW 200 litre Drum Store
  - Combined conditioned ILW 500 litre Drum Store and raw solid RHILW 200 litre Drum Store
  - 3 Stores for interim storage of containerised LLW
  - Liquid ILW storage facility
  - Solvents and oil storage facility
  - Interim spoil (clean and exempt) storage compound

- Future:
  - Conditioned ILW 500 litre Drum Store
  - Conditioned ILW 3m^3 Box Store
  - Conditioned ILW 4m Box Store
  - LLW Disposal Facility

24) The LTP10 has a range of key and major milestones identified within it. Key milestones are steps leading to major milestones. These cover groupings of activities rather than specific waste treatment operations e.g. all ILW conditioned. The following tables provide a listing of some of the key and major milestones but split by Reactor related, Site Decommissioning, Final End State and Site Closure and finally ILW and Waste Activities.

PFR Reactor Hall Area - Auxillary			LTP08 Rev D	LTP10
D17.92	Stand Down Fuels & Nuclear Materials Analytical & Accountability Programmes	Key	Nov-22	Nov-22
D21.3	PFR Structures Demolished	Key	Apr-25	Jun-25
PFR Irradiated Fuel Caves & Buffer Store Area				
D09.4	All PFR Liquid Metal Residues Removed	Key	Oct-19	Oct-19
PFR Irradiated Fuel Storage facility				
D15.4	Complete Transfer of Irradiated Fuels to Cask Store	Key	Mar-21	Mar-21
D15	All Fuels & Nuclear Material Offsite or in Onsite Safe Storage	Major	Nov-22	Nov-22
PFR Reactor Hall Area - Decontamination Area				
D19.2	PFR Decontamination Complete	Key	Sep-22	Jun-24
PFR Turbine Hall Area				
D09	All Alkali Metals passivated & Disposed	Major	Nov-22	Mar-22
D09.5	All Misc. Alkali Metal Removed	Key	Nov-22	Mar-22
D09.9	Stand Down Alkali Metals Analytical Capability	Key	Nov-22	Mar-22
DFR Sphere Area - Bulk NaK removal				
D09.1	DFR Bulk Liquid Metal Removed	Key	Aug-11	Apr-13
DFR Breeder Fuel Building - Element removal				
D15.10	DFR Breeder Fuel Removal Complete	Key	Nov-13	Mar-15
DFR Sphere Area - Vault				
D09.2	All DFR Liquid Metal residues Removed	Key	Nov-22	Mar-22
DFR Ancillary Buildings				
D19.1	DFR Decontamination Complete	Key	Nov-22	Mar-22
D21.1	DFR Structures Demolished	Key	Mar-25	Mar-25
DMTR Area				
D19.4	DMTR Decontamination Complete	Key	May-22	May-22

Table 1: Key and Major Milestones: Reactor-Related

Site Decommissioning - Active Facilities			LTP08 Rev D	LTP10
D17.90	Site Criticality Risk Removed	Key	Mar-25	May-23
FCA - Fuel Buildings				
D21.1	FCA Structures Demolished	Key	Mar-25	Mar-25
FCA Support Facilities				
D07.4	MTR Raffinate Immobilisation Complete	Key	Oct-13	Oct-13
D07.6	ILW Liquor Storage Facility Operations Complete	Key	Mar-21	Apr-21
D25.1	FCA Gaseous LLW Operations Complete	Key	May-24	Aug-23
Environmental Restoration Management & Support				
D27.3	Complete Remediation of DSRP Zones	Key	Mar-25	Mar-25
D27	Landfill Closure, Misc Soils Remediation & ER Programme Complete	Major	Oct-25	Apr-25
Programme Management				
D30	Interim End State Achieved	Major	Dec-25	Jul-25
Final End State - Store Operations Storage Phase				
D40.2	Waste Storage/Disposal Ooperations Complete	Key	Sep-50	Apr-50
Site Management Closure Phase				
D50	Final Closure Activities Completed	Key	2294	2296

Table 2: Key and Major Milestones: Site Decommissioning, Final End State and Site Closure

Shaft & Silo Complex			LTP08 Rev D	LTP10
D03	Radwaste Store Construction Complete	Major	Jun-17	Dec-17
D11E1	Nirex Approvals Complete	Key	Sep-18	Jun-17
D11.4	Shaft Headworks Operational	Key	Apr-19	Apr-19
D11.5	Silo Headworks Operational	Key	Sep-18	May-17
D05.1	Waste Treatment Plant Operational	Key	Jul-19	Dec-17
D05	All Planned ILW Processing Plants Operational	Major	Jan-20	Dec-17
D11.6	Silo Waste Retrieval Complete	Key	Jul-22	Jan-21
D11.8	Silo Waste Treatment Complete	Key	Jul-22	Jan-21
D11.7	Shaft Waste Retrieval Complete	Key	Jul-23	Feb-23
D11.9	Shaft Waste Treatment Complete	Key	Jul-23	Feb-23
D11	Historic Waste Facilities Emptied with All wastes Encapsu	Major	Jul-23	Feb-23
D19.5	Historic Waste Facilities Decontamination Complete	Key	Mar-25	Oct-24
D21.5	Historic Waste Facilities Structures Demolished	Key	Mar-25	Oct-24
RHILW Immobilisation & Encapsulation Plant				
D05E2	Nirex LoC	Key	Mar-16	Mar-16
D05E3	NII Safety Case Approved	Key	Feb-16	Feb-16
D05E4	RHILW IEP SEPA Authorisation received	Key	May-16	May-16
D03.1	RHILW IEP Conditioned ILW Store Operational	Key	May-17	May-17
D07.3	PRF raffinate immobilisation complete	Key	May-18	May-18
D05.2	RHILW IEP operational	Key	May-17	May-17
D07.2	DFR Raffinate Immobilisation Complete	Key	Dec-19	Dec-19
D07.1	ADU Floc Immobilisation Complete	Key	Mar-21	Mar-21
D19.6	Balance of Site Decontamination Complete	Key	Aug-23	Aug-23
D07.7	RHILW IEP Operations Complete	Key	Mar-25	Mar-25
D21.5	All Buildings demolished & underbuilding	Major	Mar-25	Oct-24
D07	All ILW raffinates & Flocs immobilised and in Storage	Major	Mar-25	Mar-25
D21.6	Balance of Site Structures Demolished	Key	Sep-25	Mar-25
Waste Treatment				
D07.5	DCP Operations Complete	Key	Dec-13	Dec-13
D25	All Authorised Effluent Discharges Complete	Key	May-24	Aug-23
Waste Storage				
D23.1	Solid ILW Operations Complete	Key	Mar-25	Mar-25
Waste Storage				
D15.2	Complete PCM Storage Operations	Key	Mar-22	Mar-22
LLW Pits				
D23.3	LLW Pits Retrieval & Disposal Complete	Key	Jun-22	Jun-22
New LLW Disposal Facility				
D01E2	SEPA RSA Disposal Authorisation Received	Key	Mar-10	Oct-11
D01E1	NII Site License received for LLW Disposal Facility	Key	Mar-11	No Longer Applicable
D01E3	NII Authorisation for Operational Safety Case received	Key	Mar-14	No Longer Applicable
D01.1	Procurement & Construction of LLW Disposal Facility	Key	Mar-14	Mar-15
D01	New LLW Disposal Facility Accepting Waste	Major	Apr-14	Sep-15
D01.2	Start LLW Disposal Facility Operations	Key	Apr-14	Apr-14
D23.4	LLW Disposal Facility Closed	Key	Dec-25	Mar-26
D23.2	Solid LLW Operations Complete	Key	Mar-25	Mar-25
D23	All Solid Waste Transported Offsite or in Onsite	Major	Dec-25	Mar-25
Ancillary Buildings				
D27.1	Relinquish Landfill 42 Licence	Key	Mar-12	Mar-12

Table 3: Key and Major Milestones: ILW and Waste Activities

25) In conjunction with the key and major milestones, DSRL agree with the NDA a number of Performance Based Incentives (PBIs), against which DSRL can earn a fee. Some examples of waste related PBIs which have been agreed with the NDA for the current year (2009/10) are detailed below:

PBI Description	Due Date	Achieved
Process up to and including Batch 30	13/07/09	18/06/09
Complete Active Commissioning (Batch 50) and submission of commissioning report to NII	14/10/09	11/09/09
Process up to and including Batch number 75	31/03/10	09/01/10
Process up to and including Batch number 85 (Stretch PBI)	31/03/10	At risk
Process up to and including Batch number 100 (Stretch PBI)	31/03/10	At risk
First Dirty Dump Tank size reduced and loaded into half height ISO container (LLW)	21/10/09	22/10/09
Second Dirty Dump Tank size reduced and loaded into half height ISO container	01/02/10	18/12/09
Removal of the asbestos and PVC sheathed cables running around the Reactor (sectors 1 to 10 under 14 foot floor level) and loaded into half height ISO container (LLW)	18/12/09	17/12/09
Complete processing of 72kg of alkali metal, from stored metal alkali metal contaminated items at PFR	31/03/10	24/12/09
D1207 LLW Complex - Crane removal and size reduction	15/02/10	On target
D6499 Above Ground Building Structure - Dismantle Vent Fan and Stack, size reduce and consign as waste	28/10/09	16/10/09
D1251 (D9875 Store) Transfer at least 56 drums of stored RHILW waste and DFR Breeder from D9875 Store to D2701 Store and/or D2001	31/07/09	22/07/09
Decontaminate or size reduce 19 No ex LAD pipe sections	14/11/09	02/11/09
D1251 (D9875 Store) Transfer to achieve a total in year of at least 225 (Interim 56 and Final 169) drums (approx 44% of total contents in-year, cumulative approx 88%) of stored RHILW waste and DFR Breeder from D9875 Store to D2701 Store and/or D2001	31/03/10	On target
Completion of 15 loaded movements of the Z6037 Padirac Flask, from D2670 to D2001.	26/11/09	15/12/09
Completion of the repacking of legacy D1203 waste drums, repacking the final 31 drums for 2009/10	3/09/09	25/09/09
Declad 8 x Z6033 DFR breeder drums	31/03/10	On target
Operate D1208 and DCP process systems at design throughput to process 25m³ of raffinate	30/06/09	22/06/09
Operate D1208 and DCP process systems at design throughput to process 25m³ of raffinate	30/09/09	10/09/09
Operate D1208 and DCP process systems at design throughput to process 25m³ of raffinate	31/09/09	27/12/09
Operate D1208 and DCP process systems at design throughput to process 25m³ of raffinate	31/03/10	On target

Table 4: Examples of 2009/10 PBIs (Waste)

26) In addition to the key and major milestones, there are also a number of milestones in the programme which are Nuclear Installations Inspectorate (NII) regulated. These milestones relate back to the original Dounreay Site Restoration Plan (DSRP). Any changes to these milestones have to be formally approved by the NII.

27) As stated in the Executive Summary, the LTP for the Dounreay site is split into 4 key phases. An overview of those phases is provided below.

28) Phase 1 represents the period of decommissioning and waste management from the current day through to the IEP, currently set at 2025 in LTP.

29) At the IEP, it is estimated that ~30% of the current licensed site will be delicensed, dependant on a robust business case being made. The following facilities will remain on the licensed site at that time:

- Two conditioned ILW 500 litre drum stores and associated import/export facilities
- One conditioned ILW 3m^3 box store (sharing same import/export as one of the 500 litre drum stores)
- One conditioned ILW 4m box store
- Fuel storage facilities
- The DFR Sphere and ancillary administration building (under review)
- The Police Command and Control Building (PCCB)
- Other associated infrastructure and utilities to support the remaining facilities

30) During the 2nd Phase, the site, remaining stores and packages will be monitored and maintained, awaiting the availability of off-site transfer routes, for the conditioned ILW and packaged nuclear material, which are scheduled to be available from 2050 onwards.

31) The conditioned ILW and nuclear material packages will be transported off-site in the 3rd phase. The current assumption is that an ILW Geological Disposal Facility (GDF) will be available to receive all Dounreay's ILW by 2060. The packaged nuclear material is scheduled to be transported from the Site between 2075 and 2076.

32) In the 4th Phase, the site will be under care and surveillance until up to 2300, the site's FEP, when it is anticipated the remainder of the Site will be delicensed. During phases 2 to 4, the residual radioactive and chemical contamination in the areas of site which remained licensed will be covered by an integrated Post Closure Safety Case (PCSC), which will demonstrate the long-term safety of the entire site in its end state. Dounreay will seek authorisations to support its FEP strategy at appropriate times in the LTP, following regulatory consultation.

2.3 Site Vision, Mission, Values and Objectives

33) DSRL has issued a statement detailing the site's vision, mission and values (4). This statement is as follows:

"Vision:
Our aim is to be recognised as the best Site Licence Company in the UK.

Mission:
Our mission is to restore the Dounreay site to a publicly acceptable condition in a safe, secure, environmentally responsible and efficient manner, whilst supporting our people and our community to prosper beyond site closure.

Values:
Within our work culture, we all must:
- Observe safety and environmental compliance.
- Deliver and make things happen.
- Work together and share our success.
- Trust and respect each other.
- Embrace change and adapt."

34) At Dounreay, the Site objectives are derived from the UKAEA "Parent Body Organisation Expectations of SLC Management Team (5). Within that document are objectives related to decommissioning and waste management:

- To restore the sites we manage using the best solution overall, taking into account the needs of the environment, the safety of workers and the public and the potential future uses of the sites;
- To carry out initial decommissioning as soon as reasonably practicable taking account of all relevant factors following cessation of routine operations;
- To schedule further decommissioning work to reduce the hazards systematically and progressively assuring safety of the site at all times, including:

  a. worker and public safety
  b. site security and stewardship
  c. effective, efficient and economic use of resources
  d. minimisation of environmental impacts including reusing or recycling materials whenever practicable
  e. any potential benefit or dis-benefit of radioactive decay
  f. access to relevant skills and knowledge
  g. use of best practice
  h. development of necessary techniques which are not already available
  i. consultation with public and stakeholder groups
  j. prioritisation within funding constraints, taking account of relative hazards

- To package radioactive wastes, including historic accumulations of waste, to render them passively safe in compliance with agreed national standards on timescales consistent with safety, the environment, dose uptake and value for money;
- To ensure that waste arisings are minimised and that those wastes which are unavoidable are characterised and segregated at source, so far as is reasonably practicable;
- To make prompt and proper use of available authorised waste disposal routes and to seek out additional disposal authorisations where necessary;
- To provide adequate storage capacity of an appropriate standard for existing and expected arisings of wastes for which there is currently no disposal route or other off-site management option;
- To keep a permanent record of redundant radioactive facilities and wastes;
- To use BPM to reduce radioactive discharges to the environment, and in particular to meet the requirements of the Oslo Paris Convention (OSPAR) agreement.
- To agree clean up levels for the remediation and restoration of the site.

35) Dounreay management have introduced a Conduct of Operations manual (6), updated in 2009, which was made available to all staff working on the site. Under section 6.8 Management of Waste and Radioactive Items, the following statement is included:

"The Executive Team expects that all discharges and waste generated on the Dounreay Site complies with approved limits and conditions."

36) These preceding statements encompass the requirement to demonstrate compliance with Health and Safety Executive (HSE) Site Licence Conditions 31, 32 and 33 and the Radioactive Substances Act (RSA) discharge authorisations for the discharge and disposal of wastes issued by the Scottish Environment Protection Act (SEPA).

2.4 Significant Changes from Previous Version of IWS

37) The main changes requiring recognition within this years IWS are;

- **The reference strategies in the past year have not changed, some have simply moved further through the implementation phase.**

- In order to demonstrate direct compliance by each facility with the Site Discharge Authorisation, DSRL have continued the production of Environmental Support Files.

- DSRL continue to integrate a revised fuels strategy review into the LTP, there will be impacts on waste and those will be assessed as part of the Baseline Change Proposals (BCPs) that are taken forward.

- DSRL continue to undertake detailed plant walkdown surveys to improve future decommissioning waste estimates.

- DSRL have just completed Stakeholder Engagement on the site’s Heritage Strategy, the results of which will potentially impact facilities, especially the DFR Sphere.

3 WASTE MANAGEMENT POLICY, ORGANISATION and ARRANGEMENTS

38) This section outlines the regulatory and policy framework against which the Dounreay IWS has been developed. Further, it outlines the site organisation and arrangements for management of wastes and ensuring compliance with this framework.

3.1 Statement of Policy and Principles

3.1.1 Principles of Waste Management at Dounreay

39) An overview of the Government policy, legislation and regulatory requirements relevant to waste management and disposal is given in Section 4.3 and Annex 1 to this IWS. Further details are provided in the Companion Document to the Integrated Waste Strategy Specification (2).

40) In summary, the key principles of policy applicable to management of waste on the Dounreay site are:

Protection of the public, workforce and environment (Cm2919 Para 50) through:

- Keeping radiological doses and environmental impact As Low As Reasonably Achievable (ALARA) (Cm5552).
- Converting wastes into a passively safe state as soon as practicable.
- Minimising discharges through the use of BPM (Cm5552).
- Strategic planning.
- Application of the waste hierarchy (see glossary).
- Consideration of BPEO/BPM in the selection of waste management options.
- Proximity principle (see glossary).

- Sustainable development (see glossary).
- Use of good practice guidance, such as the Industry Code of Practice on Clearance and Exemption.
- Application of SEPA waste strategy for non-radioactive wastes.

41) These key principles are currently reflected in the proposed Dounreay Decommissioning and Waste Management Policy (5). This policy is consistent with the Energy Act direction to the NDA regarding decommissioning and clean-up of its Sites. These objectives were stated earlier in Section 2.3.

42) Scottish Government HAW Policy is currently under consultation – this will impact on DSRL's future management of its HAW. The draft policy allows for the export of waste for treatment along with indefinite long term storage of HAW on site and also the opportunity for near surface disposal.

43) Scottish Government consultation on waste substitution may also result in amendments to the amount and form of waste returned to Overseas customers who held processing contracts with Dounreay.

3.1.2 Dounreay Approach to Waste Minimisation and the Waste Hierarchy

44) One of the key requirements of waste management at Dounreay is to ensure that the production and accumulation of new waste is minimised. This is encompassed within the site requirement for the application of the principles of the waste hierarchy to both radioactive and non-radioactive wastes. The waste hierarchy is intended to ensure that the amount of waste requiring disposal is minimised and ensure that when planning projects, project teams fully address opportunities to avoid waste production, minimise volumes and maximise reuse or recycling of materials. This is consistent with national policy and is reinforced in the Dounreay Waste Manual (7).

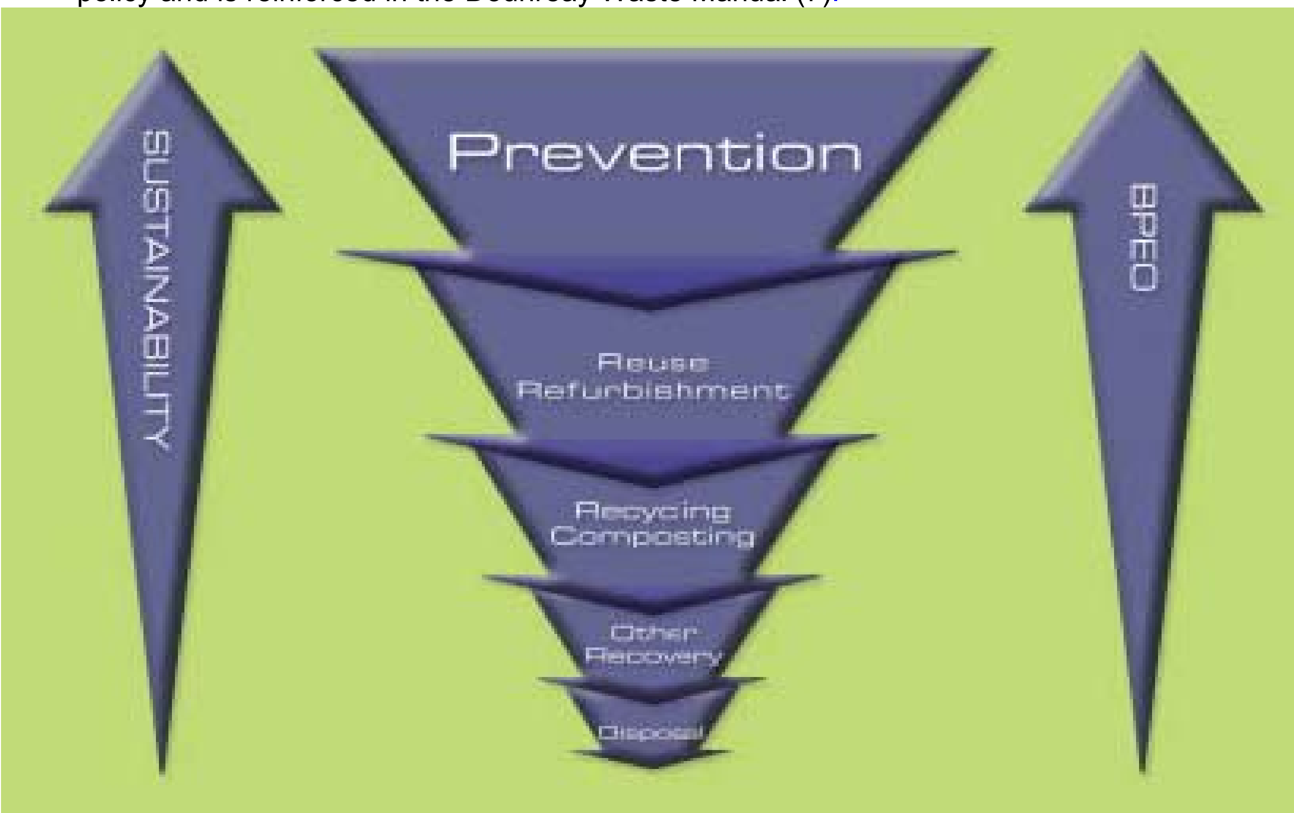

Figure 1: Waste Management Hierarchy

45) Examples of how the waste hierarchy is applied at Dounreay are:

- Application of Waste Management systems and operation and maintenance of an Environment Management System (ISO 14001).
- Embedding of Project or building Waste Tactics Officers to facilitate effective waste minimisation techniques.
- Requiring that, as part of contracting procedures, a contractor and any of his sub contractors working on the Dounreay site must comply with the waste hierarchy for reuse/recycle. All waste disposals must be reported to the project manager and recorded.
- Continual monitoring of opportunities to recycle material where cost effective and practical.
- Re-use of material in a cost effective and environmentally responsible manner.
- Mandatory training for all consignors of waste generated at Dounreay (e.g. Area Waste Officers, Tactics Officers and project personnel).
- Continual improvements to methods of working, learning from best practice and benchmarking (e.g. monitoring protocols, characterisation techniques).
- Site wide targeted campaigns and programmes, where appropriate.
- External and internal auditing and assessment of procedures and systems, incorporating, where necessary, best practices from other sites and industries.
- Active participation in industry working parties (National LLW Strategy Group, Clearance and Exemption Working Group (CEWG), Cross Industry Assay Working Group).
- Dedicated support sections to facilitate sites demand during decommissioning (e.g. Non-Destructive Assay, Chemical Support Services, Land Remediation).
- Effective planning providing more accurate estimates relating to site waste generation and requirements.
- Education for waste generators on the importance of implementing BPM and BPEO.
- Undertaking characterisation (both desk based and intrusive) work ahead of the main project task to define the waste categories and strategies (routes) before work commences.
- Ensuring the production of waste is avoided by ensuring that cross-contamination during operations or decommissioning does not occur and that, where possible and BPM, surface activity is removed and segregated from the bulk material.
- Compaction of much of the LLW generated to minimise the volume requiring disposal. Segregation of waste at source also minimises the volume requiring disposal.
- Where possible, existing disposal routes are utilised so that waste is not accumulated which does not currently have a disposal route.

46) Annually, DSRL produces a "Dounreay Site Waste Minimisation Report" (8), which details the waste minimisation achievements for that year and the planned activities for the following year. This is a requirement of the RSA Solid Radioactive Waste Authorisation.

47) In the report for January 2009 to December 2009, the waste minimisation achievements included:

- Initiation of recycling schemes.

- Reuse of 2,344 tonnes of waste aggregate from various decommissioning projects to construct a road on-site.
- Release of 4,766 tonnes of clean material (concrete, rubble and rock) for off-site use by local farmers and contractors.
- Recycling of 471 tonnes of clean hazardous and non-hazardous waste.
- Disposal of 171.5 tonnes of exempt waste.
- Continued reduction in the volume of clean waste disposed of to Seater (see Figure 2).

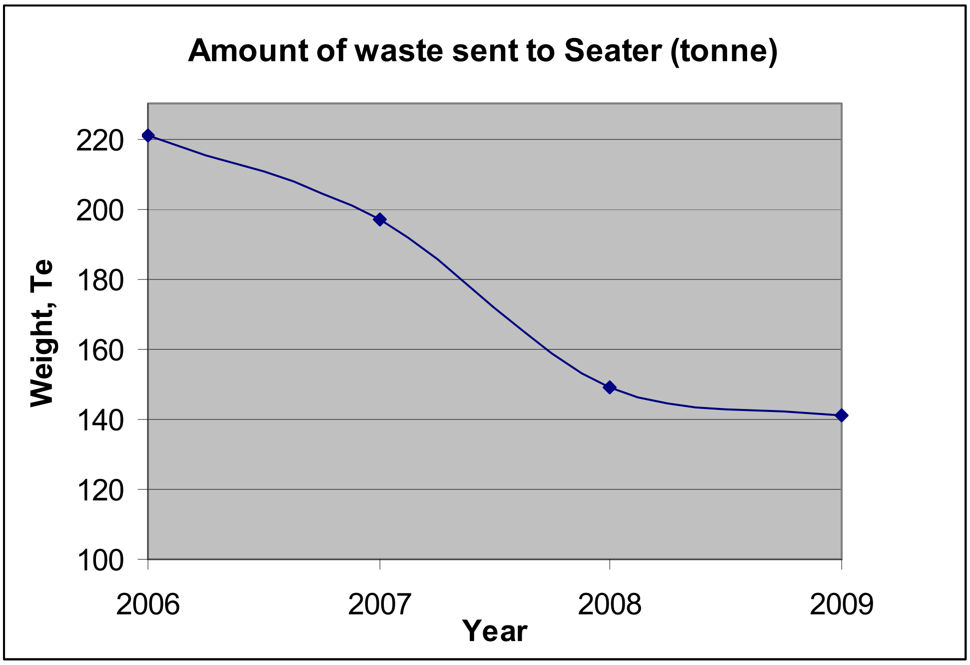

Figure 2: Amount of Clean Waste Disposed of to Seater

3.1.3 Dounreay Approach to Sustainable Development

48) Sustainable development principles require that there is no undue burden on future generations. This is part of the strategy for Dounreay in ensuring that radioactive wastes are in a passively safe state by the IEP reducing burdens on future generations. Sustainability will also be achieved during decommissioning and remediation operations by the application of the waste management hierarchy to the management of all wastes at Dounreay. Support and information will be obtained from the Site Decommissioning: Sustainable Practices in the Use of Resources (SD:SPUR) network as the IWS and decommissioning plans are developed.

3.1.4 Recent Developments in Policy and Regulation

49) The main focus in the past year has been on a number of consultations:

- Scottish Government HAW Policy
- Scotland's Zero Waste Plan
- Exemption Orders Review

50) The Scottish Government has entered into a consultation on the development of its policy for the long term management of HAW in Scotland. DSRL have participated as part of the technical team and related workshops. This consultation closes in April 2010.

51) The Exemption Orders under the RSA 1993 remain under review, with the review expected to be complete in late 2010. DSRL has input to the review at all its stages

throughout 2009, in the form of DSRL responses and also through the membership of CEWG and the Inter-Industry Group on Contaminated Land (IIGCL). The Exemption Orders are statutory instruments made under the RSA and specify classes and descriptions of radioactive material which do not need to be registered or further authorised. This is a key part of the Dounreay IWS as it allows further flexibility in the management of wastes on the site, especially where the history is unclear.

52) In addition to these consultations, DSRL has input to the development of the NDA's Strategy II, due for publication for consultation in autumn 2010.

3.1.5 Local Waste Management Plans:

53) Dounreay's strategic planning for the management of its wastes takes account of local and regional waste management plans. This includes Highland Council's Reduce, Reuse and Recycle programme whose objective is "towards zero waste". The main objectives are:

- That effective waste minimisation measures will be adopted and, following these, that waste, including radioactive waste, will be managed at the highest achievable level within the waste hierarchy;
- That waste will be managed as near as possible to where it is produced;
- That the environmental impacts of waste management developments, including traffic, will be kept to a minimum;
- That there will be increased community and stakeholder involvement and ownership for initiatives and planning for sustainable waste developments.

3.1.6 Good Practice Guidance Used by the Site

54) Guidance on good practice and general advice on waste management is taken from a variety of sources by the Dounreay site and include the following:

- Nuclear Industry Code of Practice for Clearance and Exemption – provides guidance on how to measure and assess waste in order to dispose of waste as exempt or non-radioactive;
- SAFEGROUNDS – Good practice guidance for the management of contaminated land and defence sites;
- SD:SPUR
- HSE/Environment Agency (EA) and SEPA – Joint Guidance on Radioactive Waste Management: The management of higher activity radioactive waste on nuclear licensed sites;
- EA and SEPA: Guidance for the Environment Agencies Assessment of BPEO Studies at Nuclear Sites;
- EA Pollution Prevention Guidance (PPG) notes;
- EA Requirements Working Group (EARWG) which was established as a Best Practice Forum for radioactive waste and manages the production of a best practice website including a waste minimisation database. Dounreay recognised early in the development of its decommissioning plans for the Site that the future management of waste was a key building block in achieving success.
- NDA Strategy Management System – participation in the HAW strategy group as well as interfacing with the NDA Strategy team as part of the incorporation into the Dounreay Site Specification.
- Participation in the NDA's Integrated Project team on Waste Storage which is looking to provide Industry Guidance on the management of conditioned waste packages.

3.2 Waste Management Organisation

55) Site Decommissioning Waste and Characterisation Unit (SDWCU) within the DSRL management structure continues to have a primary focus on the delivery of:

- Ongoing development, and refinement, of waste and fuels strategies at Site and project levels as well as the communication of the strategies to the projects.
- Waste Compliance Section providing advice to projects and maintaining quality management of waste consignments and associated records.
- Management of waste stores and treatment facilities.
- Provision of a waste transport and collection system.
- Provision of Qualified Experts on radioactive waste management.
- Provision of a Non Destructive Assay service for both SDWCU and Site Projects.
- Overseeing the management of the new LLW Disposal project.

56) SDWCU has responsibility for the provision of an effective 'one-stop shop' for waste management activities and provide the interface with the NDA strategic teams, regulators, decommissioning projects and off-site waste management operators. The main benefits of this approach is:

- Clarity and accountability for all waste matters and therefore improving business efficiency.
- Development and optimisation of the IWS.
- Optimisation of waste and fuels strategy implementation.
- Management of all waste storage and transport which allows for clearer and more focussed waste management provision.

57) The SDWCU organisation structure is shown in Figure 3 and has been slightly amended since over the past year in order to improve the service provided:

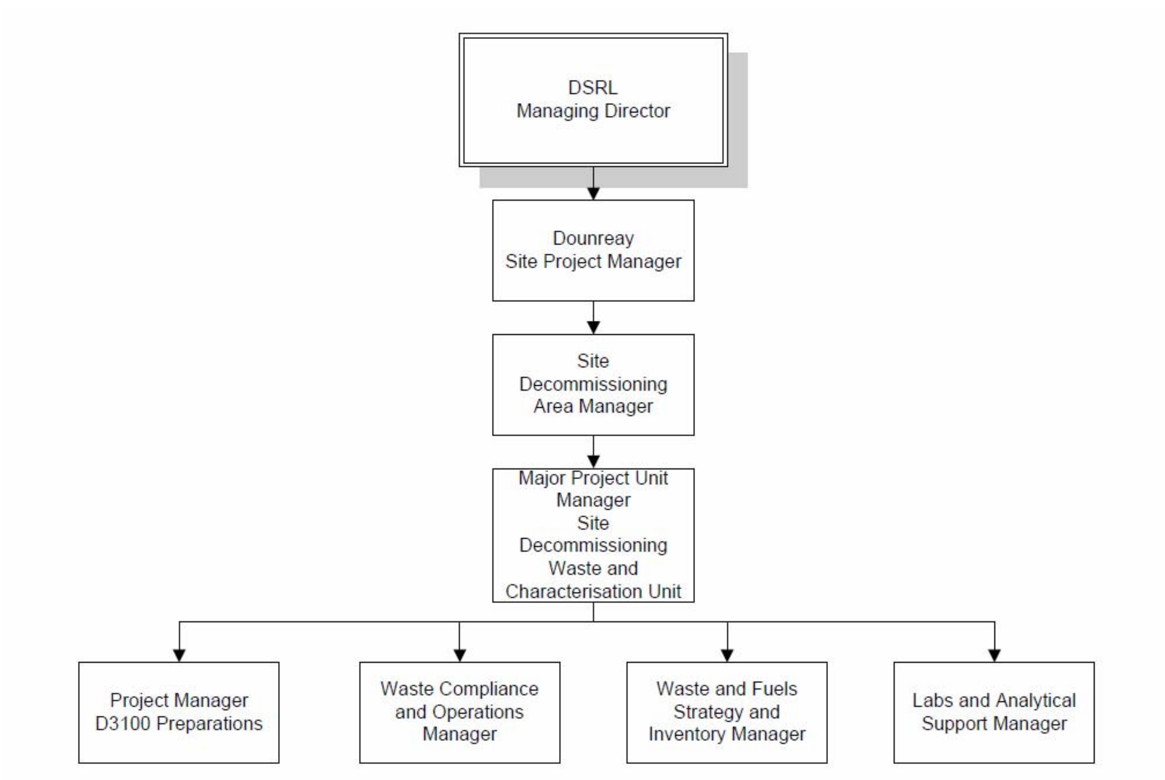

Figure 3: Dounreay SDWCU Organisational Structure

- **SDWCU Manager has overall responsibility:**
  - To provide the site with a comprehensive waste service by providing waste and fuel strategies and support, transport requirements, Quality Assurance (QA), record keeping and operation of the site Waste Treatment and Storage Facilities for all waste types except those provided by New Build Projects Area.

- **Waste and Fuels Strategy and Inventory Manager has responsibility:**
  - To prepare, collate and prioritise the site waste inventory in line with decommissioning schedules.
  - To resolve waste and fuels treatment strategy options and ensure appropriate agreements are in place along with regulatory and stakeholder approval.
  - To develop technical solutions for remaining waste routes and obtain regulator and stakeholder approval.
  - To develop and underpin reference strategies/routes for all waste streams in the LTP, as part of an IWS.
  - To provide technical guidance and strategies such that all wastes will be compliant waste forms.
  - To provide support to project managers on the strategy and definition of wastes and fuels.
  - To produce the IWS on behalf of the SDWCU Manager.
  - To manage and administer DRWI and the Dounreay Fuels Inventory (DNI) database.

- **Waste Compliance and Operations Manager has responsibility:**
  - To provide advice and technical support on waste characterisation, consignment and disposal.
  - To manage and operate waste treatment and storage facilities safely and efficiently.
  - To provide on and off site transportation.
  - To operate and maintain the Low Active Drain and the Non Active Drain System in accordance with SDWCU's LTP.
  - To coordinate the gaseous effluent monitoring and discharge systems.
  - To provide the Non- Destructive Assay service to the site.
  - To manage the Dounreay Site Waste QA system and associated records.

- **D3100 Preparations Project Manager has responsibility:**
  - To gain the relevant approvals and authorisations for the construction of the new LLW Disposal Facility.
  - To manage the safe delivery of the New LLW Facilities project and associated operations within the specified scope of responsibility associated with decommissioning the Dounreay site.

- **Labs and Analytical Support Manager has responsibility:**
  - To provide the site with destructive and non-destructive analytical services including statutory gaseous and aqueous discharge and environmental analysis, bioassay and asbestos sampling and analysis.
  - To provide support to decommissioning operations.
  - To provide instrumentation and computational support and DSEAR advice.
  - To provide laboratory management systems advice.

58) Project Managers and Authority to Operate (ATO) Holders have direct responsibility for waste management within their project or area of responsibility including demonstrating use of the waste hierarchy, minimisation of waste and having waste routes defined and

agreed. They have the responsibility for the production of Project Specific Waste Plans (PSWPs) to allow SDWCU to approve their waste routes.

59) Additionally, each Major Project Area or facility on the Site has the help of embedded Waste Tactics Officers whose responsibilities are to assist in the preparation of project documentation to allow consignment of waste.

60) Each project or facility also has its own dedicated Area Waste Officer appointed to deal with day to day waste issues, mainly waste consignment.

3.2.1 Key Formal Meetings

61) The Dounreay site waste management organisation and development of the IWS is supported by a number of formal meetings where waste strategy and issues are discussed. They include:

- DSRL Executive Committee (DEXCOM) provides a forum where the DSRL Managing Director and his senior Leadership team can:
  - Seek and offer advice on key decisions
  - Regularly review and provide information on major parts of DSRL activities
  - Share information
  - Set and monitor actions to improve DSRL performance

- Dounreay Accountability Meeting (DAM) takes the form of individual reviews of each Major Work Group with each Group Manager with respect to project performance.

- Dounreay Investment and Change Control Meeting (ICCM) are responsible for the review and approval of all the changes with the potential to affect the delivery of the LTP. The ICCM ensures that proposed changes are assessed in the context of the whole LTP.

- The Dounreay Environment Committee (DEC) ensures that all key environmental documents go through DSRL "due process" as defined in DSRL management arrangements. It also provides a forum at which Senior Managers can review environmental performance, environmental strategy, compliance with environmental legislation, and cultural and behavioural issues relevant to the environment. There is a focus on improving performance, management arrangements and culture. The meeting has executive authority but any significant issues are referred to the DAM for endorsement.

- The Dounreay Site Safety Working Party (DSSWP) meets to discuss project safety documentation and facility safety cases. As the management of waste is a key part of most projects and safety cases, the proposals for waste management are also scrutinised here.

- SDWCU holds weekly meetings specifically on the production and review of PSWPs. This allows discussion on the content and any issues which may impact on one or more project area.

- The Site Plan of the Day and Week meetings, at which short term waste logistic issues are one of the topics discussed.

All these are in addition to the feedback of information from attendance at NDA or Industry working groups or meetings.

3.3 Waste Management Arrangements

3.3.1 Accreditation

62) To ensure that the requirements of relevant legislation are achieved, Dounreay operates an integrated management system, independently certificated to ISO14001, ISO9001 and BS OHSAS 18001. This covers the overall health, safety and environmental arrangements required of the site. These certifications are currently valid and subject to formal reassessment on a routine basis. Additionally, Dounreay has achieved UKAS accreditation for its Laboratory facilities which support the decommissioning and waste management process.

3.3.2 Overview of Dounreay's Integrated Management System

63) Dounreay's management system is designed around the various processes required to support the delivery of the LTP. One key process is that of management of waste. All of the following processes and guidance are available to all staff through the Dounreay Intranet.

64) Dounreay's Waste Management Process, summarised in Figure 4, aims to ensure:

- the consistent preparation and endorsement of waste management strategies at Site level;
- consistent standards are applied in implementing these strategies;
- compliance with legislative requirements and CfA.

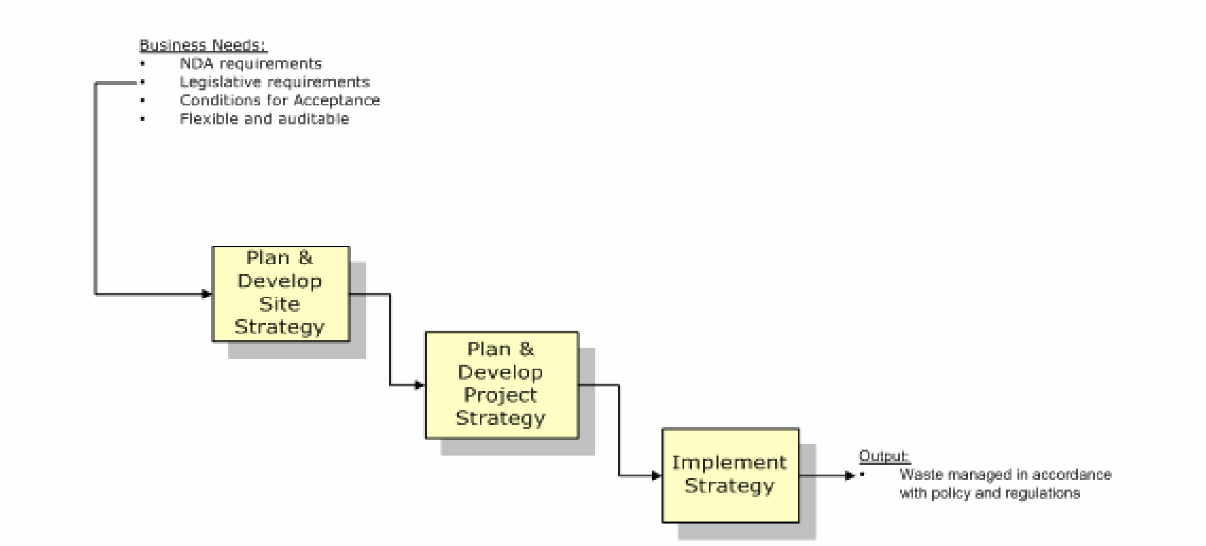

Figure 4: Dounreay Waste Management Process

65) This top level process is then supported by lower level processes, which provide further definition and guidance for Site Strategy development (see Figure 5 below).

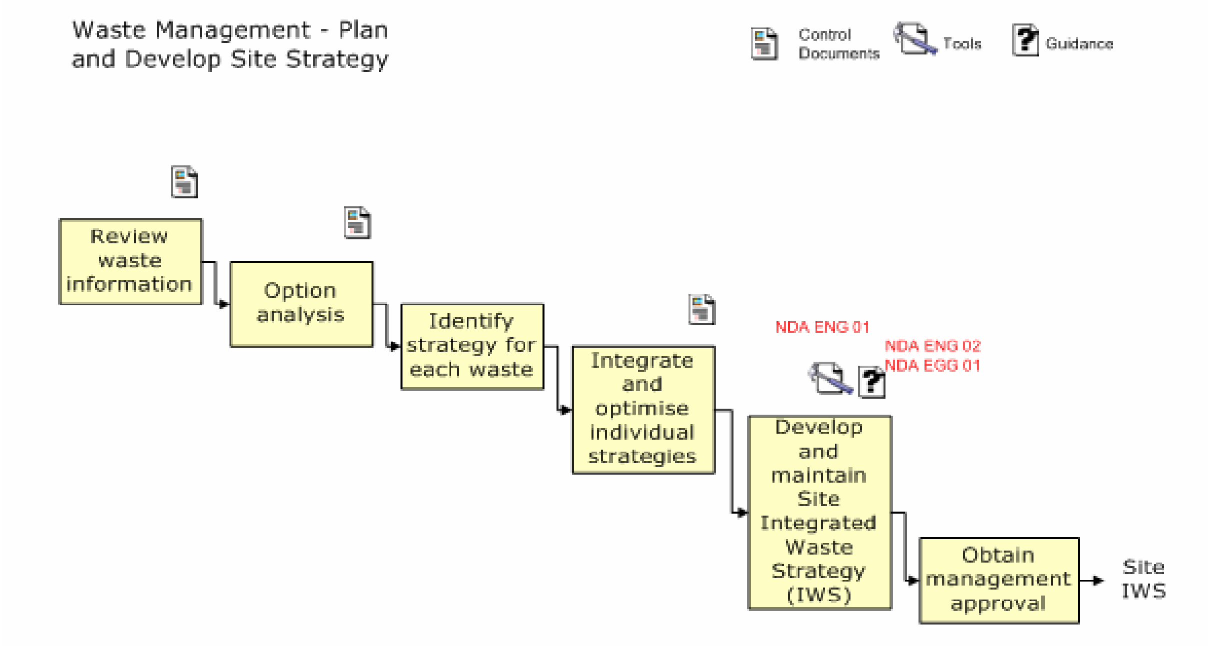

Figure 5: Site Strategy Development Process

66) With the overall Site and key waste stream strategies in place, the responsibility then falls to individual projects to develop their own waste strategies for review and approval. Projects prepare their strategies in accordance to the process set out in Figure 6.

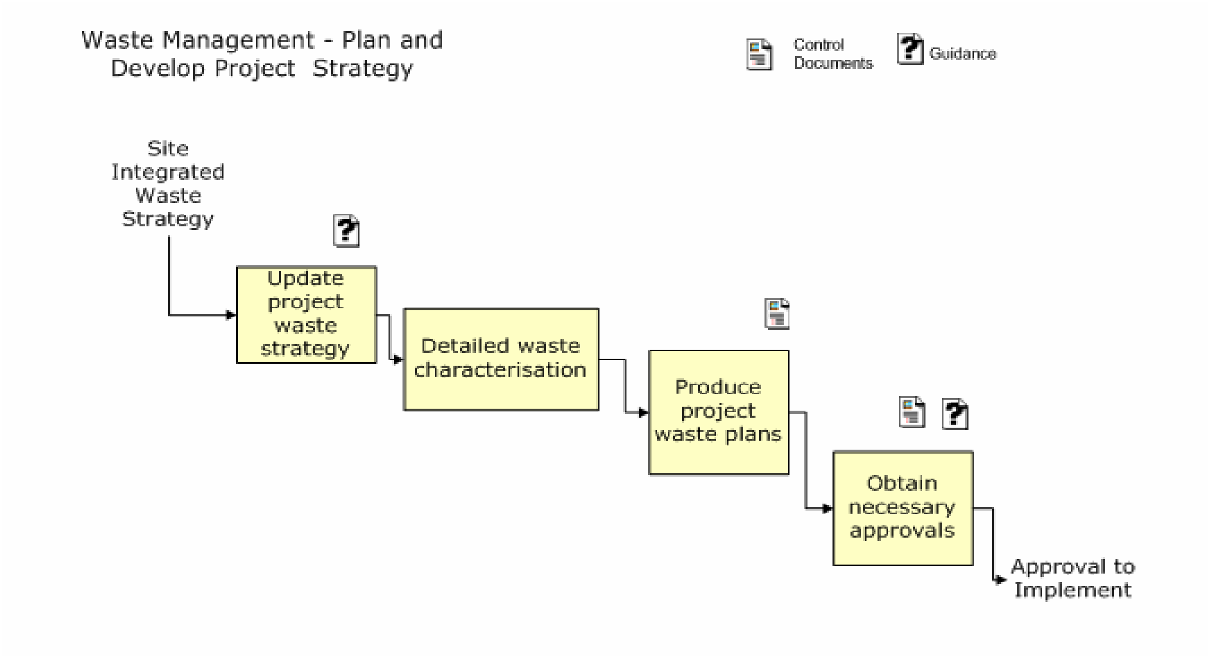

Figure 6: Plan and Develop Project Waste Strategy

67) Following approval of the project strategies these are then moved to the implementation phase. Again, the following process map, Figure 7, defines the key steps to be undertaken by the project.

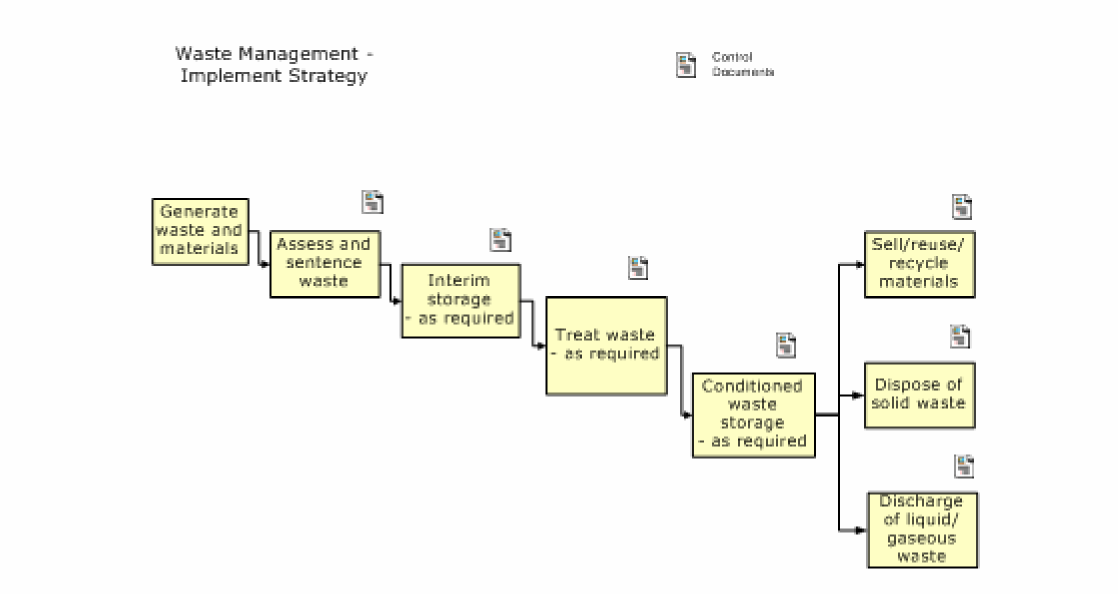

Figure 7: Waste Management – Implement Strategy

68) Dounreay ensures continual improvement in its Safety, Health, Environmental and Quality Management by establishing and monitoring annual objectives and targets. The overall site performance in implementing management systems is measured through a programme of integrated monitoring activities.

3.3.3 Waste Management Requirements

69) Dounreay's waste management requirements are covered in the Dounreay Waste Manual which details the roles, responsibilities and requirements to allow consignment of solid wastes and some liquid wastes and aids demonstration of compliance against the Site Authorisations (9).

70) The combination of the Dounreay Waste Manual and associated Guidance Notes set down the requirements to implement the waste hierarchy both at a Strategic level and then again at the PSWP level. This is supplemented with BPM studies.

71) The following diagram (Figure 8) details the relationship between the documents currently in place.

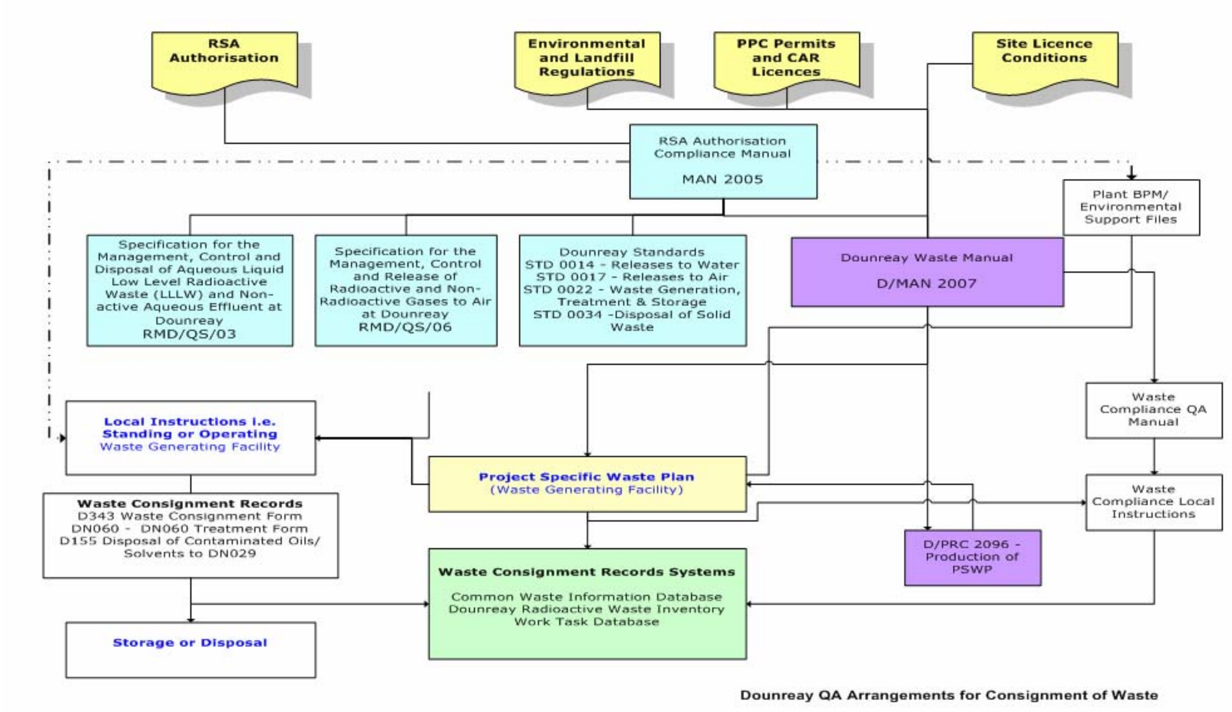

Figure 8: Dounreay Waste Management Documentation Hierarchy

72) The Waste Manual requires Project Managers/ATO holders to:

- Ensure that a waste management plan consistent with the IWS is developed and maintained for the facility or project within his responsibility.
- Make arrangements to prevent or otherwise minimise the creation of all wastes where possible in accordance with the waste hierarchy, and to avoid the unnecessary accumulation of waste.
- Categorise waste appropriately, segregating wastes as necessary.
- Ensure that the approach taken to manage current and future waste arisings represents the BPEO in accordance with the site IWS.
- Check and maintain the effectiveness of arrangements and equipment required to manage waste by ensuring that the quantities of waste are minimised via robust and transparent options studies e.g. BPM or Best Available Technique (BAT) as appropriate, and that re-use and recycling opportunities are maximised where practicable.
- Maintain documented arrangements for the management and disposal of all wastes across the Site and for each facility or project, ensuring recording of relevant facility and waste information. The documented arrangements include the arrangements and responsibilities for:
  - Receipt, transport, processing, storage, consignment, disposal of wastes and monitoring of transfers/consignments
  - Maintenance of waste-service agreements
  - Sampling, monitoring and measurement
  - Management and retention of information, records etc
  - Management of interfaces with other facilities and projects and other Sites

73) The PSWPs detail the methodology and equipment being used by a project to characterise and consign wastes where appropriate. These PSWPs are independently checked and verified by a number of Specialist Advisors in the areas of radiological protection, intermediate level waste and waste compliance. Only once all parties have agreed the methodology and waste quantities can the waste be consigned. The

emphasis is on “at source” monitoring and categorisation with subsequent assay operations focussed on compliance.

3.3.4 Good Practice and Research and Development (R&D)

74) Dounreay promotes the sharing and use of good practice across waste streams and projects on the site through the formal meetings listed under Section 3.2. DSRL have allocated individual Site representatives to attend a wide range of NDA, Regulatory and inter-industry workshops, meetings and good practice sharing activities. Dounreay believes these forums are important to information exchange with other SLCs and also influencing future initiatives. Examples include:

- Attendance at national working groups such as:
    - Clean & Exempt Working Group (CEWG),
    - Nuclear Waste Research Forum (NWRF),
    - Magnox Radioactive Waste and Decommissioning Technology Group (RWDTG),
    - Inter Industry Group on Contaminated Land (IIGCL),
    - Soil and Groundwater Technology Association (SAGTA),
    - NDA Strategy, Technical Working Groups and Integrated Project Teams,
    - NDA Radioactive Waste Management Department (RWMD) Packagers liaison meetings.
- Participation in the collaborative development of a cross-industry web-based database on waste minimisation.
- Attendance at conferences and workshops.
- Specific industry collaborations on particular issues.

75) The interaction developed between the 3 Scottish NDA sites (Dounreay and the 2 Magnox SLCs, Hunterston and Chapelcross) on environmental issues has continued, with a meeting held in December 2009 and another planned for March 2010.

76) Dounreay also maintains a Lessons Learned database containing safety, waste and environmental issues as well as project management.

3.3.5 R&D

77) Dounreay’s R&D requirements are set out in the Technical Baseline and Underpinning Research Document (TBuRD) document which accompanies the LTP. The R&D work can focus on many areas with the key ones related to decommissioning and waste management.

78) Dounreay is represented as an SLC on the NWRF and the RWDTG. This has led to project interactions taking place on specific topics and DSRL also reviewing and participating in some of the Generic R&D being undertaken by Magnox.

79) With respect to ILW issues, Dounreay follows the LoC process as a framework to demonstrate in a robust manner that wastes can be suitably treated and packaged to make them passively safe. This framework then provides a structured approach to development work. This process remains applicable to the long term storage of HAW at Dounreay once it is formally implemented.

80) Some good examples of the R&D being undertaken by DSRL are shown below, firstly from the Shaft and Silo Retrieval Project:

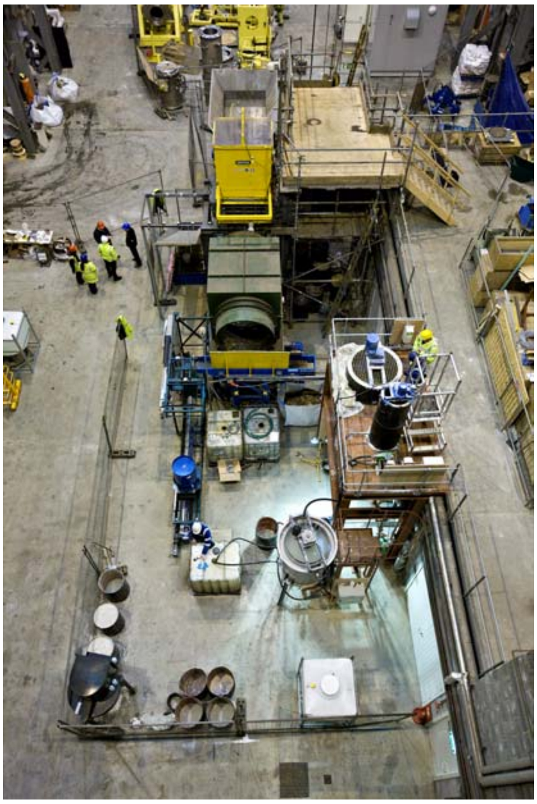

Figure 9: Shaft and Silo Trials Equipment

81) In the past year, PFR have undertaken sampling of reactor components to ascertain the validity of computer modelling of radionuclides. To date the same have confirmed that the modelling correctly identified the correct boundary between ILW and LLW. It also identified higher than anticipated amounts of tritium and these are now being investigated further.

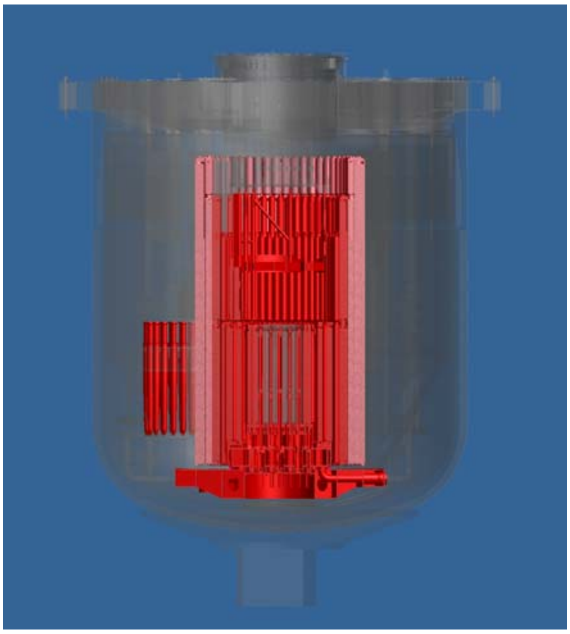

Figure 10: PFR Reactor Vessel – ILW Zone

82) It must also be recognised that decommissioning practices also require changing from those used in historical projects. Therefore, the use or design of new equipment may be required to assist in the decommissioning facilities where decommissioning was not a primary concern during construction. With decommissioning, a key area for learning is associated with the success or failure of decontamination agents, strippable coatings or fixative solutions with an aim of reducing hazard to workers and possibly reducing the waste category.

Figure 11: Use of Decontamination Agents and Strippable Coatings to Protect Workers during Decommissioning

3.3.6 Skills, Records and Interfaces

3.3.6.1 Skills

83) Dounreay also produces a “Workforce Transition and Skills Plan” (10) for submission to NDA which, as a minimum, covers: key skills required in the short, medium, and long term; identification of skills gaps and links to the migration of the existing workforce; sensitivities relating to demographic change; recruitment and training strategies; links with training providers; succession planning; and supply chain strategies for long-term availability of skills. Each skills strategy also includes a technical competency framework which incorporates key technical areas including waste management. The sites' skills strategies are analysed and developed to ensure the appropriate supporting infrastructure is in place, and that any key issues or skills gaps are identified.

3.3.6.2 Records

84) The management of waste records and information is the responsibility of the SDWCU in accordance with the current quality management arrangements. This applies to both waste retained on-site and despatched off-site. The exception to this is the recording and reporting (internally and externally) of site environmental discharges which is managed by the Environmental Team from the Assurance Unit. The external reporting requirements are laid down in the Site Authorisation.

85) Dounreay has to retain records for all wastes consigned off-site as part of its “Duty of Care”.

86) Dounreay also utilises a Record Retention Schedule which defines the type of records requiring to be archived and for how long. Dounreay has its own on site archive and at set review periods, records are either retained, destroyed or transferred to the national

archive at Kew. DSRL will consign information to the new NDA Archive facility once it is established.

87) The NII/EA and SEPA have also recently issued guidance (11) on "Managing Information and Records Relating to Radioactive Waste in the United Kingdom" as part of their Joint Guidance for the management of Higher Activity Waste on nuclear licensed sites. DSRL have participated in the review of this guidance and will look to incorporate it into its management systems once the document is formally released. This may involve a review of record ownership and retention periods.

3.3.6.3 Interfaces

88) The interfaces with other sites relating to waste are managed in a variety of ways:

- The waste disposal and authorised transfer routes utilised by the Dounreay site are outlined in Annex 2 and section 6.4. At present, Dounreay has no reference strategies in place requiring handshakes to dispatch waste to other NDA sites. SEPA has indicated that opportunities to transfer wastes, under the RSA, outside Scotland for treatment and/or disposal should be explored (12). This has been further strengthened in their HAW consultation which asks for views on the treatment of HAW at other locations either within Scotland, the UK or elsewhere in the world.

- Interface management is required to ensure that wastes can be returned to overseas customers as part of Dounreay meeting its contractual and regulatory obligations. These requirements are also enshrined in the Site Authorisation.

- An important waste strategy interface is that with the neighbouring MoD establishment, Vulcan. Regular meetings are held with Vulcan management to update them on decommissioning timescales for Dounreay to allow them to assess any potential impact on their programme and also for the MoD to provide information on their plans for future operations and decommissioning.

- Individual agreements are in place with a variety of waste brokers, waste carriers and waste management contractors for the purposes of reuse, recycling or disposal of a variety of non-radioactive waste types from the Dounreay sites. These include metal scrap yards, inert landfill and non-hazardous landfill.

- DSRL all have informal exchanges of information when they attend industry meetings in addition to any formal actions.

4 FORMULATION OF INTEGRATED WASTE MANAGEMENT STRATEGY

89) Dounreay led the way in the UK when it published the DSRP in 2000. It was the first time a UK nuclear facility operator had attempted to produce an integrated decommissioning and waste management strategy and programme to take the site through to closure.

90) That experience and the evolution of strategies and technology advancements are now being built upon in the continuous improvement of those strategies which underpin the LTP for the Dounreay site. This section describes how Dounreay undertakes a range of options studies as necessary to develop and implement its waste management strategy.

4.1 Methodology for Strategic Option Studies

91) Dounreay undertakes a variety of strategic option studies as necessary to develop and implement the waste management strategy. These may comprise BPEO studies used for the management of wastes, strategic option studies used for decommissioning projects and the use of BPM methodology to minimise the production of waste when implementing a preferred option.

92) Sometimes, rather than formal BPEO studies, there is a requirement for technical options workshops, which is essentially the next level down. These meetings are conducted using BPEO type methodology to determine the best technical solution.

4.1.1 BPEO Studies

93) The BPEO is the option that provides the most benefit or least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term. This option is usually identified using a systematic and consultative decision-making procedure in which options are assessed against various criteria including environmental impact, socio-economic impact, health and safety, technical viability and financial cost.

94) Dounreay has updated existing procedures for performing BPEO studies (13), which involves the assessment of waste management options against a range of attributes and encourages the use of options assessment workshops.

95) One of the key stages of a BPEO Study is the information gathering stage. Information needs to be gathered to ensure that the Study identifies realistic options for each of the wastes. Information should cover current best practice, techniques which have been applied elsewhere, any new or novel techniques which might have been developed and any 'blue-skies' research issues that may be relevant. Information gathering is carried out early to avoid reassessing options where information already exists and remains valid.

96) The Dounreay guidance for BPEO Studies provides a list of assessment attributes which should be considered as a minimum. This ensures that, regardless of site and waste stream, all Studies undertaken deliver consistency in the consideration of relevant attributes. However each study is unique so this list is often modified to exclude attributes which are not relevant to the study and/or to include any extra attributes thought relevant to the particular study.

97) Where a study covers more than one waste stream, waste streams are grouped to which the same strategic options can be applied to all the wastes within each group. This promotes consistent management strategies for equivalent wastes. It is essential to the BPEO Study that the waste streams are well defined prior to commencing any options identification.

98) In carrying out a BPEO study, cognisance is taken of other such studies which are being carried out on the site in order to manage interrelationships between different wastes streams. The study also recognises opportunities for cooperation with other sites and organisations. For example, there may also be interfaces with other sites where strategy options involve utilising waste management facilities on another site.

99) Three types of BPEO studies have been typically carried out: Site-wide studies, facility specific studies and waste stream specific studies. BPM studies are generally carried out for individual facilities or waste streams.

100) Dounreay, as part of its RSA authorisation requirements has completed the initial 2 phases in the production of a "Site Wastes BPEO". The first phase was to benchmark the current waste strategies against UK and International best practice on waste minimisation. That work concluded that at the strategic level, DSRL were already implementing best practice, or BPEO, for most of its waste streams.

101) However it did also identify that several waste streams required the BPEO to be assessed. Those streams were:

- CHILW Graphite
- LLW Sludge (granular, putrescible)
- LSA Scale.
- Clean Hazardous Sludge.
- Exempt Hazardous Sludge.

102) A group of DSRL staff and a representative from the Dounreay Stakeholder Group (DSG) participated in assessing the options for the management of the streams identified above. A report (14) was issued. For streams such as the CHILW graphite and LSA scale, the assessment panel confirmed that the reference strategies which had been developed by DSRL can now be supported by a BPEO assessment.

4.1.2 Decommissioning Studies

103) At Dounreay, strategic options studies for decommissioning are undertaken at a facility or project, rather than at a site programme level. The original Dounreay Site Restoration Strategy (DRSR) was underpinned by a suite of these strategic options studies, or Level 2 decommissioning studies as they were titled at that time. These studies were completed in 2000. Projects use these Level 2 studies as the starting point for developing their LTP and can lead to more detailed options studies to develop and improve their decommissioning and waste management strategies.

104) DSRL have no formal requirement to produce Decommissioning studies for facilities to be decommissioned although some Project Managers still adopt this structured approach, DSRL guidance simply points to the production of LTP deliverables such as scope, basis of estimate and schedule as the "decommissioning study".

4.2 Site Prioritisation

105) The NDA prioritisation procedure (15) is applied to the site's liabilities to support the LTP schedule, with the results of the prioritisation exercise being used to inform the development of the schedule. Because the calculations cannot be completed until the schedule is frozen, the submitted schedule was influenced by the LTP 2008 Rev D scores. The prioritisation scores submitted with LTP 2010 will be used in the subsequent development of the schedule.

106) An exercise is carried out annually to calculate the Safety and Environmental Detriment (SED) scores of facilities, taking into account any changes which have occurred throughout the year. Facilities are then ranked according to their SED scores.

107) The ten facilities with the highest SED scores are given in the table below:

SED Rank 2010	SED Rank 2008 RevD	Facility code	Facility Description
1	1	D1101	Ion Exchange Plant - DFR
2	2	PFR(12)	PFR (Secondary Containment Building - housing Reactor Hall)
3	N/A	PFR (20)	Steam Generator Building
4	3	D1225	ILW Disposal Shaft
5	N/A	DN226	Primary NaK Dump Tanks(1-6) Containment Building
6	N/A	PFR (15)	Sodium Store Tank Farm
7	13	D1206	PFR Processing Plant (includes D1214 link)
8	4	D1208	Liquor Store
9	N/A	D1115	Store – formerly Evaporator Repair Workshop (former Turbine Generator House)
10	5	Zone 4	Area of Contaminated Land

Table 5: Top 10 DSRL Facilities Based on SED Scores 2010

108) As last year, the site's top ranked SED score relates to the bulk NaK in DFR. Significant progress has been made this year on the management of this liability, with 10.24 tonnes of bulk NaK being destroyed to February 2010.

109) Although the PFR Reactor Hall remains in position 2, a reassessment of the sodium quantities and an improvement in the condition of the facility (ground water ingress in West End Mortuary has been prevented by grouting of area) has resulted in a lower SED score.

110) Most changes in the top 10 ranking relate to a reassessment of the potential detriment scores of the various sodium and potassium residues in PFR and DFR, as these were not well modelled in the previous systems. This robust alkali metal remodelling exercise has resulted in the creation of 6 additional facility SED scores, 4 of which now appear in the site's top 10:

- Position 3 - Steam Generator Building – houses the Secondary Cold Trap Loop and the Secondary Dirty Dump Tanks.
- Position 5 – Primary NaK Dump Tanks.
- Position 6 – Sodium Store Tank Farm.
- Position 9 – Store – houses Eutectic NaK drums, Reactor NaK bowser and Winfrith sodium bowser.

111) The main reason for the appearance of D1206 in the top 10 is due to the identification of a number of significant faults in D1206, including defects relating to the plant engineering systems and the structure of the building.

112) The Shaft has dropped down the rankings due to a reduction in the waste uncertainty, resulting in a reduced overall SED score. The reduction in waste uncertainty was recommended in the findings of "Report from a Review Panel which Considered the Scoring System for Safety and Environmental Detriment" (16).

4.3 Waste Management Constraints and Dependencies

113) The external policy drivers and constraints that affect the radioactive waste management and which have influenced the development of the IWS are considered in this section.

4.3.1 Regulatory Constraints and Dependencies

114) The external policy and regulatory framework is complex with regulations/legislation covering radioactive waste, liabilities management, nuclear facility decommissioning, radioactive discharges, general waste strategies, sustainable development, health and safety, and security being of relevance. The Regulatory principles and related drivers and constraints which affect Dounreay's waste management strategy are given in Annex 1 under:

- Legislative Framework
- RSA Authorisations
- Site License Conditions
- EURATOM Treaty Requirements
- Requirements of the Office for Civil Nuclear Security (OCNS)
- OSPAR Convention
- Scottish Government Policy on HAW and Waste Substitution

4.3.2 Financial Constraints and Dependencies

115) Although acceleration of Dounreay's baseline is an objective, current planning activities lead to an Integrated Programme which is reasonable, achievable, defensible and agreeable to Stakeholders within the Annual Site Funding Limit (ASFL).

116) The NDA have started a competition process to identify a new Parent Body Organisation (PBO) for the management of DSRL. As part of that competition process the NDA have announced that, after 2010/11, that funding will be capped at a level of up to £150 million per annum for the duration of the contract to achieve the interim end state, currently planned to be achieved by 2025. This has been termed Planned Assured Funding. This level of funding will require a reworking for some of the current strategies on the Dounreay site but this will only be addressed during 2010/11.

117) Dounreay receives a small amount of income associated with the storage of cemented product from historical reprocessing contracts, the storage of fuels and the management of solid and liquid low level wastes from the MoD facility at Vulcan.

4.3.3 Timing Constraints and Dependencies

118) The high level strategies for each major waste stream are now fully integrated in the logic of the Dounreay LTP schedule and therefore the waste strategy drives the programme. This ensures that any changes to the timing of projects will also highlight any impact on waste facilities or strategies.

119) During the development of IWS, due consideration has been given to what waste is scheduled to be produced and when on the Dounreay site. This has assisted in determining the required timing and availability of waste treatment and storage facilities/routes to deliver the IWS.

120) The LTP schedule recognises that there are timing constraints associated with minimum times for design and construction of new facilities, standard regulatory periods or technical issues such as the availability of sample or inventory information to allow the development of encapsulation formulations and to then specify plant requirements. DSRL are continually working with the Regulators to streamline review and approval processes.

121) Although the Site IEP is shown as a specific date in each LTP, it is a target derived from planning estimates and therefore subject to change dependant on other

programme constraints, funding etc. It should not be viewed as a deadline. This is particularly important due the NDA announcement on the Planned Assured Funding levels which may impact on the construction of new facilities for the packaging of HAW.

4.3.4 Technical Constraints and Dependencies

122) DSRL will require a considerable amount of technical knowledge and development to facilitate both the decommissioning and waste treatment and packaging operations.

123) Dounreay sends its own representatives to participate in NDA initiatives as well as technical and stakeholder forums. This is viewed as a significant benefit and offers the opportunity to share knowledge with other SLCs and perhaps influence work packages and save the NDA money by doing so.

124) The TBuRD for Dounreay details, at the project level, the main R&D requirements but the collective themes are listed below.

- Waste retrieval and size reduction systems
- Robotics and remote handling/cutting technology
- Fuel extraction, conditioning and repackaging
- Waste encapsulation (cementation/grouting)
- Waste characterisation
- Particles monitoring/retrieval and contaminated ground
- Alkali metal removal
- Tank washout and chemical decontamination
- Radioactivity abatement by ion exchange
- Mercury decontamination
- Gas and liquid filtration and monitoring
- Waste containment/packaging

125) DSRL have published a version of its 2008 TBuRD (17) on its website.

4.3.5 Transport Constraints and Dependencies

126) There are no current plans to transport radioactive waste from the Dounreay site until conditioned ILW is transported to a UK GDF from 2050 onwards, apart from any conditioned ILW required to be returned to Overseas Customers.

127) The draft Scottish Government policy for HAW discusses a number of transport related issues that could impact on the DSRL IWS, namely the option of transporting HAW from its site of origin for treatment along with the possibility of transporting wastes to central locations for long term storage.

128) When the new LLW Disposal Facility is constructed the assumption is that it will remain part of the Site and therefore no off-site transport requirements will need to be met.

129) Clean or exempt waste is collected for recycling, re-use or disposal mainly by approved contractors. They then transport the materials to other locations in Scotland and the UK. Whilst transport of materials over long distances may not seem BPM it is sometimes the only location the material can be taken to. Overall, this is managed to be efficient and cause least disturbance to the local community.

130) On-site waste transport is a key function within SDWCU at Dounreay. SDWCU is tasked with ensuring that the correct transport provision is available for the movement of wastes on the Dounreay site. SDWCU also collect LLW HHISO containers from the

manufacturer, often tying in the collection with the transfer of other materials to other UK locations.

131) It is recognised that better project waste estimates leads to better integration in waste transportation. Therefore, the introduction of PSWPs has improved near term planning of waste collections on-site. Improvements are still required for estimates out-with the first year covered by PSWPs.

132) Currently, the provision of flasks for the movement of RHILW on the site has not been adequately reviewed, which could lead to a potential bottleneck in the LTP. Assumptions on the provision of additional flasks have been made in LTP but these assumptions require to be validated. However, this year a package of work is being carried out to model the site's flask requirements which will allow DSRL to visualise how many flasks are required over what timescales. This will allow DSRL to prioritise flask movements and allow them to identify if and when additional flasks will be necessary. This work is due to be complete by the end of March 2010.

133) Dounreay has made provision in the LTP for the purchase of new flasks to allow the transfer of unconditioned overpacked 200 litre drums as well as conditioned 500 litre drums and $3m^3$ boxes around the site to the RHILW-IEP drum and box stores.

134) Last years IWS highlighted the opportunity to potentially utilise redundant Waste Product Encapsulation Plant flasks from Sellafield however this has not been realised.

135) Provision for new cross site transporters to move these flasks around has also been included in the LTP. DSRL have been collaborating with Magnox North in this area in the past year.

136) Within the Final End State (Phase 3), the assumption is that NDA, or the UK GDF operator, will provide transport flasks to take waste to a UK GDF. Dounreay will load these flasks on site and then transfer them to a nearby railhead, currently assumed to be Georgemas Junction.

137) There are 2 constraints associated with this transfer:

- Suitability of the public roads;
- Clarification of transport regulations regarding indivisible loads. This topic has been the subject of a recent Department of Transport seminar.

138) This baseline will be revisited once the Scottish Government Policy for HAW is published later in 2010.

4.3.6 Key Site Specific Constraints and Dependencies

139) The key dependencies are covered in the sections above. The constraints on the overall management and prioritisation of the Dounreay LTP will have the biggest impact on the waste management tasks undertaken on the site. Waste management strategy is fully integrated in the current schedule and processes will be undertaken to ensure that any changes in LTP are fully assessed as part of the BCP process.

140) A waste strategy is only as good as the data on which it is based. A number of the underpinning studies are now several years old, but are still relevant. DSRL continue to undertake a programme of "walkdown" surveys to provide detailed improved information on specific facilities.

141) DSRL will also be committing to undertake the development of 3 point estimates for its waste streams to allow the robustness of the strategies to be investigated.

4.4 Site End Points and Contaminated Land

4.4.1 Site End Points

142) In 2006/07, stakeholder consultation was undertaken with the aim of recommending to the NDA, the preferred end state for the Dounreay site. The results of this consultation are described in the publicly available document “Defining the Dounreay Site End State – Results of Consultation” (18).

143) The recommended end state has been incorporated into Dounreay’s LTP. The details of the end state for Dounreay are outlined below and are also described in draft document 14312/TR/0041 “Summary of End States Descriptions in Support of the NDA End States Strategy” (19).

144) The decommissioning and restoration programme for the Dounreay site is split into 4 key phases:

- 1st Phase – Decommissioning – Present day to 2025 (IEP)
- 2nd Phase – Interim Storage – 2025 to 2050
- 3rd Phase – Off-Site Transfer and Final Demolition – 2050 to 2078
- 4th Phase – Care, Surveillance and Site Closure – 2078 to about 2300 (FEP)

All site restoration work is planned to be complete by IEP, albeit some further clean up will take place when the stores are finally demolished.

145) By the IEP, at the end of the 1st Phase:

- Decommissioning of all redundant facilities will have been completed;
- All waste streams will have been appropriately treated and conditioned, with the solid LLW disposed to in the new LLW Disposal Facility;
- ILW will have been conditioned and packaged and will remain stored on-site within 3 stores, awaiting the availability of the national GDF;
- Nuclear material will have been packaged and will remain stored on-site awaiting the availability of an off-site route;
- The LLW Disposal Facility will be partially closed off; with final closure a year or so into the 2nd phase;
- The DFR sphere will remain as a historical monument depending on the outcome of work currently in hand with Historic Scotland to define a site heritage strategy;
- Redundant infrastructure will have been removed or isolated;
- Infrastructure associated with the remaining stores, including security infrastructure and the PCCB, will remain in place;
- All the engineering work to enable the site to be delicensed at a future date will have been executed, apart from the decommissioning and demolition of facilities in use at the IEP.
- Approximately 30% of the currently licensed Site will have been delicensed (dependant on a robust business case being made).

Figure 12: Dounreay at IEP 2025

146) During the 2nd Phase, the conditioned ILW and nuclear material packages in the remaining stores will be monitored awaiting the availability of the off-site transfer routes, which are scheduled to come available from 2050 onwards.

147) During the 3rd Phase, the conditioned ILW and nuclear material packages will be transported off-site. The current assumption is that an UK GDF will be available to receive Dounreay's waste from 2050, with all ILW removed from the Site by 2060. The nuclear material is scheduled to be transported from the Site between 2075 and 2076. As each building is emptied, it will be demolished along with any associated infrastructure that needs to be removed. The final activity of this phase will be to demolish the PCCB, once the nuclear material has been completely removed, and to undertake any minor remediation tasks arising from the demolitions.

148) From 2078 onwards (the 4th Phase) the site will be under care and surveillance up to ~2300, when the remainder of the site will be delicensed.

Figure 13: Dounreay at FEP

149) During Phases 2 to 4, it is anticipated that residual radioactivity and chemical contamination on the areas of site that remain licensed will be covered by a PCSC, which will demonstrate the long-term safety of the site in its end state. In the period up to the IEP and beyond, an Integrated Performance Assessment tool, will be used to aid

decision making for restoration activities, calculate clean-up levels and act as a source of much of the information required for the PCSC.

150) Dounreay will seek authorisations to support its End State strategy at appropriate times in the LTP, following regulatory consultation.

4.4.2 Contaminated Land

151) Dounreay has produced a strategy for contaminated land management and remediation (20) that has been submitted to the NDA, NII, SEPA and Highland Council. The Dounreay site also has a Contaminated Land Safety Case (21) in place which details the known contamination hazards and assesses them against industry standard safety case assessment criteria. The safety case refers to a supporting assessment of radiological risks from contaminated land in its current state, which will also be updated using the Integrated Performance Assessment tool. Current understanding of contaminated land is documented in a Land Characteristics Report (22) and Contaminated Land Annual Reports (23), updated as appropriate.

152) In terms of contaminated land management through to the IEP, Dounreay is characterising land around facilities and under facilities when this becomes possible as decommissioning progresses. Characterisation comprises measurement of possible contamination and assessment of associated risks to human health and the environment. Where it is not possible to demonstrate that the risk-based end-state criteria can be met by leaving contamination *in situ*, remedial work will be undertaken. Where remediation must be delayed for logistical reasons, contamination will be managed *in situ* to meet safety and environmental requirements.

153) The intention is to produce the least excavated waste possible whilst still demonstrating compliance with the "no danger" criterion for radioactively contaminated land and both no "significant possibility of significant harm" and "no significant possibility of significant pollution of the water environment" in respect of non-radioactive contamination. Dounreay will continue to monitor its areas of contaminated land and characterise areas in support of projects as and when necessary. The scope and schedule of work to achieve this is contained in the current LTP and is revised through change control. An inventory of estimated lifecycle waste arisings is maintained in DRWI and updated annually. This inventory includes radioactive and chemical contamination.

154) The land and associated groundwater on the Dounreay site have been surveyed over a number of years in order to determine the extent and concentration of contaminated land and groundwater. Results of these surveys are documented and processed using a Geographical Information System (GIS) based records management system developed to enable the systematic collection, interpretation and assessment of associated data. The system is known as IMAGES - Information Management and Geographical Evaluation System.

155) It has been assumed that a cap will be placed over parts of the Site that require it to make the safety case. This might be up to 2m thick and be composed of clean and exempt material from decommissioning and construction works including the new LLW Disposal Facility. The assumption is that the material used for this and any other backfilling operations will be material which has been retained in the Onsite clean/exempt storage compound for recycle/reuse, subject to Regulatory consent. It is anticipated that there will be no significant export of clean/exempt rubble and soil from decommissioning operations.

156) An assessment is being made of the necessary protocols and processes to maximise the retention, recycle and reuse of decommissioning materials for use in site restoration.

157) National strategy for LLW recognises a category High Volume Very Low Level Waste (VLLW), which could be authorised for disposal to landfill. DSRL may consider making an application to dispose of material in such a manner, although restricted to the filling of below ground voids and cavities on-site rather than to local landfills.

158) The main uncertainty over the site end state is whether it can be fully implemented through the current regulatory regime. The Dounreay IWS is consistent with the end state but there may be events beyond Dounreay's control which make it impossible to achieve this e.g. the transfer of ILW to UK GDF as this will depend on Scottish Government policy for HAW. Should the physical state evolve differently, leading to a different end state, then the impact on the IWS will be re-assessed.

4.4.3 Groundwater

159) Dounreay has a series of boreholes across its site to allow both an understanding of groundwater flows and also to monitor the possible presence of radioactive and chemical contamination in groundwater. Monitoring results are reported annually.

160) Groundwater contamination is known to be present on the site and characterisation is ongoing through both monitoring of seepages and also of borehole water. Once information is available assessment of the possible need for remedial action is undertaken.

161) In 2009 the highest priority, and a regulatory requirement, was to manage the seepage of radioactively contaminated water offsite at the Castle Gate Drain seep. The seepage no longer poses a problem due to groundwater pumping from Manhole 5 to the LLLETP for discharge through the authorised disposal route.

162) A package of work to understand groundwater flows through the site has been completed. The output of this work will be an action plan to address any issues which arise.

163) Initial indications from the work suggest that the Site is managing a large volume of clean water which runs through the site from the South. Much of that volume has to be discharged via regulated outfalls. Options are being considered for capturing a fraction of the groundwater before it enters the site, so that it can be routed round the site or down the Mill Lade.

4.5 Assumptions, Exclusions and Risks

164) The Dounreay LTP is underpinned by assumptions and exclusions as well as identifying risks. Assumptions and exclusions are addressed in accordance with NDA requirements in PCP-09 for cost estimating and the management of risk is carried out in accordance with NDA requirements in PCP-10 for risk management.

165) The LTP10 Site Summary contains lists of the major assumptions and exclusions and top level risks which are associated with the Dounreay LTP10 baseline. The following tables provide some **examples** of the major assumptions and exclusions which are related to waste. Dounreay has an ongoing process of review to ensure that the assumptions and exclusions are relevant and underpinned.

ASSUMPTION	JUSTIFICATION
It has been assumed that environmental remediation will be able to reduce the radiological risk from the site to less than 1 death per million per year.	Regulator guidelines show that risks are tolerable at this level.
It has been assumed that no further ground contamination is discovered.	Based on historical finds, up-to-date knowledge and well managed projects.
It has been assumed that the Dounreay Interim End State conditions will be radiological and industrial brown field. Areas of the Dounreay Site may become available when appropriate for other potential uses.	This assumption has been taken from the results of the stakeholder consultation on Site End State, undertaken in 2007.
It has been assumed that off-site facilities will continue to be able to accept non-radioactive hazardous and non-hazardous waste on an as-needs basis.	There is a National Customer Demand for these facilities and as such they will remain open and available to accept these waste streams.
It has been assumed that unirradiated uranium and plutonium will be stored on-site until site activities end in 2076.	This is consistent with NDA strategic assumptions 11 and 12 (see EGG08 for LTP2008).
It has been assumed that spent fuel will be stored on-site until a national High Level Waste/Spent Fuel Repository is available in 2075.	This is consistent with NDA strategic assumption 6 (see EGG08 for LTP2008).
It has been assumed that the conditioned Intermediate Level Waste and Spent Fuel will be transferred off-site.	This is in line with the current NDA strategy.
It has been assumed that utilities, waste and infrastructure will be supplied to support Vulcan as long as they are also required by Dounreay.	This is consistent with NDA instructions see T1-010-05-eNDA-0912 and T1-010-05-eDSR-1846.

Table 6: Example Major Assumptions from Site Summary

EXCLUSION	JUSTIFICATION
Restoration and decommissioning activities at Vulcan except for provision of services.	DSRL are not contracted to undertake restoration and decommissioning at Vulcan.
The scope, schedule and cost for the long-term management of (i) ILW transferred from the Dounreay Site in the period 2050-2078, and (ii) disposed LLW beyond 2078 are excluded from the Dounreay Lifetime Plan.	Derived from NDA instruction.
The scope, schedule and cost for the long-term management of contaminated land at Dounreay beyond 2078 are excluded from the Dounreay Lifetime Plan.	Derived from NDA instruction.
Changes in the letter-of-compliance requirements specified by RWMD.	Industry practice.

Table 7: Example Major Exclusions from Site Summary

4.5.1 Risks

166) Risks are identified by means of a top down (strategic) review and bottom up (project) review to capture events which may impact positively or negatively on the outcome of objectives. Risks are reviewed on a monthly basis.

167) All risks to the Dounreay programme, including those relating to waste, are captured on the site's Risk Management Database (RMD), which records a description of the risk, its probability, consequence, mitigating actions and magnitude in terms of time and cost.

168) Some **examples** of the top level waste-related risks to the Dounreay LTP10, together with the possible impact, mitigating activities and status, are summarised below.

TOP LEVEL RISKS	
Description	**There is a risk that the transfer system in D1208 fails.**
Possible Impact	Resulting in being unable to immobilise the remainder of the tank inventory without major additional work. Major delay to Interim End State and significant extra cost.
Mitigation Activities	Develop the design and safety case to modify cell 5 transfer system utilising spare pipework and investigation of liquor chemistry.
Status	Further understanding of the impact to the complete transfer system being developed.
Description	**There is a risk that there is a major failure of the sodium/potassium disposal plant.**
Possible Impact	Resulting in damage to the Reactor Vessel or associated valves and ultimately in DSRL being unable to recover the DFR Breeder in time to be processed at Sellafield.
Mitigation Activities	Continuous monitoring of the state of the plant.
Status	Maintenance and monitoring activities continue.
Description	**There is a risk that regulations (or standards at that time) may indicate that the new fuel storage facility will require to be built underground.**
Possible Impact	Resulting in major cost implications to construct an underground storage facility.
Mitigation Activities	Early discussions with the regulators.
Status	Continued discussions with the regulators.
Description	**There is a risk that additional processes are required for the CHILW waste feeds.**
Possible Impact	Additional development work may be required. Additional design and build costs and LoC/product development work.
Mitigation Activities	Further inventory investigations. Waste will be pre-characterised prior to export. Design to incorporate area for re-packing drums.
Status	Strategy being reviewed.
Description	**There is a risk that the shaft waste retrieval equipment is unable to empty the shaft.**
Possible Impact	Resulting in the need to develop and install alternative methods.
Mitigation Activities	Part of the ongoing Scheme Design work to demonstrate, by inactive trials, that the technology will work.
Status	Develop scope to carry out inactive trials.
Description	There is a risk that DSRL are required to empty/retrieve/remediate Landfill 42.
Possible Impact	Resulting in retrieval/remediation being required with the potential for project delay and high cost impact for the remediation work.
Mitigation Activities	Scope is being developed to close and cap the landfill in line with regulator requirements.
Status	A post operational closure report is being prepared.

Table 8: Example Top Level Risks from Site Summary

169) Dounreay continually strives to look at opportunities to either improve the site programme through management of technology, changes in assumptions etc. At this time, there are no off-site opportunities identified for radioactive waste management treatment.

4.6 Stakeholder Engagement

170) DSRL is committed to open and honest two-way communication and active engagement with all its stakeholders as part of its open and honest policy.

171) The strategy for stakeholder engagement is justified by the achievement of a good working relationship with many internal and external stakeholders. It is easier to make good progress developing and implementing waste strategy when stakeholders understand the objectives and constraints of the site.

172) DSRL has many Stakeholders ranging from its customer (the NDA) through to national regulatory bodies like the SEPA to groups from the local community and individuals like MPs, MSPs and MEPs and members of the press and public. Dounreay also engages with relevant safety, security, transport and planning regulators. These groups and individuals have a variety of needs and interests and require information to be provided in different formats and at different levels. DSRL therefore uses a range of communication activities to inform stakeholders of developments at Dounreay and to respond to enquiries from members of the press and public. Local stakeholder groups e.g. DSG and its associated sub-committees are involved in decision making wherever practicable.

173) Stakeholder engagement activities are managed on behalf of the DSRL Managing Director by DSRL's Community Relations Department, with support as required from Communications and project staff.

174) DSRL's communication team, with support from the Community Relations Department, is responsible for communicating all site activities including generic waste information and issues internally with staff and externally with the wider community. Communications Department produces a fortnightly bulletin for stakeholders that covers all decommissioning activities, including waste-related developments on the site and provides regular updates on decommissioning progress. It also keeps stakeholders informed of any news and developments in the wider nuclear industry. DSRL also attend the NDA Stakeholder meetings.

175) The DSRL Community Relations Department supports both formal and informal consultation with stakeholders. Formal consultation encourages participation in decision making (see next Section) whilst informal consultation takes the form of comments or suggestions received during site visits, meetings and briefings with site staff and the wider community.

176) DSRL produces material such as information sheets about projects taking place at Dounreay on behalf of the NDA. Press and public relations are an essential part of stakeholder engagement and regular meetings, site visits and similar media-related activities are expected to continue indefinitely.

177) DSRL run a website, www.dounreay.com, on behalf of the NDA, which is complemented by a community office in Thurso of the same name. Latest publications are available along with details on Site activities including waste topics.

4.6.1 Stakeholder Engagement on IWS and Specific Waste Management Issues

178) There is no formal stakeholder engagement on the IWS at Dounreay. The document is placed on the www.dounreay.com website once approved.

179) Dependant on the specific waste management issues which arise in the future, consultation will be achieved via the public participation process. This is planned within the overall site stakeholder communication strategy and ensures that stakeholder engagement is effective, targeted and proportionate; it is important that stakeholders are not flooded with information and requests for involvement and reaction to waste management issues.

180) As stated earlier in the IWS, a Site Waste BPEO has been completed this year. That did involve participation by a member of the DSG and the summary document has been placed on “Dounreay.com”.

181) When required, a newsletter is published to alert all registered stakeholders to the consultation and provides background information, list of options, the criteria with which the options will be assessed and the proposed timeline for consultation. Stakeholders are invited to attend the BPEO workshops, ensuring that they have the opportunity to participate in the BPEO during, rather than after the study and that the study report subsequently reflects their input in the identification of options and the attributes and weightings against which the options are assessed.

182) Involvement in these studies ensures that stakeholders are given the opportunity to question and challenge the site’s prioritisation logic in regards to waste matters. Attendees can include employees on the site, members of the DSG and representatives from the NDA and Non-Governmental Organisations.

183) Following the BPEO workshops, a summary document is produced which records the issue, the panel discussions and invites further comment from a wider distribution. From the date of issue there is a further 12-week period to allow interested parties to respond either to the questions posted in the summary paper or fuller if so required.

184) Once the 12-week period of consultation comes to a close, the responses are reviewed with a view to addressing them in the BPEO document. The BPEO will be revised if appropriate and put through DSRL’s due process before a Recommendation paper on the preferred way forward is published and issued to the registered stakeholder distribution.

185) To date, Dounreay has consulted with the public on the following:

- How to Deal with the Management of PFR Raffinate;
- The End State for Decommissioning the Dounreay Waste Shaft;
- Developing the Long Term Strategy for Managing Dounreay's Solid Low Level Radioactive Waste
- Dealing with Radioactive Solvents and Oils stored at Dounreay
- Determining a strategy for managing radioactive Particles in the environment.
- Defining the Dounreay Site End State
- Site Waste BPEO
- DSRL’s Heritage Strategy

186) There are no further external BPEO consultation exercises identified at present.

4.6.2 Linking of Site Engagement Plans with External Engagement on Waste Issues

187) The strategy for stakeholder engagement relating to waste at Dounreay takes account of external stakeholder engagement, such as the government output relating to waste from the Committee on Radioactive Waste Management (CoRWM) consultation, the LLW Policy consultation and the Scottish Government's consultation on HAWs. Stakeholder engagement plans relating to waste transfers to or from another site are managed in discussion with the recipient or donor.

5 IWS OVERVIEW

188) Dounreay has developed a decommissioning strategy to enable it to reach an IEP by **2025**. This is the point at which:

- Conditioned ILW will be stored on-site awaiting the availability of a national strategy for its long-term management.
- Nuclear materials will be in storage on-site awaiting a decision on its long term disposition.
- The LLW Disposal Facility will await capping.
- Radioactive liquid discharges will have ceased.
- There will be ongoing radioactive gaseous discharges.

189) The Dounreay IWS is made up of a number of individual strategies and is supported by BPM and decommissioning studies.

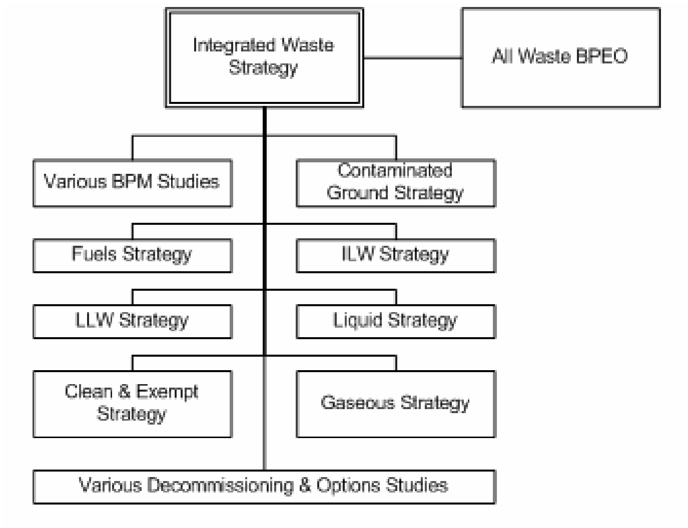

Figure 14: IWS Support Documents

190) In order to assist in the communication of the waste strategies to the Dounreay site and stakeholders, a number of high level strategy wiring diagrams have been prepared. These cover the waste category and define the facilities they pass through for treatment, conditioning or packaging and then disposal. These cover the following waste categories, with the wiring diagrams included in Annex 3**.**

- Solid RHILW
- Solid and Liquid CHILW
- ILW Liquors and Sludge
- LLW (including High Volume Low Activity (HVLA))
- Low Level Liquid Effluent (LLLE)
- Exempt – Inert
- Exempt – Non-Hazardous
- Exempt – Hazardous

- Clean – Inert
- Clean – Non-hazardous
- Clean - Hazardous

191) These wiring diagrams set out the waste category and the current reference strategies to permit storage and disposal of both radioactive and non-radioactive wastes. These are all explained in more detail in the following sections.

192) Table 9 summarises the predicted volumes of future arisings of raw solid radioactive waste. A comparison with the figures contained in previous years LTP is provided.

Waste Type	LTP 2007 (m^3)	LTP 2008 (m^3)	LTP2008 Rev D (m^3)	LTP 2010 (m^3)
HLW	0	0	0	0
RHILW	8,835	2,735	2,394	2,127
CHILW	392	429	368	289
LLW	70,744	48,790	51,527	52,688
HVLA	18,283	18,280	18,083	13,499
HVLA (left in-situ)	30,009	30,056	30,056	14,154

Table 9: Future Raw Solid Radioactive Waste Arisings

193) Dounreay also maintains estimates for the volumes of non-radioactive (exempt and clean) raw solid wastes predicted to arise over the LTP.

Waste Category	LTP 2007 (m^3)	LTP 2008 (m^3)	LTP2008 Rev D (m^3)	LTP 2010 (m^3)
EW Inert	165,138	64,515	59,941	68,664
EW Non-Hazardous	44,830	60,687	28,084	25,214
EW Hazardous	368	308	238	640
EW (in situ)	168,261	167,443	167,443	93,554
Clean Inert	156,968	118,394	116,269	483,085
Clean Non-Hazardous	26,689	23,833	65,597	64,669
Clean Hazardous	211	271	1,124	1,533

Table 10: Future Raw Solid Waste Arisings for Non-radioactive And RSA93 Exempt Wastes and Contaminated Soil

194) The main changes in volume in Tables 9 and 10 are directly related to:

- Some arisings moving into Stocks;
- Improvements in near term estimates through the use of PSWPs;
- Improvements in waste estimates through the Building Waste Inventory work being carried out;
- A review of some future waste arisings with resulting changes from originally quoted as “envelope” volumes of a facility or tanks etc rather than the actual waste volume.
- Correcting in DRWI the estimate of the surplus rock generated during the construction of the new LLW Disposal Facility vaults.
- A better understanding of contaminated land volumes (in-situ values) due to characterisation work being carried out on-site and the availability of accurate data.

195) DSRL currently report single point, best estimate figures within its DRWI system. DSRL are considering ways of including uncertainties against these baseline estimates to

allow more robust development of reference strategies and consideration of fallback strategies.

196) The key and major waste management milestones identified for the LTP were presented in Section 2 and have not been repeated here.

6 INTEGRATED WASTE STRATEGY (IWS)

197) This section summarises the strategy for specific groups of waste and their inter-relationships where appropriate. The inventory of existing and future expected/or estimated solid decommissioning waste arising for the Dounreay site is listed in Annex 4.

198) The overall strategy for radioactive wastes is treatment as necessary to allow removal from the site. This will largely be achieved by disposal via authorised disposal routes or conversion to a passively safe state for long term storage on-site prior to disposal to a UK GDF. Based on NDA guidance that a UK GDF will not be available until 2040 at the earliest, DSRL has made provision for the interim storage of conditioned ILW on the Site until that time.

199) Although the Scottish Government has announced that it does not support the deep geological disposal of ILW, its detailed policy is under consultation and cannot be utilised to change the DSRL baseline at this time.

200) The Clearance and Exemption Code of Practice (24) has been produced with technical support from DSRL to identify and facilitate good practice within the nuclear industry regarding the clearance and sentencing of articles, substances and wastes which may or may not require disposal as radioactive waste under the RSA 1993. The Code of Practice has been developed and agreed by representatives from the nuclear industry and the Dounreay site has established and maintains arrangements to comply with the code.

201) Issues identified as a result of previous stakeholder engagement which have an effect on waste strategy include:

- The health and safety of workers and public and protection of the environment are top priorities
- The impact of transport, particularly of radioactive waste, concerns local residents
- Discharges from processes
- Location of new facilities
- Importation of waste from other areas or sites.

202) The Dounreay IWS is taking account of the waste management policy, principles and constraints discussed in Sections 3 and 4 by:

- Undertaking waste minimisation initiatives;
- Sampling and characterising wastes in order to improve understanding, assist in the development of strategies and reduce uncertainty;
- Undertaking BPEO/BPM studies to determine optimum waste management strategies where appropriate;
- Decommissioning and removing buildings and facilities as early as is practicable, commensurate with any hazard and so as to minimise “hotel” costs;
- Packing and conditioning ILW wastes into drums and boxes to make passively safe;

- Obtaining NDA RWMD LoC to ensure that conditioned ILW packages meet the requirements for final disposal;
- Storage of ILW and LLW under controlled conditions until a disposal route becomes available;
- Segregating, size-reducing and compacting LLW waste to minimise volumes sent for interim storage and subsequent disposal;
- Transferring filtered radioactive liquid effluents to the LLLETP where they are treated prior to discharge;
- Discharging gaseous wastes through abatement systems (e.g. High Efficiency Particulate in Air (HEPA) filters) in order to reduce discharges to the environment.
- Production of Radioactive Waste Management Cases for Higher Activity Wastes

203) DSRL are also aware of the new NDA Strategy Management System (25) which, with respect to wastes, requires alignment with the following categories:

- Non-radiological and hazardous waste.
- Lower Activity Waste (LAW) covering LLW.
- HAW, covering ILW and HLW.

DSRL will continue to work with the NDA to understand the developing requirements in this area.

6.1 Radioactive Wastes

6.1.1 Radioactive Waste – Inventory and Categories

204) DSRL currently operates DRWI which provides a formal record of the quantities of radioactive and non-radioactive wastes held on the Dounreay Site, together with best estimates of the future waste arisings. This is linked into the LTP P6 site programme via activity coding and routinely updated. It doesn't however contain information on LLLE, non-active liquors nor gaseous wastes.

Figure 15: DRWI Screenshot

205) Currently, DRWI contains the following detailed information:

- A description of the waste (including the state of the waste and storage conditions)
- Activity of the waste
- Waste quantities, including a statement of confidence in these values
- Waste characteristics (e.g. hazardous properties) including a comment on confidence in this data
- When it will arise or whether it is a legacy waste
- When and where it will be processed (including major new facilities and their planned operational dates)
- How the waste will be transported on site
- When and where it will be stored
- When and where it will be transferred off-site

206) A summary of the main radioactive wastes expected to be generated from the Dounreay facilities, operational and decommissioning, is given in the Table 9 in Section 5. The data in the tables is based on current waste stream information in DRWI [DRWI Dataset – DRWI Frozen LTP2010 DOUND Node 10 5 Feb 2010 (26)]. Dounreay recognises that the quality of the volume data and some of the radionuclide and physical/chemical data, is variable and studies are continuing to refine and improve the information.

207) Detailed information on the waste is included in Annex 4. This includes:

- Waste Stream Number (ID)
- Waste Stream Description
- Waste Category (RHILW etc)
- Stock Date
- Raw Stocks (m^3)
- Raw Stock Activity (TBq)
- Future Arisings (m^3)
- Future Arisings Activity (TBq)
- Conditioning Plant
- Conditioning Container
- Total Conditioned Packages
- Total Conditioned Packages Activity (TBq)

6.1.2 Strategy Definition and Status

208) The following sections give details of the radioactive waste generated on the Dounreay site. The titles also include the status of the strategy. The status can be "**Operational**", "**Approved**", and “**Reference**" or "**Draft**" and these terms are defined below.

209) It should be noted that the Dounreay Site Waste BPEO or specific facility or waste BPM studies will underpin some of the strategies and a direct correlation to the strategy status is possible.

Operational
The strategy is being implemented. Waste is being transformed into a form suitable for long-term storage awaiting disposal or for disposal itself. For ILW, it will have a final LoC.

Approved
An "Approved" strategy is one that has been approved by the Dounreay management or by subordinate bodies to whom the authority to approve has been delegated in accordance with company procedure. For ILW, an approved strategy is one that has also gained an Interim LoC.

Reference
A "Reference" strategy is one which is selected as the preferred (or best) strategy at the time but it is not necessarily the one that will be approved. It is the strategy against which other strategies can be compared. For ILW, a reference strategy is one that is working towards gaining an Interim LoC. It may or may not have a Conceptual LoC.

Draft
A "Draft" strategy is one that is being considered and developed as part of the optioneering process. For ILW, a draft strategy is unlikely to have a LoC although some interaction may have taken place with NDA RWMD to help define technical options.

210) In addition, a further strategy status of “Fallback” is used to describe the management arrangements should the Reference, Approved or Operational strategy fail. At this time no fallback strategies are presented in the IWS. The definition of a “Fallback” strategy is:

Fallback
A "Fallback" strategy is one that is selected as a back up to the preferred (or best) strategy at the time. It is the strategy that would become the preferred management route should the Reference, Approved or Operational strategy fail.

6.1.3 High Level Waste (HLW)

211) There is no HLW on the Dounreay site.

6.1.4 Higher Activity Waste (HAW)

212) Dounreay follows the national definition of ILW. Additionally, it splits this category by physical type into Solid, Liquid and Sludge. The Solids category is further broken down into Remote Handleable, where individual packages for consignment have a dose rate exceeding 7.5mSv/hr beta/gamma and Contact Handleable, which is below this 7.5mSv/hr figure.

213) The high level objective for HAW management on the Dounreay site is treatment of the wastes into a conditioned, passively safe form using a cement matrix. This is assisted through the use of the LoC process. This then allows long term conditioned waste storage on site pending the availability of a GDF. All HAW will be in a passively conditioned state by the IEP of 2025.

214) At the Site Level, there are a number of wiring diagrams that help describe the overarching strategy for the management of HAW. Those are included in Annex 4 and cover:

- Solid RHILW
- Solid and Liquid CHILW
- ILW Liquors and Sludge

215) As stated earlier, these outline the current strategy and set down where wastes will be placed in unconditioned storage, conditioned and packaged and then finally undergo conditioned waste storage ahead of disposal.

216) This approach will also allow DSRL to start to demonstrate and meet the expectations of the Joint Guidance on the management of HAWs issued by the NII, EA and SEPA.

217) During 2007/08, Dounreay staff undertook a review of the robustness of the ILW strategy. The key findings remain valid and are re-stated here:

- ILW strategy is robust but needs some improvements.
- RHILW-IEP is still required but the waste streams and associated volumes have been better defined resulting in a shorter operational period (10 years).
- WTP for packaging shaft and silo wastes should also treat and package CHILW and THTR Graphite, thus optimising its capabilities.
- The Site will standardise on 500 litre drums, fixed design, and 3m^3 boxes for most RHILW and CHILW.
- 4m box use will be restricted to the packaging of DFR Graphite, Low Specific Activity (LSA) Scale and DMTR unless the LoC process identifies alternative packages.
- No conditioned waste store at WTP, all drums from WTP will be flasked to RHILW-IEP drum store.
- RHILW-IEP will also have a 3m^3 box store.
- PFR, DFR and ILW Liquor Storage Facility all to have local waste packaging plants that will grout their waste. This offers the opportunity to standardise designs.
- DMTR to have its own small waste packaging plant.
- Waste characterisation initiatives must continue to refine estimates and identify any orphan wastes.

218) The status of the strategies for ILW is further amplified by describing how far Dounreay has reached in obtaining approval from NDA RWMD for the proposed packaging route against the requirements for safe disposal against the phased disposal concept. The definitions of the stages of LoC are given first below.

- **Conceptual LoC**: presents the known information regarding the waste, the proposed conditioning method and process, and the expected average and maximum package properties. This stage should take place before any resources are committed to a waste management strategy. Although a conceptual LoC may be received, their will be Action Points, requirements identified to be completed at the Interim or Final stage submission.

- **Interim LoC:** presents further information on the waste (and may include the results of mathematical modelling to determine radionuclide inventory), method of conditioning (e.g. grout formulation envelope), results of wasteform trials, and describes the facility and conditioning process in detail. This stage typically occurs when design(s) and processes for the treatment/conditioning facility have been finalised but no capital has yet been committed. Action Points from the Conceptual stage will have been addressed, generally leaving only QA related activities.

- **Final LoC:** presents information on commissioning of the waste packaging plant along with documentation to demonstrate that Action Points from the Interim stage submission have been closed out.

219) Dounreay makes use of the LoC process to assist in the definition and underpinning of strategies and plant designs. The current list of LoC's achieved by Dounreay are listed in the Table 11 below:

Dounreay Letter of Comfort/Compliance - As at 12/03/2010

NDA RWMD File Ref	Other Doc Ref	Waste Stream	Stage	Date
TPC 10 004	UX/53/12	MTR Liquors in Dounreay Cementation Plant	Conceptual	11/06/90
TPC 10 004	UX/53/12	500 Litre “Liquor” drum for DCP	Drum Only	04/01/91
TPC 10 004	N/A	Cemented DFR Raffinate	Conceptual	22/06/92
TPC 10 041	N/A	Tank 1 MTR Raffinate Liquors in DCP	Final	25/11/93
TPC 10 130	N/A	Dounreay Supercompacted PCM	Conceptual	01/12/94
TPC 10 043	B/LTR/10033	MTR Raffinate Tanks 1,3 & 7	Final	23/08/96
TPC 10 170	T/LOC/8	TRIGA (Never Implemented)	Conceptual	30/05/97
TPC 10 163	T/LOC/12	Dounreay Shaft	Conceptual	23/09/97
TPC 10 190	T/LOC/13	Dounreay Silo	Conceptual	16/02/98
TPC 10 080	T/LOC/22	DFR Raffinate	Conceptual	19/04/99
TPC 10 250	T/LTR/323475	Dounreay PFR Boron Carbide Absorber Pins	Conceptual	14/01/00
TPC 10 310	368228	Dounreay Solid RHILW	Conceptual	06/06/01
TPC 10 081	369097	PFR Ion Exchange column Waste	Conceptual	14/06/01
TPC 10 083	420611	DFR Pond Ion Exchange Columns	Conceptual	21/03/03
TPC 10 047	T/LOC/423571	MTR Raffinate High Solids	Final	14/05/03
TPC 10 340	LOC/423503	Dounreay Thorium Nitrate	Conceptual	22/05/03
TPC 10 290	439699	DFR NDP IX Columns	Conceptual	23/12/03
TPC 10 044	LOC/450044	MTR Raffinate Overarching	Final	14/05/04
TPC 10 390	LOC/463765	PFR Pond Ion Exchange Columns	Conceptual	26/11/04
TPC 10 046	LOC/482195	PFR Raffinate	Conceptual	18/08/05
TPC 10 560	LOC/497220	PFR ETP IX Columns	Conceptual	03/03/06
TPC 10 085	LOC/499492	DFR Breeder Fuel Removal Wastes	Conceptual	31/03/06
TPC 10 501	LoC/509504	PFR Raffinate ILoC	Interim	14/08/06
TPC 10 241	LOC/524672	ADU Floc	Conceptual	05/02/07
TPC 10 313	LOC/525168	Cemented Irradiated Dissolver Liquor (D2670)	Conceptual	06/02/07
TPC 10 312	LOC/530063	D3900 RHILW	Interim	05/04/07
TPC 10 680	LOC/546790	PFR Decommissioning ILW	Conceptual	28/09/07
TPC 10 631	LOC/553493	PFR Mixer Breeder Sections	Conceptual	08/01/08
TPC 10 470	LOC/9542129	Irradiated Thorium Fuel Pin Pieces	Conceptual	13/02/2009
TPC 11 050	LOC/10305789	DFR Decom - reactor metals	Conceptual	29/05/2009
TPC 11 050	LOC/10307096	DFR Decom - DFR Graphite	Conceptual	29/05/2009
TPC 11 070	LOC/11990933	THTR Graphite	Conceptual	05/03/2010

No Letter of Compliance (at Present)				
LTR/500310	N/A	DFR Breeder Waste (Out of Reactor)		
TPC 10 660	LTR/6782660	PFR Fuel packaging*	Pre-Concept	20/03/2008
TPC 10 166	LTR/9796473	D3200 Shaft & Silo Wastes	Conceptual	08/10/2008
TPC 11 010	LTR/9257787	Dounreay Oxide Fuels*	Pre-Concept	08/12/2008
TPC 11 013	LTR/9329415	Carbide Fuels*	Pre-Concept	09/01/2009

Submissions Being Assessed or In Preparation				
N/A	N/A	PFR Mixer Breeder Sections	Interim	Preparation
N/A	N/A	Dounreay PCM	Conceptual	Preparation
N/A	N/A	Dounreay UCM	Conceptual	Preparation

*submissions made under the HLW/Spent Fuel Concept

Table 11: LoC Status

220) The following sections provide further detailed information on both the key facilities required for the future treatment and management of HAW at Dounreay along with waste stream data.

6.1.5 Higher Activity Waste (ILW) – Dounreay Cementation Plant

221) There is currently only one ILW immobilisation plant on the Dounreay site. That facility is the DCP. It receives MTR raffinate liquor from the adjacent ILW liquor storage facility, immobilises the waste in a 500 litre drum before transferring the drums into the adjacent DCP Interim Drum Store (DCP-IDS) and Store Extension (DCP-SE).

6.1.5.1 MTR Raffinate (Operational)

222) Dounreay reprocessed irradiated MTR fuel. The liquid waste is an anion-deficient aluminium nitrate solution containing fission products and some actinides. The liquor is currently stored in twelve storage tanks. Table 12 shows the approximate volume of MTR raffinate remaining in each of those twelve tanks.

Tank Number	Remaining Volume (m^3)
1	0
2	9.821
3	9.869
4	3.641
7	1.911
8	2.364
9	76.952
11	77.056
12	79.452
17	19.418
18	7.285
AGST	Heel
Total	287.769

Table 12: Volume of MTR Raffinate Remaining in Tanks (03/03/10)

223) There are no future arisings of MTR Raffinate. The DCP started immobilising MTR raffinate in 1996 and processed 1879 drums until it shutdown in 2005 following an incident.

224) The DCP restarted routine immobilisation operations in April 2008. Up until the end of January 2010 it had produced 515 drums of conditioned waste in the past year. Currently there are 3104 drums in storage.

225) Immobilisation of the MTR raffinate should be completed by the end of 2013. It is estimated that around 4700 drums of cemented MTR raffinate will be produced**.** Figure 16 shows the proposed output of cemented MTR raffinate drums to be generated**.**

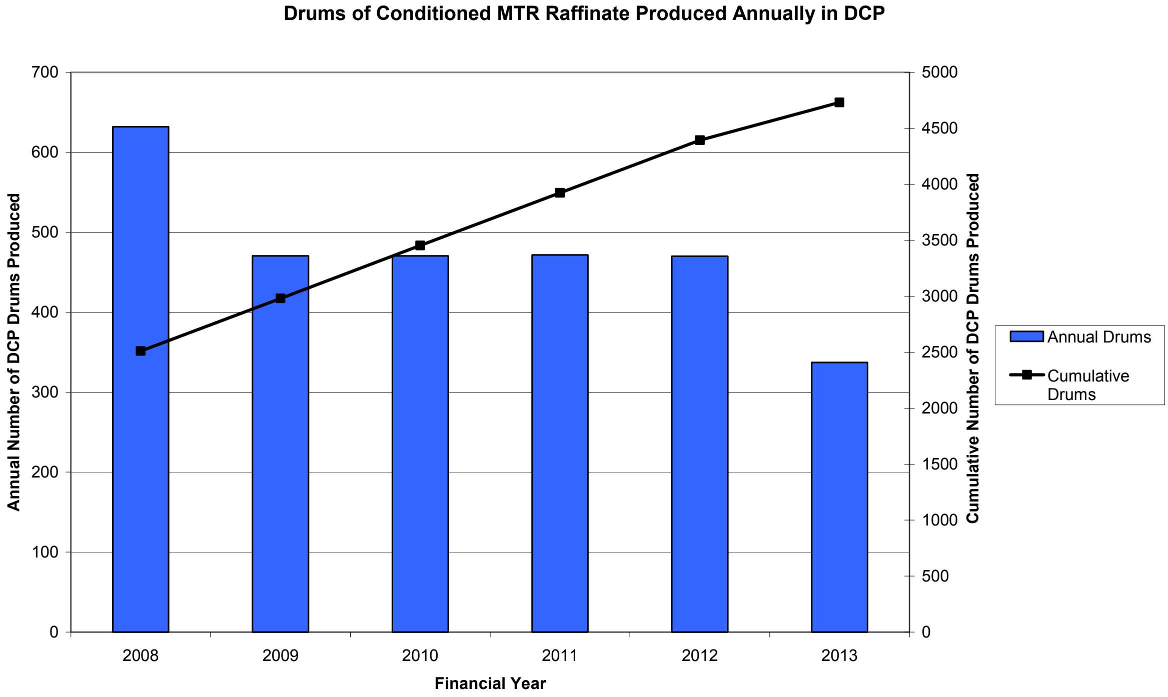

Figure 16: Conditioned MTR Raffinate Waste Drums Produced by DCP

226) A Final LoC (27) has been received from NDA RWMD endorsing the immobilised product from eleven of the twelve tanks. Only Tank 12 remains without a LoC although once the tank is sampled, a further submission will be made.

6.1.6 Higher Activity Waste (ILW) RHILW -IEP

227) The highest hazard material on the Dounreay site is the PFR raffinate currently held in four tanks in the ILW liquor storage facility. The material is unsuitable to be immobilised in the current DCP, although modification has been looked at previously. Therefore a new facility is required to package this material into 500 litre drums. This led to the establishment of a project to build the RHILW-IEP.

228) This facility was also assessed for suitability to immobilise other ILW liquors and therefore as part of the ILW strategy it will also immobilise DFR raffinate, Ammonium DiUranate (ADU) Floc and any associated tank washout liquors. These are explained in more detail later in this section.

229) The Dounreay site also had no facilities available to encapsulate its historic arisings of solid RHILW currently held in interim storage in 200 litre drums. Therefore work was completed to justify an encapsulation capability in the RHILW-IEP. Again the wastes will be treated and packaged into 500 litre drums.

Figure 17: RHILW-IEP

230) With respect to the immobilisation capability, the facility is anticipated to receive PFR raffinate as part of active commissioning from the summer of 2016. The immobilisation process will be designed with a throughput of 150m^3 of raffinate liquors per year. The schedule for processing the liquors is given below:

Financial Year	16	16	16	17	17	17	17	18	18	18	18	19	19	19	19	20	20	20	20
Wastestream	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
PFR Raffinate																			
DFR Raffinate																			
ADU Floc																			

Figure 18: Liquid Waste Process Timetable in RHILW-IEP

231) The figure below shows graphically the anticipated number of 500 litre drums of conditioned liquid ILW immobilised through the RHILW-IEP.

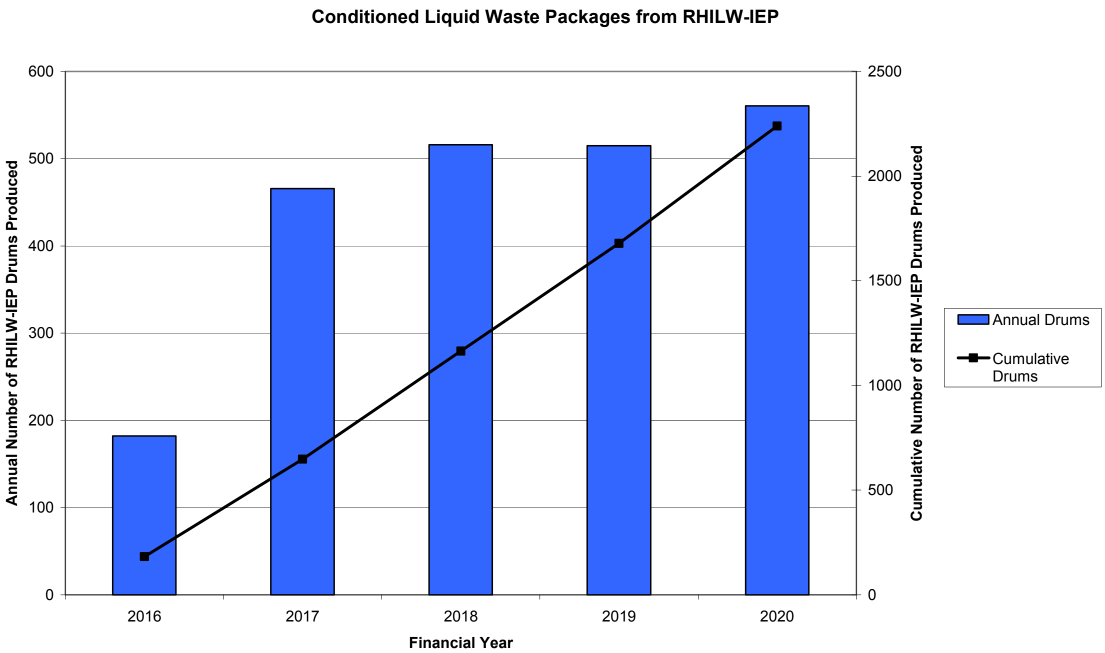

Figure 19: Conditioned Liquid ILW Drums Processed Through RHILW-IEP

6.1.6.1 PFR Raffinate (Operational)

232) PFR raffinate is the liquor produced from the reprocessing of irradiated PFR Fuel. The liquor is a nitric acid solution containing fission products and trace quantities of uranium and plutonium. This is the highest hazard waste stream on the Dounreay site. The material is stored in four stainless steel tanks.

233) This ILW raffinate will continue to be stored safely in ILW Liquor Storage Facility. The only addition was the transfer of plutonium nitrate liquors, which was transferred from another FCA facility and was added to one of the tanks during 2009. The LTP states that PFR raffinate will be immobilised between 2016 and 2018.

234) The waste stream is estimated to produce 701 x 500 litre drums. It should be noted that the design of this drum has been value engineered to maximise the amount of raffinate liquors that can be added whilst producing an acceptable product.

235) Dounreay has received an Interim Stage LoC (28) from NDA RWMD for the packaging of this waste stream.

236) A draft radioactive waste management case (29) was prepared and submitted to the Regulators for comment. This draft document is undergoing a second revision at this time and will be included as part of the permissioning documentation for the RHILW-IEP.

237) This stream also underwent full stakeholder consultation before agreement was reached on the strategy being implemented.

6.1.6.2 DFR Raffinate (Operational)

238) DFR raffinate has been produced from the reprocessing of spent DFR fuel elements. The waste consists of a ferric/aluminium nitrate solution containing fission products and actinides and is stored in three tanks.

239) There are no future arisings of this ILW liquor. The raffinate will be immobilised after PFR Raffinate between 2018 and 2019.

240) This waste will utilise the same 500 litre drum design as for the PFR raffinate. It is anticipated that 841 drums will be produced.

241) A Conceptual LoC (30) for this proposed wasteform has been received from NDA RWMD. An Interim stage submission (31) has been assessed for 2 of the tanks but a number of issues still require to be addressed before an Interim LoC is issued. Sampling of the third tank is still awaited to allow final development work to take place.

6.1.6.3 ADU Floc (Reference)

242) ADU Floc was produced in the flocculation plant of the ILW Liquor Storage Facility which uses a chemical precipitation process to remove the majority of the plutonium and uranium activity from the ILW liquors discharged to the Plant Washings Tank (PWT) thus allowing the supernate to be discharged as a low active effluent. However, this process has not been in operation for a period of time and therefore the supernate is currently stored as with the floc.

243) The ADU Floc is held in three tanks. The current reference strategy is to continue to store the Floc until it can be retrieved and dissolved into a form ready for transfer to the RHILW-IEP.

244) The ADU Floc will be processed after the PFR and DFR raffinate, starting in 2020 and running through to 2021. It will produce up to 698 x 500 litre drums.

245) A Conceptual LoC (32) has been received for the conditioning of just the ADU Floc. Future submissions will consider both treatment and packaging of the ADU Floc and the associated supernate. New samples of both the floc and the supernate have been taken during the past year. These will be used for further development trials and in the production of an Interim stage LoC submission.

6.1.6.4 ILW Liquor Storage Tank Washout Liquors (Reference)

246) The previous liquors are all already contained within various tanks within the ILW Liquor Storage Facility. Once the bulk of the liquors are removed, a heel of liquor will remain which cannot be removed using in built systems.

247) Therefore, it is assumed that a series of “dilutions” to reduce the activity in the tanks will be carried out. These dilute liquors will be transferred to the RHILW-IEP for immobilisation. The RHILW-IEP will also have an evaporator that will concentrate up the liquors, to a similar “characteristic” as the earlier feeds and hence minimise the number of drums being produced. However, work is ongoing to look at engineering methods of removing the heels without adding additional liquor.

248) The current estimate is that around $250m^3$ of liquors, of a mixed inventory will be produced which will generate around 250 x 500 litre drums of conditioned product for storage.

249) However, the LTP currently has a mismatch between the assumptions made by the ILW Liquor Storage Facility and the RHILW-IEP. This will be reviewed as part of the new funding scenarios.

6.1.6.5 Solid Remote Handled ILW (Reference)

250) As stated in the introduction to this section, the RHILW-IEP will have 2 functions: immobilisation of liquors and the encapsulation of solid RHILW. This next section addresses the solid waste streams.

251) Solid RHILW has historically arisen from the reprocessing and post irradiation examination of irradiated fuels from the DMTR, DFR and PFR. Those wastes, which were low in alpha activity, were originally consigned to the Shaft and Silo. From 1980, when PFR fuel started to be reprocessed, higher alpha/beta/gamma activity, RHILW, wastes were placed into interim storage either directly in 200 litre drums or via a dedicated WPC. The wastes are mainly metallic with some plastics.

252) The WPC receives waste from small waste consigners in the FCA in a range of containers from 5 to 50 litre capacity. The waste is then assayed and placed into the larger 200 litre drums before being sent to interim storage.

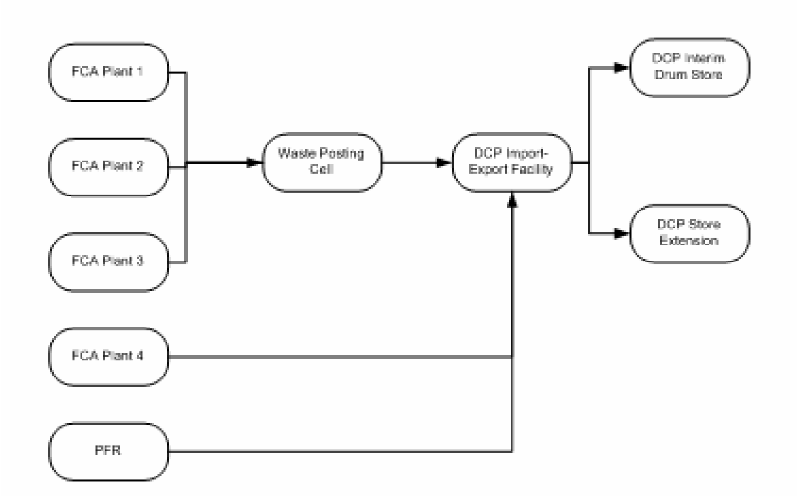

Figure 20: Role of WPC

253) These drums are then transferred into a retrievable drum store which is now the DCP-SE. The figure below shows the number of 200 litre drums exported from the WPC during the LTP.

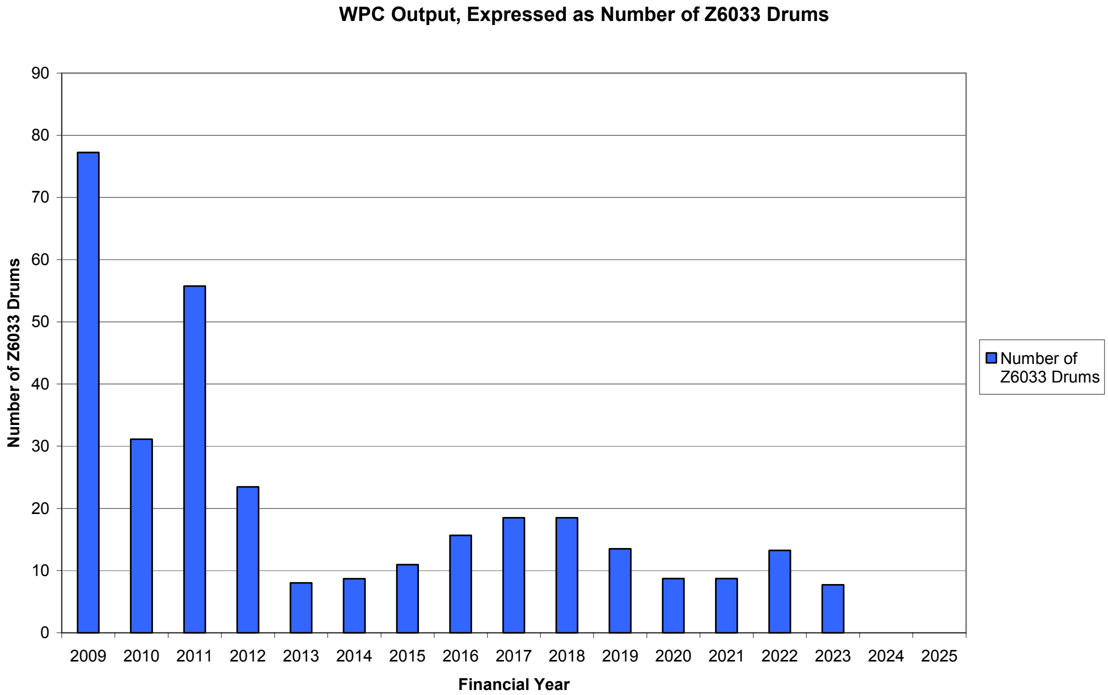

Figure 21: WPC Throughput (Number of 200 litre drums)

254) The LTP shows a mismatch in that the WPC will become available for decommissioning in 2016 however, as Figure 21 shows, there is a demand for its use beyond 2016 to support decommissioning activities.

255) The original RHILW drum store, constructed in the 1980s is currently being emptied to the DCP-SE. This operation will be completed during 2010.

256) Once the RHILW-IEP becomes available in 2016, waste drums will be retrieved from the DCP Stores and transferred by a 4 drum flask at a time. The waste drums will be opened and the waste inside sorted, assayed and repackaged before being

encapsulated into 500 litre drums. It is anticipated that 2 drums of raw waste a day will be processed producing a single 500 litre drum of conditioned waste.

257) Based on DRWI data, it is currently anticipated that around 1200 x 500 litre drums will be produced from the encapsulation of historic and future solid RHILW streams. The figure below shows the anticipated solid waste volumes being processed in the RHILW Encapsulation line.

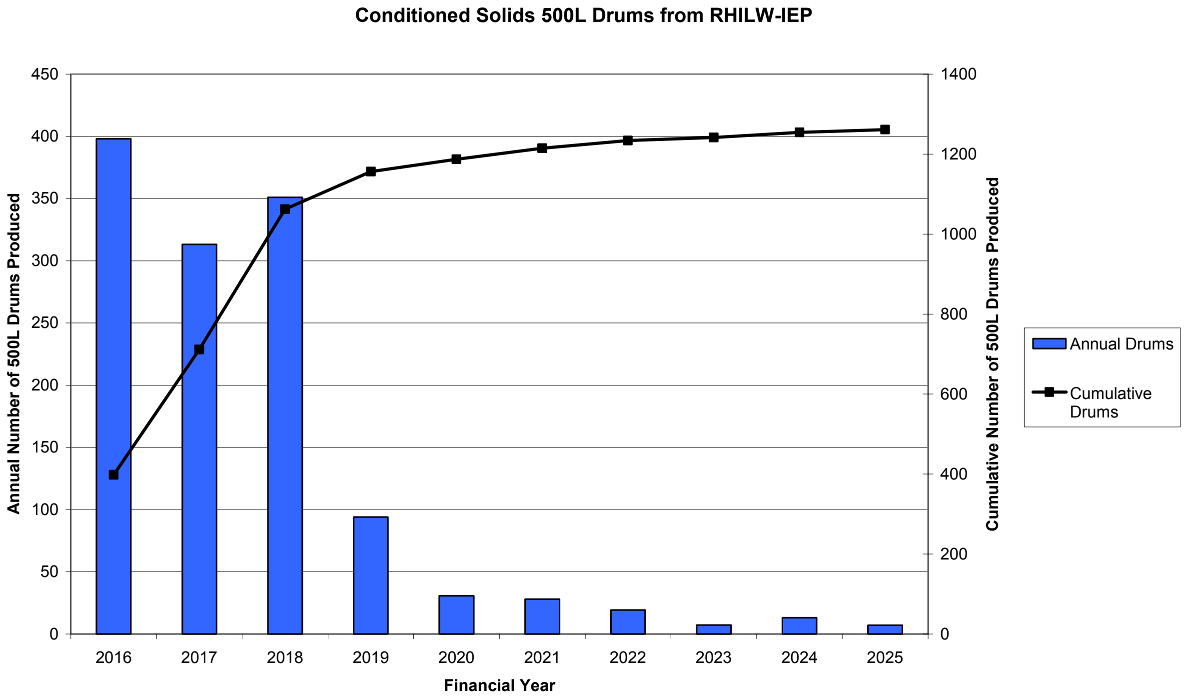

Figure 22: Conditioned Drums of Solid RHILW Produced by RHILW-IEP

258) Dounreay has received an Interim stage LoC (33) for the historic RHILW currently in storage. It is currently assumed that future arisings from decommissioning will have been bound by the physical and radionuclide data in this submission. However, if the waste differs significantly then these will be the subject of separate submissions in the future.

259) The RHILW strategy is currently identified for the packaging of the following RHILW waste streams as well as those described above:

260) **Ion Exchange Columns**: Dounreay uses Ion Exchange as its primary abatement technology for the removal of Caesium from liquor streams arising from ponds or reactor coolants. The Ion Exchange columns are designed inside existing RHILW 200 litre drums. This allows existing flasks and storage facilities to be used.

Figure 23: Spent DFR Ion Exchange Column Inside Transport Overpack

261) When transferred to the RHILW-IEP for final conditioning and packaging for disposal, the columns will either be cut open and the contents intimately mixed in a 500 litre drum or a polymer will be injected into the columns to immobilise the resin, the column would then be placed into a 500 litre drum and encapsulated.

262) Small scale development trials have been completed to assist in determining whether polymerisation or cementation offer the best method of encapsulation. Both the immobilisation processes were found to produce acceptable products. The proposal to undertake full scale trials in the past year were put on hold as the trials identified some mechanical process issues that need to be reviewed prior to committing funds to full scale trials.

263) There is a Conceptual LoC (34) in place for the ion exchange columns before they are generated.

264) **Radioactive Sources:** DSRL has a wide range of sources in storage on the Site. Strategy work has been completed for the future management of redundant sources as either LLW or ILW. The requirements have now been included in an update to an existing DSRL procedure.

265) The ILW sources will be placed in interim storage in a manner which simplifies their final packaging in the RHILW-IEP. In the RHILW-IEP they will be packaged along with the other RHILW materials but against prescribed limits. To this end, activity limits set down in the management of sources at Harwell, due to their similar packaging process has been used as the basis for the new Dounreay Strategy. This will be followed up with the production of an addendum to the existing RHILW Interim LoC specifically for sources.

6.1.7 Higher Activity Waste (ILW) – WTP

266) A key finding from the ILW strategy review was the continued requirement for a dedicated WTP for the packaging of waste retrieved from the Shaft and Silo. However, the strategy review also identified that some of the capabilities being built in the WTP could also be used to treat additional waste streams, namely CHILW and some THTR graphite.

Figure 24: Shaft and Silo Headworks and WTP

267) The proposed management schedule for the processing of these waste is detailed below:

Year	17	17	18	18	18	18	19	19	19	19	20	20	20	20	21	21	21	21	22	22	22	22
Wastestream	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
CHILW																						
Shaft																						
Silo																						
THTR																						

Figure 25: WTP – Waste Feed Timescales

268) The following sections provide details on the wastes and also the strategy associated with their management:

6.1.7.1 Silo Solids and Sludge (Reference Strategy)

269) The D9833 Silo is an engineered store that contains long-lived solid RHILW under water. The RHILW is mainly redundant and waste items from various cell operations including Post Irradiation Examination (PIE), analytical, defuelling and Post Operational Clear Out (POCO). The facility also contains sludge, which has arisen through waste disposal, material degradation, and UPP operation. The silo shut for the receipt of solid waste in 1998.

270) The strategy is to remotely retrieve the solid RHILW from the silo using newly constructed headworks. The material will then be transferred to the WTP where it will be shredded into sacrificial 200 litre drums, characterised (physical/radionuclide) before being supercompacted and then encapsulated into 500l drums.

271) The headworks will also retrieve sludge which will then be stored and sampled prior to being immobilised within 500 l drums. All operations will take place in the proposed WTP.

272) The processes described above are currently the subject of development work to ascertain their suitability and potential impacts on design and operation.

Figure 26: Grab Trials

273) The silo retrieval operations are scheduled to commence in 2017 with all material packaged by 2021. This will produce around 700 x 500 litre drums.

274) The conditioned product from the WTP will be transferred by 4 drum flask to the RHILW-IEP drum store.

275) A Conceptual LoC (35) based on the shredding concept and associated sludge immobilisation has been assessed by NDA RWMD. However, a LoC was not issued and further work to address the outstanding action points is being undertaken.

6.1.7.2 Shaft Solids and Sludge (Reference Strategy)

276) The Shaft contains solid ILW arisings from historic fuel cycle operations from the period 1959 through to 1977. In addition to the solid waste, there will also be a sludge stream to be treated. The sludge arises from discrete disposals and waste degradation.

277) The strategy is to remotely retrieve the solid RHILW from the Shaft using newly constructed headworks. The material will then be transferred to the WTP where it will be shredded into sacrificial 200 litre drums, characterised (physical/radionuclide) before being supercompacted and then encapsulated into 500l drums.

278) The headworks will also retrieve sludge which will then be stored and sampled prior to being immobilised within 500l drums. All operations will take place in the proposed WTP.

Figure 27: Compacted Pucks from Shredded Waste and Sludge Trials

279) The processes described above are currently the subject of development work to ascertain their suitability and potential impacts on design and operation.

280) The shaft retrieval operations are scheduled to commence in 2017 with all material packaged by 2023. This will produce around 1300 x 500 litre drums.

281) The conditioned product from the WTP will be transferred by 4 drum flask to the RHILW-IEP drum store.

282) A Conceptual LoC (35), based on the shredding concept and associated sludge immobilisation has been assessed by NDA RWMD. However, a LoC was not issued and further work to address the outstanding action points is being undertaken.

6.1.7.3 WTP – Other Streams:

283) The waste streams from the Shaft and Silo are the primary wastes to be treated and packaged in the WTP. The capabilities of the WTP will also allow packaging of some other ILW wastes, namely CHILW and THTR Graphite. These are explained in the following sections.

Contact Handled ILW – Plutonium Contaminated Material (Reference)

284) This waste stream comprises Plutonium Contaminated Material (PCM) from fume-cupboard and glovebox operations as well as various decommissioning operations. The waste is currently stored in 200 litre drums within the CHILW store alongside Uranium Contaminated Material (UCM).

Figure 28: View Inside CHILW Drum Store

285) Improved waste estimates during 2008/9, through the PSWPs process, identified more short-term arisings than had previously been estimated. This identified a requirement in to undertake action to maximise the capacity of the current store.

286) DSRL identified 160 historical drums which had been categorised as LLW when they were temporarily consigned to the CHILW in the 1980's. These drums have been removed ready to be consigned to the correct waste stream. A further 150 drums have been identified for potential transfer into the LLW in 2010/11 although this may require a more detailed justification.

287) The reference strategy for the PCM, and other CHILW, is therefore assay and supercompaction of the 200 litre drums followed by grouting of the pucks in 500 litre drums within the WTP. This strategy utilises a capability being built into the WTP however it is also based on an assumption that the PCM does not require any treatment apart from supercompaction.

288) Options study work for the treatment of the PCM during 2009/10 confirmed that a significant proportion of the PCM can be supercompacted and this remains the baseline. However some of the drums may contain items which would not make them suitable for this process and therefore there will be a requirement to segregate these

drums and undertake some conditioning to final packaging. This will be a future package of work.

289) DSRL have also been maintaining a watching brief on work on high temperature processes being led by Sellafield Ltd. This may provide an alternative treatment option in the future.

290) The conditioned product from the WTP will be transferred by 4 drum flask to the RHILW-IEP Drum Store for interim storage.

291) A Conceptual LoC (36) for supercompacted waste was received from NDA RWMD for this waste stream in 2001. An updated Conceptual LoC is currently being prepared and will be submitted for assessment next financial year.

Contact Handled ILW – Uranium Contaminated Material (Reference)

292) This waste stream comprises UCM from fume-cupboard and glovebox operations as well as various decommissioning operations and includes 63 drums of concrete. The waste stream also covers a number of ex-fuel type materials, such as residues, so some pre-treatment may be required. The waste is physically different to the main PCM stream and contains significantly more nuclear material.

293) The waste is currently stored in 200 litre drums within the CHILW store alongside the PCM drums.

294) The reference strategy is that the UCM material will follow the PCM strategy. Therefore the drums will be exported to the WTP for assay, supercompaction of the 200 litre drums before they are grouted into a 500 litre drum.

295) Options study work for the treatment of the UCM during 2009/10 confirmed that a proportion of the UCM can be supercompacted and this remains the baseline but the quantities of nuclear material present may render this option unsuitable so further work is required. For the bulk of the drums, some contain items which physically do not make them suitable for supercompaction and therefore there will be a requirement to segregate these drums and undertake some conditioning to final packaging. This will be a future package of work.

296) The conditioned product from the WTP will be transferred by 4 drum flask to the RHILW-IEP Drum Store for interim storage.

297) A Conceptual LoC is currently being prepared and will be submitted for assessment next financial year.

Contact Handled ILW – Thorium Contaminated Material (Reference)

298) Last years IWS had identified a Thorium Contaminated Material (TCM) waste stream. However closer investigation of the consignment data identified that this was uranium contaminated stream with associated thorium exactly the same as other material in the UCM stream.

299) Therefore the decision was made to remove this waste stream category.

Summary of CHILW Streams:

300) It is estimated that there will be a maximum of 6000 CHILW drums requiring treatment. Based on a supercompaction factor of 5:1 and using 5 pucks per 500 litre drum. It is anticipated that all the CHILW material will produce around 1480 x 500 litre drums for storage in the RHILW-IEP drum store.

THTR Graphite (Reference)

301) The final waste stream that will be processed through the WTP is some THTR graphite. This material is a legacy from an historical reprocessing contract and due to the powdery nature of the material it has been decided that this stream should be packaged last. The material is currently held in 443 drums.

302) Immobilisation trials have taken place on a small scale to ascertain the most effective method to be adopted. These trials tested both the use of grout and polymer. This information was then utilised in the preparation of a Conceptual LoC submission.

303) The Conceptual LoC is currently under assessment by NDA RWMD and the submission puts forward three options for the packaging of the graphite powder.

- Intimately mixed with grout
- Intimately mixed with polymer
- Current drum simply overpacked in a 500 litre drum and then grouted (entombed)

304) Once conditioned, the product drums will be transferred by 4 drum flask from the WTP to the RHILW-IEP Drum Store for interim storage.

6.1.8 Reactor Decommissioning

6.1.8.1 PFR Decommissioning Waste – (Reference)

305) The decommissioning of a reactor like PFR will generate a wide range of solid and liquid wastes. The following sections briefly describe the key decommissioning processes associated with PFR.

306) PFR was a sodium cooled reactor. The bulk 1500te of caesium rich coolant has been totally removed from the reactor vessel, reacted and disposed of. The abated liquor produced 18 ion exchange columns which were consigned as RHILW.

307) PFR still holds irradiated fuel and this will be removed and placed into casks for long term storage. Once this is completed, the Irradiated Fuel Caves (IFC) can be decommissioned. Solid RHILW generated from this facility will follow existing routes into interim storage. LLW will also be consigned via established routes.

308) The decommissioning of the reactor vessel and associated components will generate RHILW and therefore dedicated shielded facilities will be required. The current strategy for PFR would see a Size Reduction Facility (SRF) constructed to size reduce items which are already out the reactor and in temporary storage. This will then be complimented by a Reactor Dismantling Facility (RDF) which will be built to remove those items still in the reactor and the vessel itself.

309) The reference strategy will see both the SRF and RDF package their RHILW into $3m^3$ boxes. The waste will be grouted at PFR then flasked across site to the RHILW-IEP Box store.

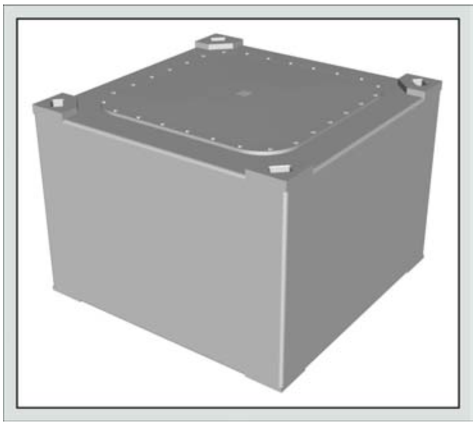

Figure 29: 3m^3 Box Schematic

310) However, during 2009/10, DSRL amalgamated its reactor teams under a single management structure. This amalgamation also resulted in a review of the proposed decommissioning strategies for both PFR and DFR to ascertain if there was an opportunity for cost and schedule savings.

311) An optioneering workshop was undertaken and work has now started on working up an option for a Common Reactor Packaging Plant which would receive and package waste from both PFR and DFR into the current reference waste packages. This task will continue through into next financial year. Once developed a justification will either be made to retain or amend the baseline.

312) The remainder of the decommissioning of the reactor hall and associated buildings will generate wastes which are either drummed or bulk LLW along with much smaller quantities of oils, mercury and tritiated steels. There will be much more volumes of HVLA and clean and exempt soils and rubble.

6.1.8.2 DFR Decommissioning Waste – (Reference)

313) DFR ceased operations in 1977 and decommissioning progress was initially slow but has made significant progress in recent times.

314) DFR, like PFR, used a liquid metal coolant, this time 57 tonnes of Sodium/Potassium Alloy (NaK) that is heavily contaminated with caesium. DFR has built a NaK Disposal Plant (NDP), which will chemically treat the NaK before passing the resultant liquor through filters and ion exchange columns. Both of these will be categorised as RHILW with the abated liquors being discharged to the LLLETP.

315) The NDP is operating and at the end of February has processed 85 batches of NaK.

316) Once the coolant has been removed from the reactor, the next step is the removal of around 1000 DFR breeder elements. A dedicated facility has been built adjacent to DFR where the retrieved elements will be declad and then washed to remove any residual NaK. The cladding will then be placed into waste drums for interim storage.

317) Interactions continue with Sellafield to align programmes and technical requirements to allow the transfer of the Breeder material.

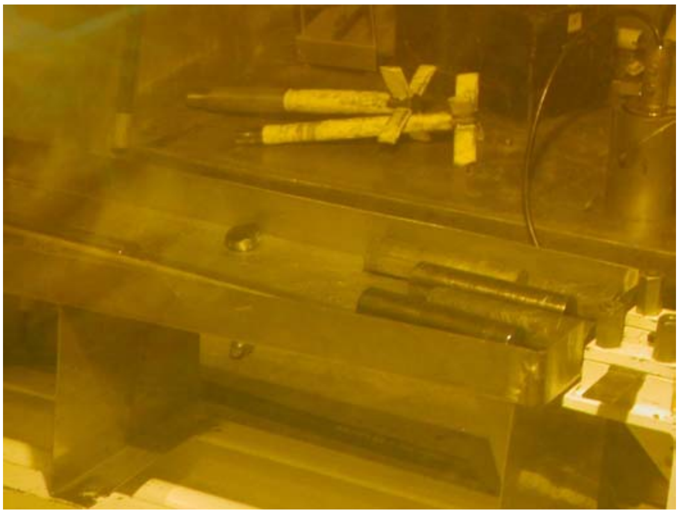

Figure 30: Declad Breeder Slugs

318) Having completed the removal of the breeder fuel, work will then be required to remove NaK wetted pipework. The internals of the pipework will be chemically cleaned with the resultant liquor abated using Ion Exchange. The assumption is that the pipework will remain RHILW after cleaning. Therefore the breeder fuel removal building will be modified to allow the sectioned pipework to be packaged directly into 3m^3 boxes and then grouted. The conditioned waste packages will then be flasked across site to the RHILW-IEP box store

319) To allow the Primary Circuit Decontamination (PCD) operations to proceed, there will also be a requirement to remove several hundred kilogrammes of contaminated mercury. The mercury will then be placed into storage until it can be treated for disposal.

320) Although the breeder fuel will have been removed from the reactor, the reactor internals and structure will still require to be packaged. These will again be cleaned of NaK residues before being packaged into 3m^3 boxes in a DFR Waste Packaging Plant.

321) The reactor vessel has a graphite (boronated graphite) shield. It is anticipated that this material will be suitable for packaging direct into 4m boxes due to low expected levels of contamination. However this assumption still has to be validated and work is identified in LTP for sampling of the graphite. However dose restrictions mean that this is unlikely to happen until after the bulk NaK has been removed.

322) DSRL have recently received 2 Conceptual LoCs (37/38) from NDA RWMD to package the reactor vessel and primary circuit into 3m^3 boxes and the graphite into 4m boxes either grouted or un-grouted leaving the option open for future treatment.

323) The NDA RWMD Assessment confirmed the packaged graphite could be classified as LLW not suitable for shallow disposal rather than as ILW.

324) As stated earlier, the strategy for a local waste packaging plant at PFR is under review and this also applies at DFR although it remains the baseline. Once the option of a Common Waste Packaging Plant to receive waste from both reactors is evaluated a decision will be made as to whether changes to the reference strategy are necessary.

325) There are 2 other major projects associated with DFR both of which are related to buildings out with the reactor sphere. Those are the decommissioning of the DFR Pond and the treatment of stored NaK wetted components.

326) The DFR pond was used for cooling of removed fuel prior to reprocessing. There has been no fuel in the pond for a number of years and facilities have been built to assist in decommissioning the pond.

327) The initial step was to reduce the activity of the pond water and this was achieved successfully using Ion Exchange and filtration. Further treatment was placed on hold but has recently recommenced to allow water to be discharged to the Low Active Drain. This is to then allow access to undertake measurements from the pond walls to ascertain the contamination levels and assist in defining their waste category.

328) Initially it was believed that the top surface may have been ILW but the reference position, at this time is that by removing the walls as concrete blocks, the average activity of the concrete will allow the material to be categorised as LLW. The measurements and sampling work will be utilised to underpin these assumptions.

329) DFR stopped operation in 1977 and since that time, an inventory of NaK wetted items has accumulated and placed into interim storage as there was no disposition route for them. These are a mixture of mainly LLW items with some ILW. The baseline assumption is that a new facility will be built at DFR which will clean the items before packaging them into appropriate waste containers. The liquors generated by the cleaning process will undergo ion exchange to remove the caesium prior to discharge to the LLLETP. If a Common Waste Packaging Plant becomes the strategy for the reactors, then an assessment would be made as to the suitability of these items to be processed though it as well.

330) Remaining wastes from the decommissioning of associated buildings will be a mixture of LLW, HVLA and exempt. The current assumption is that the DFR Sphere will remain at present, although the outcome of the recent Heritage Strategy consultation may impact this.

6.1.8.3 DMTR Decommissioning Waste – (Reference)

331) DMTR was the first reactor on the Dounreay site but has been shutdown since 1969. Most of the ancillary systems have been removed and the facility is under care and surveillance. It will remain so until circa 2015 as the facility is passively safe and a low priority.

332) Sampling has taken place through the shield block into the core to allow improved characterisation data to be generated and support future planning.

333) Once decommissioning restarts there will be some ILW generated and this will be packaged into a handful of 4m boxes. This package was selected due to low contamination levels and wide box opening. This packaging strategy still has to go through the LoC process.

334) The remaining material will be a mix of LLW and exempt materials which will follow established waste routes.

6.1.9 Other Radioactive Wastes (ILW)

6.1.9.1 Contaminated Solvent/Oils (Reference Strategy)

335) ILW contaminated Solvent resulting from PFR fuel reprocessing is stored in the PWT (13.11 m^3), a new Solvent Tank (47m^3) and an older Solvent Storage Tank (10m^3). There will be no significant future arisings. The site also has LLW contaminated oils and solvents, which arise from many areas on-site, and are collected for storage in

Intermediate Bulk Containers (IBCs) within the Oils and Solvents store. Both streams are included here as they have the same disposition path.

336) The current reference strategy for disposal of the contaminated Solvent and Oils is destruction in a new incinerator after passing the ILW Solvent through a decontamination process to remove much of the activity (a wet abatement system). The operation of this facility is scheduled to begin in 2018 and run for a period of 3 years to 2020.

337) This strategy was endorsed following a publicly consulted BPEO (39). However, work is currently ongoing to review the strategy taking into account new technologies and waste routes which have since become available. This may lead to a revised strategy being adopted by the site for this material.

6.1.9.2 Thorium Nitrate Liquors (Reference)

338) During the recovery of uranium from THTR spheres, the resultant liquors were passed through a solvent extraction process and the Thorium Nitrate liquors were generated.

339) There are currently 4 tanks of thorium liquors stored in the FCA at Dounreay. The inventory increased in 2007 with the return of liquors from overseas. This material is more concentrated than that in the tanks and is stored in drums.

340) The current strategy is for the material to be cemented into 500 litre drums using a mobile cementation facility. It is currently estimated that there are around 170 drums of conditioned ILW requiring storage. The option of using a mobile plant is currently under review.

341) Inactive small scale simulant immobilisation trials are currently being progressed in order to determine the maximum solids loading per drum and also the cementation envelope. This will then be used to inform the strategy for the management of both streams.

342) The conditioned waste will be transferred to either the RHILW-IEP drum store.

343) There is currently a Conceptual LoC (40) in place for the conditioning of the thorium liquors in the tanks.

6.1.9.3 LSA Scale (Reference)

344) Based on work already undertaken looking at the post closure requirements for both a new LLW disposal facility and the existing Pits complex, some current waste streams will be unsuitable for consignment to such a facility.

345) One currently identified stream, which does not meet the LLW disposal criteria, is that of cemented LSA Scale. These are historical drums of cemented Radium and Thorium contaminated, LSA wastes originating from oil tubular descaling operations at Dounreay, which have been ceased for a number of years. The waste is currently stored in 200 litre drums within an interim LLW store.

346) The reference strategy in LTP10 is that the material will be transferred into 4m boxes, potentially grouted, and then placed into Interim Storage before being consigned to a national GDF.

347) It is currently estimated that 38 x 4m boxes will be produced for interim storage.

348) A Conceptual LoC will be prepared in 2011/12.

6.1.10 Conditioned ILW Storage

349) The immobilisation and encapsulation of ILW materials in the RHILW-IEP will produce a conditioned waste product in 500 litre drums. Those conditioned waste packages will be transferred into a drum store which is part of the RHILW-IEP. There the drums will remain until they are transferred off-site to a UK GDF. The drum store has a capacity of 8000 drums.

350) The RHILW-IEP will be available to receive both drums and boxes from 2016.

351) This drum store will also receive 500 litre drums from the WTP. Those drums will be a mix of RHILW and CHILW drums. The storage of both these sub-categories of waste together in a shielded facility is a step change from previous management strategies at Dounreay. Figure 31 below shows the anticipated consignment of 500 litre drums to the RHILW-IEP drum store.

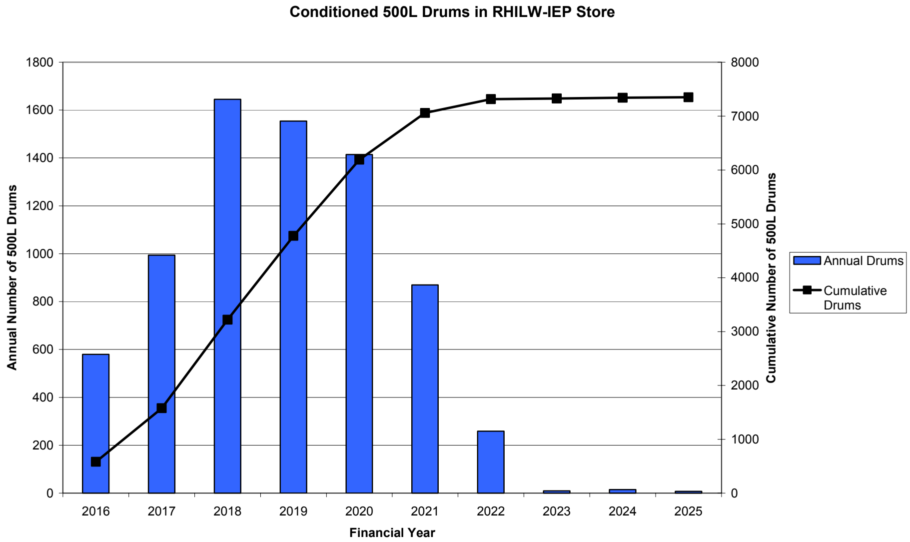

Figure 31: RHILW-IEP Drum Store – Filling Profile

352) The reactor packaging plants at PFR and DFR will both produce $3m^3$ boxes as will the ILW Liquor storage facility decommissioning plant. These $3m^3$ boxes will be stored in a new box store, again part of the RHILW-IEP. The store will hold up to 2000 $3m^3$ boxes. Figure 32 shows the anticipated consignment of $3m^3$ boxes to the store.

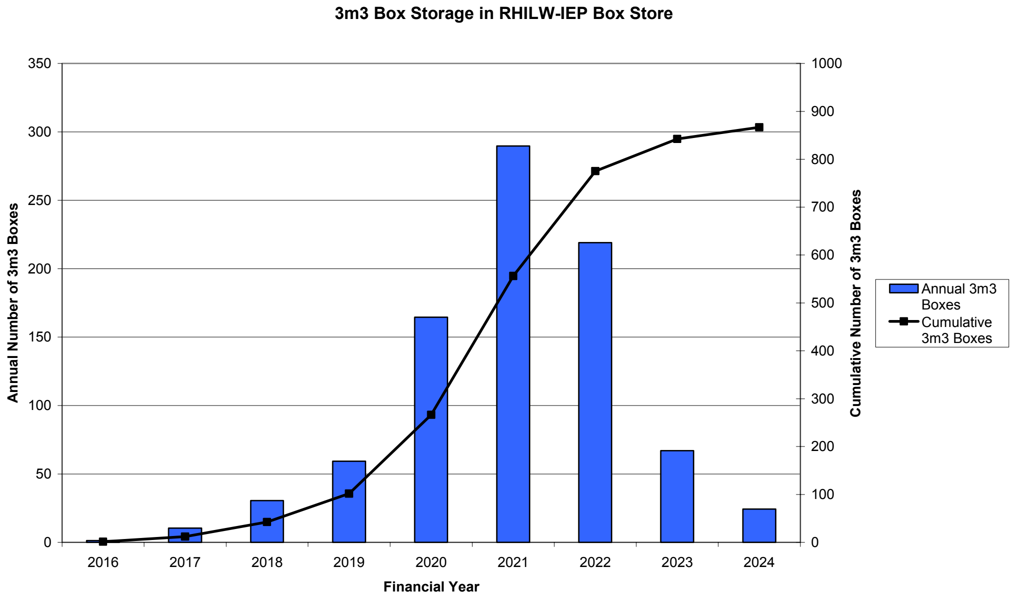

Figure 32: RHILW-IEP 3m^3 Box Store – Filling Profile

353) The RHILW-IEP store will have a design life of 100 years. The current design also identified the stores to have a common import/export facility and will have monitoring and drum inspection capabilities.

354) The 4m boxes produced at DMTR and DFR will be placed into a modified interim LLW store alongside boxes of repackaged LSA scale. This facility currently holds HHISO containers that will be transferred to the new LLW disposal facility around 2014. The facility will then be modified to provide ILW storage with a specified building life of 100 years starting in 2015.

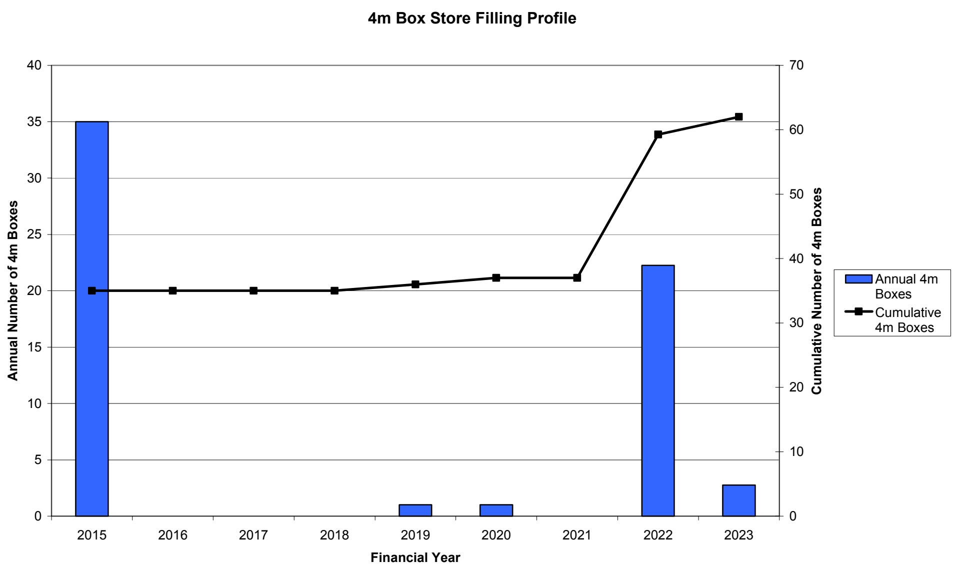

Figure 33: 4m Box Store - Filling Profile

355) These new facilities will supplement the current conditioned ILW waste stores on the Dounreay site, which are the DCP-IDS and the DCP-SE which are part of the DCP. Both of these facilities are vault stores where 500 litre drums are “free stacked”. The DCP-IDS contains cemented MTR raffinate and some unconditioned drummed RHILW.

The DCP-SE has recently been brought into operation. Both facilities have 100 year design life. The figure below shows future arising of conditioned 500 litre drums being consigned to the DCP stores as well as the total number of conditioned drums in storage.

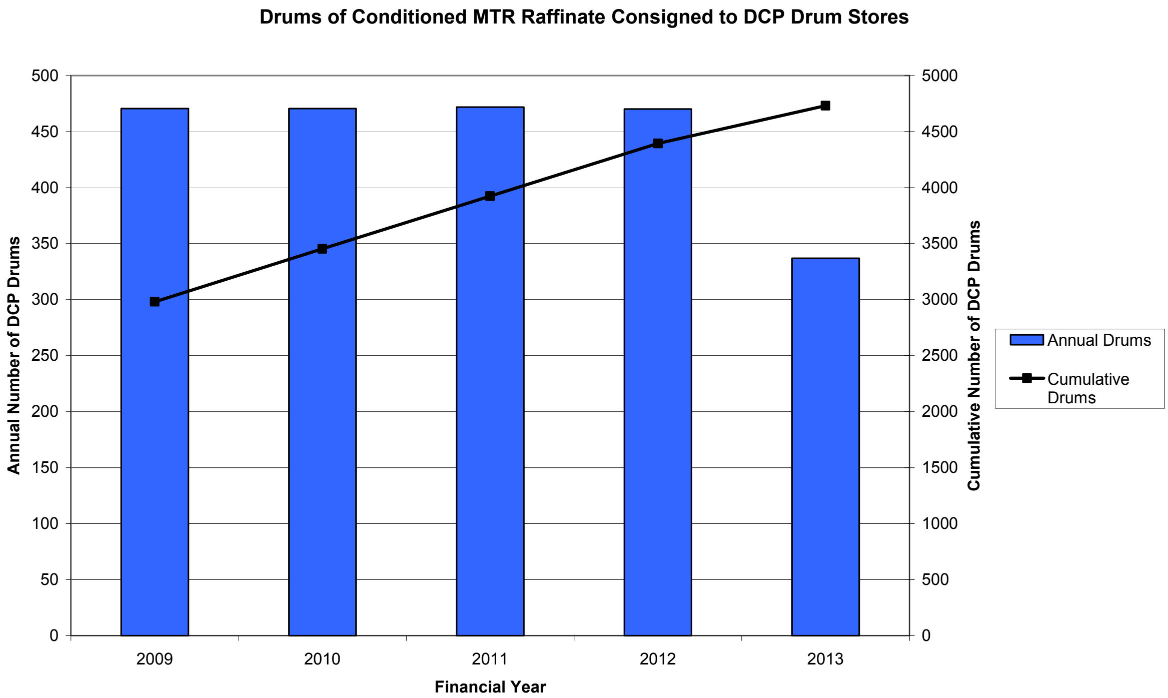

Figure 34: DCP Drum Store - Filling Profile

356) A new Import/Export Facility (IEF) is now operational at DCP. This will allow the store to import solid RHILW for interim storage or export solid RHILW for treatment or to return cemented MTR raffinate to be returned to overseas customers.

357) At this time, all the above stores will remain until the final end state and ILW is transferred offsite to a UK GDF. However, the Scottish Government does not support the UK position on the disposal of waste to a GDF. It is therefore developing a Policy for near-site, near surface storage and disposal. Once the policy is implemented this will impact on the long term storage of conditioned ILW at Dounreay.

358) DSRL have been participating in the NDA's Integrated Project team on Waste Storage. This is looking at a number of topic areas including package failure, store environmental conditions and package monitoring and inspection. The aim is to provide industry wide guidance in these areas and encourage best practice.

6.1.11 Low Level Waste

359) Solid LLW arises from routine operations and decommissioning and consists of a wide range of materials. This will include metal waste such as ducting or vessels through to soft wastes such as laboratory materials or disposable protective suits. There will also be bulk materials such as benches or large items of equipment where it is not As Low As Reasonably Practicable (ALARP) to size reduce them.

360) Historically, Dounreay disposed of LLW on-site but started to store its waste in containers when the disposal capacity became limited. Although work was undertaken to open a route for the transfer of LLW to the LLW Repository near Drigg, this option was closed off following a decision by the Scottish Executive.

361) In April 2009, DSRL was granted planning permission with conditions for the construction of LLW disposal facilities capable of accepting all anticipated solid LLW arisings from Dounreay and Vulcan.

362) The proposed new disposal facility will offer containerised storage in concrete lined vaults but will also have the capability for disposal of HVLA waste, essentially contaminated soil, in nylon bags or similar. A cross section of the proposed facility is shown below:

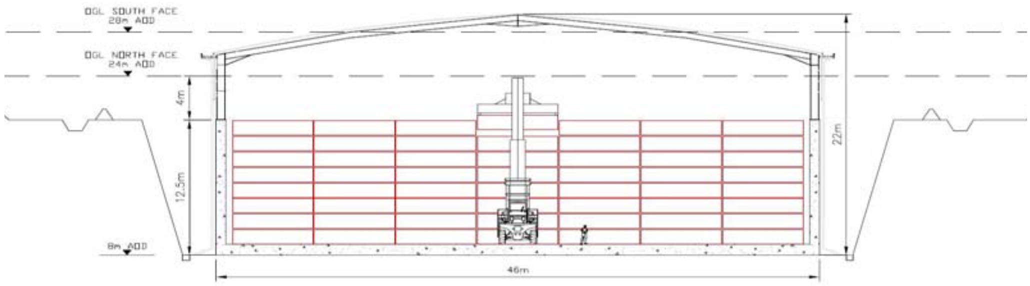

Figure 35: Cross Section of Proposed New LLW Disposal Facility

363) The LLW strategy wiring diagram is provided in Annex 3. The graph below shows the future arisings of solid LLW (and HVLA waste) anticipated from operations and decommissioning.

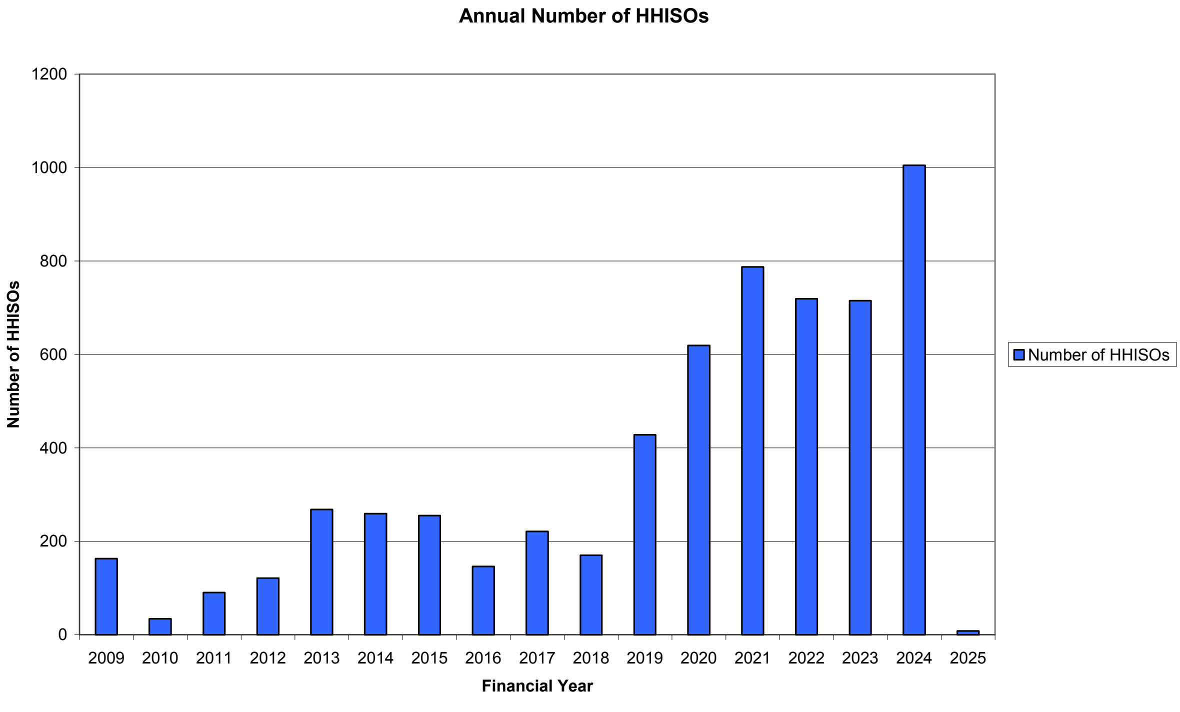

Figure 36: Solid LLW and HVLA Arisings (HHISOs) per Year

6.1.11.1 Low Level Waste – Current and Future Arisings (Reference/Operational)

364) After implementation of the waste hierarchy, and where appropriate, LLW from operations and decommissioning on the Dounreay site is packaged in 200 litre drums. The waste volume arising is further minimised by use of the WRACS facility.

Figure 37: View of WRACS

365) The current estimates of throughput of waste drums through WRACS are provided in the following figure.

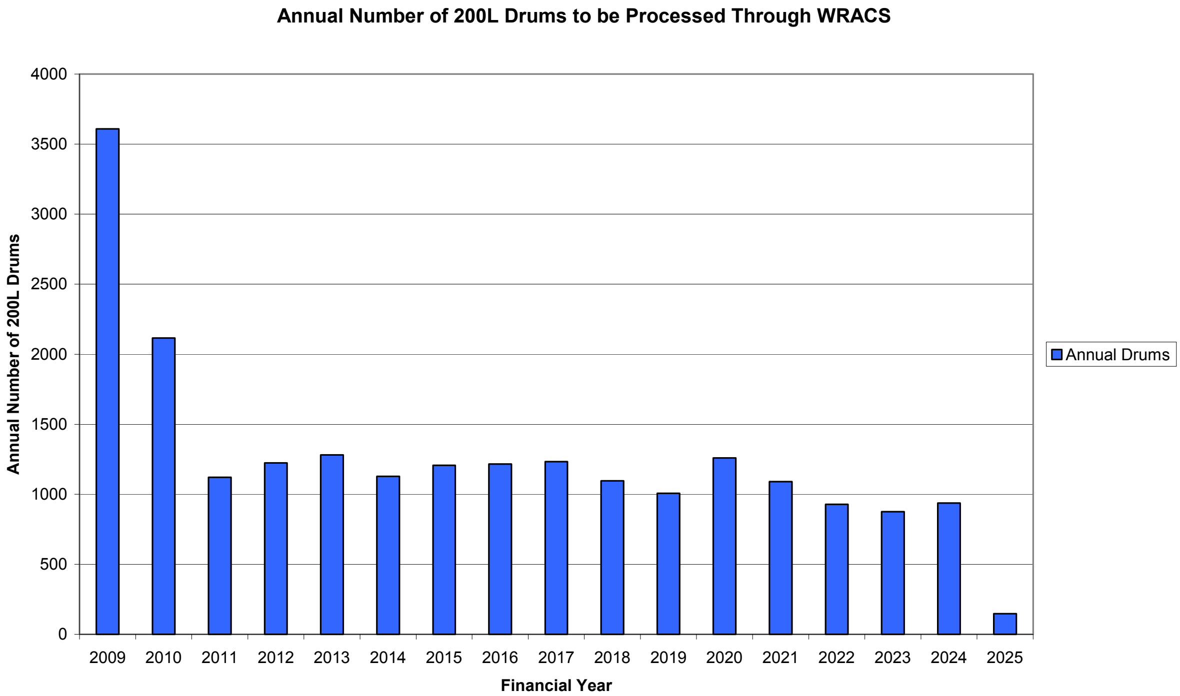

Figure 38: LLW Drums Processed Through WRACS – Current Estimates

366) The supercompacted drums are placed into HHISO freight containers and transferred into interim on-site storage.

Figure 39: HHISOs in Interim Storage

367) Large items (not suitable for 200 litre drums), or bags of contaminated soil (HVLA) are separately loaded, at the source facility, directly into HHISOs for interim storage in one of 2 interim LLW stores.

368) As part of the forward LLW strategy, Dounreay has converted an existing building to undertake segregation and/or size reduction of LLW from exempt and clean waste to ensure the best use of available capacities both on and off-site. This facility is currently undergoing inactive commissioning. The facility will also offer a monitoring station for exempt wastes.

369) As stated earlier, Dounreay disposed of its own LLW in a series of pits excavated from the rock along the northern coast of the site. It is assumed that DSRL will not be able to make a PCSC for this facility and therefore a strategy is in place to remove and disposed of waste, repackage into HHISOs and then re-dispose of the materials to the new LLW disposal facility. This is currently scheduled to happen between 2019 and 2022. Current predictions estimate that this work will produce around 1300 HHISOs of waste.

370) The following graph shows the consignment profile of wastes, containerised LLW to the new LLW disposal facility.

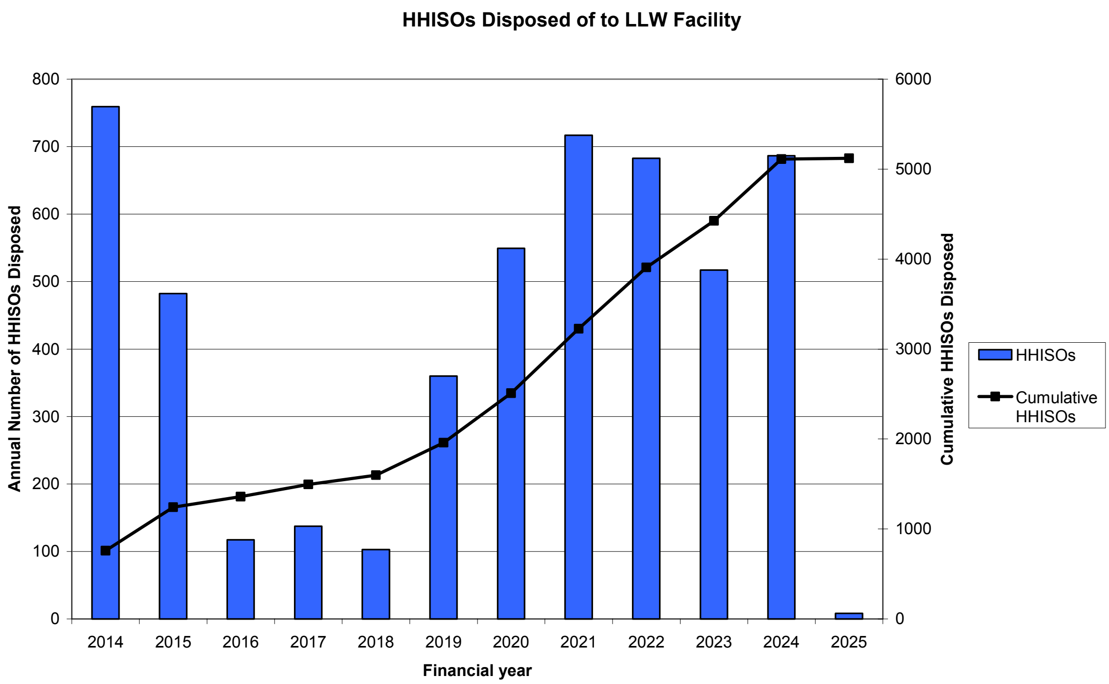

Figure 40: HHISO Disposals to LLW Disposal Facility

Contaminated Soil (Reference Strategy)

371) Dounreay has areas of contaminated land. These are currently managed through a Contaminated Land safety case against risk criteria (21). Estimates of contaminated land which will potentially be excavated are included in DRWI estimates of LLW, HVLA and exempt.

372) Whilst Dounreay already has those estimates of contaminated ground, the LTP clearly sets out that further characterisation work will be undertaken with a considerable effort focussed on when buildings are due to be demolished. This is supplemented by “at source segregation” which assists in correctly sentencing material as it is packaged.

373) Dounreay are also looking at initiatives such as bio-remediation as a method for reducing the volumes of contaminated materials to be disposed of. Current arisings of this type of waste are held in bags within HHISO containers.

6.1.12 Nuclear Materials

374) DSRL continue to look at opportunities to consign certain types of nuclear materials to suitable waste routes either in compliance with the NDA RWMD guidance for a HLW/Spent fuel GDF or an ILW GDF where appropriate.

375) This approach has resulted in DSRL receiving a Conceptual LoC for the packaging of Mixer Breeder material (41) as ILW. An interim stage LoC submission will be made in 2009/10 and dependant on the assessment output a formally strategy change will be proposed.

376) DSRL have also been instrumental in making pre-conceptual submissions to NDA RWMD for a number of its nuclear materials streams to assess their suitability against the HLW/Spent fuel concept. This has proven beneficial to both DSRL and NDA in understanding the developing assessment processes and also the diversity of materials to be assessed.

377) The reference strategy for Uranium and Plutonium nuclear materials is to produce a passively safe stable product and to place it in storage pending a decision on national policy. In order to achieve this, the operations will produce both secondary wastes and also identify some nuclear materials that will not be suitable and hence require management as a waste. Work will continue in 2010/11 on refining these estimates.

6.1.13 Discharges

378) The DSRL site discharges its liquid and gaseous wastes in accordance with the current authorisations under RSA, Pollution Prevention and Control Regulations (PPC) and Controlled Activities Regulations (CAR), previously Control of Pollution Act (CoPA). Although this covers the main site discharge points contributory sources (facilities) are identified in the SDWCU ATO Agreements and Emission Agreements respectively.

379) In addition to these regulatory limits for both liquid and gaseous discharges, Dounreay has a management system which sets down Derived Discharge Limits (DDL) and Discharge Control Objectives (DCO).

380) The facility or Building DDL is an internal equivalent to the RSA authorisation limits and is provided as a safeguard against a breach of the RSA limits.

381) The facility or building DCO is an internal control, based on operational requirements and the full application of BPM. It is challenging but has no regulatory consequence if exceeded.

6.1.13.1 Liquid Waste Discharges - Source of Discharges

382) This waste stream covers all the liquid discharges from the Dounreay site, discharged under the authorisation and licence granted by SEPA. There are no current stocks as wastes are discharged as they accumulate.

383) Dounreay discharges its radioactive liquors direct to sea via its own dedicated pipeline from the LLLETP. Discharges utilising this route will continue until 2022 when LLLETP is anticipated to be decommissioned. Thereafter it is assumed that radioactive liquor arisings will be minimal and will be conditioned as solid waste for disposal.

384) The sources of discharge of radioactive effluent are mainly from decommissioning and waste management work in radiologically controlled areas. This will include effluent from sample analysis, liquor transfer operations, from decontamination operations through to simple hand washing in controlled areas. Effluents containing higher levels of radioactivity are abated by Ion Exchange processes.

6.1.13.2 Main Liquid Waste Radiological Characteristics.

385) The Dounreay site, due to the nature of both its historical and current operations, discharges a wide range of radionuclides. The main ones considered in the discharge authorisation are: tritium, sodium 22, strontium 90 and caesium 137. There is also a requirement to record total alpha and net beta/gamma activity. Additionally non radiological parameters are required to be recorded. These parameters include pH, trace metals concentrations, discharge volumes and particulate loading.

6.1.13.3 Key Controls to minimise Discharges:

386) There are a number of key controls in place at Dounreay to minimise and control liquid discharges, namely:

- The RSA authorisation sets down the 12 month rolling limits for the level of radioactivity in discharged effluent.
- There is a requirement for facilities to demonstrate BPM with respect to their discharges, samples, measurements tests calculations and surveys. The documents produced to demonstrate compliance with the RSA Authorisation conditions are reviewed by Qualified Experts and approved by the DEC.
- Discharge liquors are characterised before release.
- Radioactive liquor discharges are filtered at source to remove particulate.
- Management procedures control how discharges are carried out - "Specification for the Management, Control and Disposal of Aqueous Liquid Low Level Radioactive Waste and Non-active Aqueous Effluent at Dounreay (42)"
- DSRL is committed to meet the UK's OSPAR Obligations.

6.1.13.4 Treatment of Liquid Effluent

387) Dounreay's original effluent treatment plant, constructed in 1957, consisted of 2 below ground tanks which were recirculated and sampled before discharge to sea. Some pH control was used. This facility has now been removed from service and has been replaced by the LLLETP.

388) LLLETP consists of an underground effluent receipt tank, a buffer tank, two main effluent treatment tanks and sludge removal equipment. The main purpose of the plant is to adjust the pH of incoming low active effluent to between pH5 and pH9, and to separate any resulting sludge and remove any solvent before discharge to sea. LLLETP started operating in October 2004. An additional in-line 'goalkeeper' filter was later fitted into the sea discharge line.

389) Liquid waste streams are filtered prior to being discharged to the site Low Active Drain system which routes liquid effluent to LLLETP.

390) LLLETP will remain in operation until 2022. No new effluent treatment facilities will be required beyond this date.

391) Considerable development of Ion Exchange materials has been undertaken for the abatement of effluents from PFR, DFR and fuels storage ponds. Further abatement technology development is anticipated to further reduce discharges at source rather than at end of pipe.

392) Plans to meet the requirements of the National Radioactive Discharge Strategy involve an ongoing programme of effluent minimisation through BPM assessments.

393) Dounreay continues to be committed through its BPM review process to routinely review abatement developments. A key risk is that decommissioning is dependent on effluent abatement technologies being available that may not yet be fully developed. .

394) Due to the nature and source of effluent consigned to the LLLETP, and the subsequent filtration therein, the tanks within are routinely de-sludged, with the solids component accumulating within a dedicated tank in the adjoining building. Characterisation to date has established that current sludge stocks can be categorised as LLW. The reference strategy for this stream will be immobilisation in cement within a dedicated facility located within the LLLETP buildings . This reference strategy was endorsed during the Site Waste BPEO.

395) At this time there is an engineering study underway to identify how to remove the sludge from the tank and immobilise it within 200 litre drums.

6.1.13.5 Discharge Graphs

It should be noted that the discharges from the site have little on no impact on the environment. When converted into dose to the critical group these are well below any level of regulatory interest.

396) As part of its recent new 2009 RSA authorisation application, Dounreay produced estimates of future effluent arisings. These estimates cover the period from 2010 to 2025. Figure 41 shows the variation of discharges predicted in line with LTP 2008 Rev D.

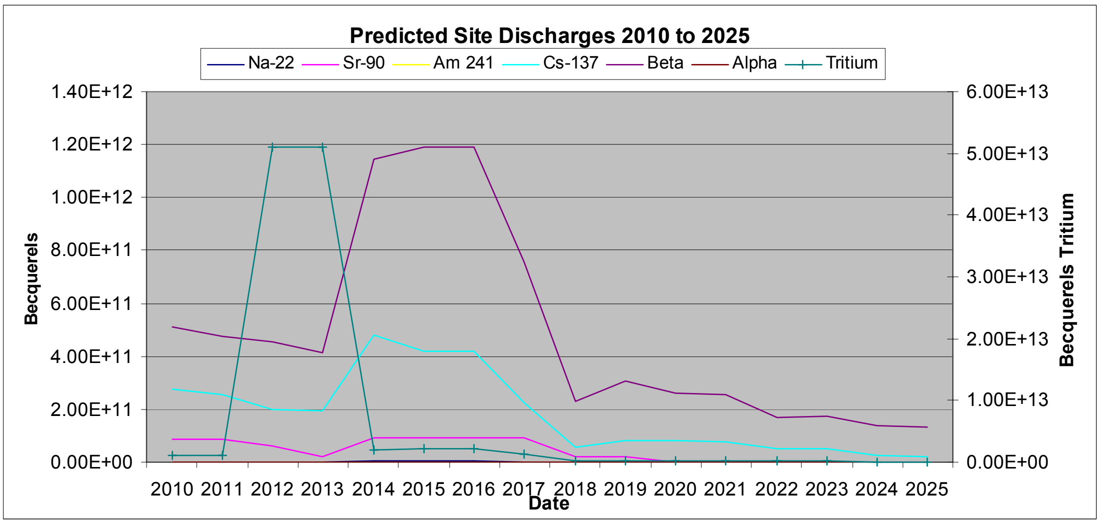

Figure 41: Predicted Radioactive Site Liquid Discharges up to 2025*
(* - Note axis values.)

Gaseous Wastes

6.1.13.6 Source of Gaseous Discharges

397) This waste stream covers gaseous discharges from the Dounreay site, discharged under authorisation from SEPA.

398) Dounreay discharges its radioactive gaseous wastes through a number of major and minor stacks. Most of these will be decommissioned by the IEP in 2025. Thereafter, there will continue to be radioactive gaseous discharges on the Dounreay site until all

the conditioned ILW and nuclear material are transported from the Site and the facilities decommissioned. This is programmed to be completed by 2078.

399) The wastes come from a range of ventilated sources such as filtered cell, glovebox and fumecupboard extracts, along with active area space extracts and is discharged from stacks at PFR, DFR, from the FCA, and from a range of minor sources known as the East Minor Sources, West Minor Sources and PFR Minor Sources.

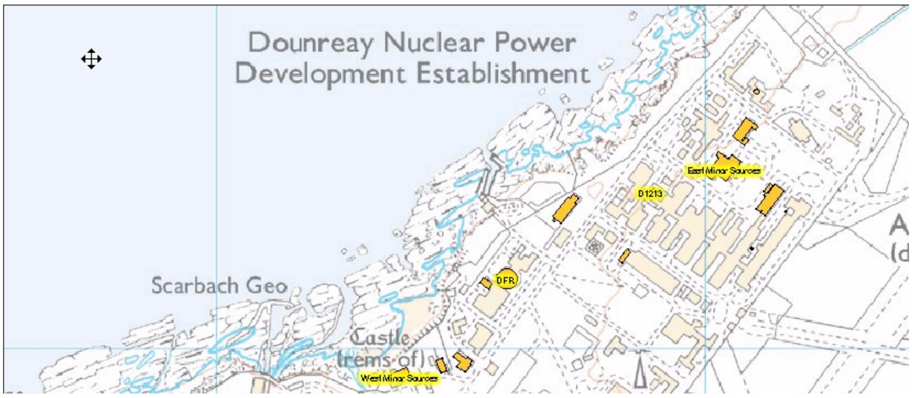

Figure 42: Gaseous Discharge Points on the Dounreay Site

6.1.13.7 Main Gaseous Radiological characteristics

400) The radionuclides discharged from Dounreay stacks reported to SEPA are :

- Tritium, Krypton 85, Strontium 90, Ruthenium 106, Iodine 129, Iodine 131, Caesium 134, Caesium 137, cerium 144, Plutonium 241, curium 242 and curium 244;
- There is also a requirement to record total alpha and total beta/gamma radionuclide groups by analysis.

401) Dependant on the facility, monitoring may be restricted to certain radionuclides dependent the nature of those operations and the facility inventory.

6.1.13.8 Key Controls to Minimise Discharges

402) There are a number of key controls in place at Dounreay to minimise gaseous discharges, namely:

- The RSA authorisation sets down the 12 month rolling limits for the level of radioactivity in discharged effluent.
- There is a requirement for facilities to demonstrate BPM with respect to their discharges, samples, measurements, tests, calculations and surveys. The documents produced to demonstrate compliance with the RSA Authorisation conditions are reviewed by Qualified Experts and approved by the DEC.
- All facilities have “at source” filtration in line with BPM requirements. Dependant on the location, additional filtration at the main discharge point may also be undertaken.
- All discharge points are sampled
- Management procedures control how discharges are carried out - “Specification for the Management, Control and Release of Radioactive and Non-Radioactive Gases to Air at Dounreay (43)”

6.1.13.9 Treatment of Gaseous Effluent

403) DSRL’s approach is to define the likely gaseous discharge from a facility or project and then determine the BPM for that stream. This will most likely result in local filtration.

Alternatively, by better defining the waste stream, it may be possible to justify increased discharge levels for specific tasks.

404) Airborne discharges are measured and sampled to demonstrate compliance with agreed discharge limits. Where appropriate, the discharges are passed through two stages of testable HEPA filters, considered to represent BPM for treatment of gaseous discharges. Filters are then consigned as either solid LLW or ILW. Other forms of abatement may be used depending on the characteristics of the gaseous stream e.g. wet scrubbers.

405) Within the FCA, the main stack, which is over 50 years old, was deemed unsuitable to support future decommissioning. Two replacement smaller stacks, built to provide FCA ventilation though to the final decommissioning of the FCA, is scheduled to come online in mid-2010.

406) As part of its recent new 2009 RSA authorisation application, Dounreay produced estimates of future gaseous effluent arisings. These estimates cover the period from 2010 to 2025. Figures 43a – 43d depict the variation of discharges predicted in line with the DSRL LTP 2008 Rev D.

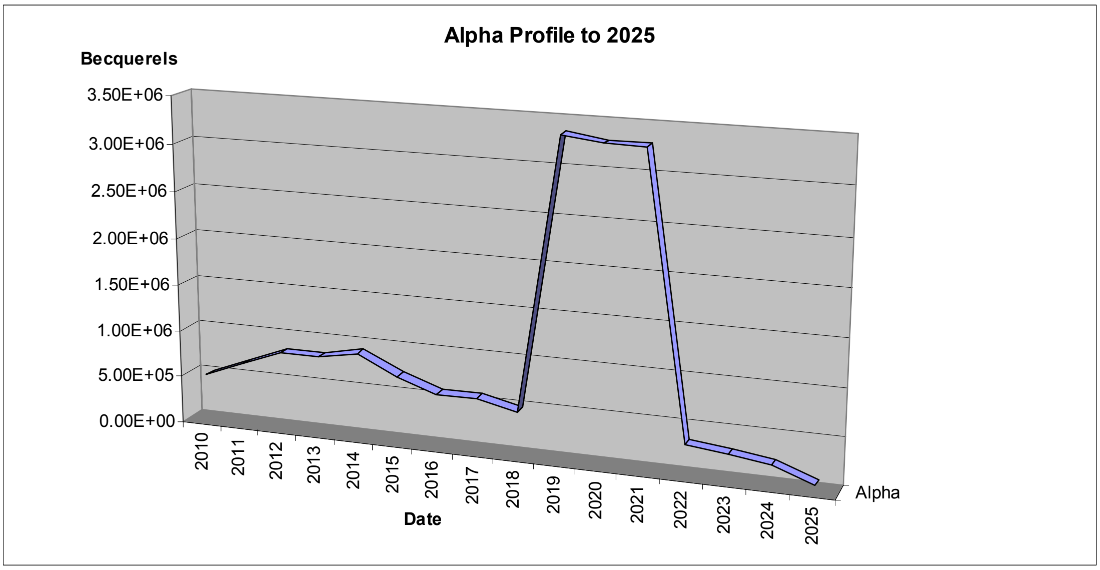

Figure 43a: Predicted Site Gaseous Alpha Discharges up to 2025*
(* - Note axis values.)

407) With respect to the predicted alpha discharges, the peak observed between 2018 and 2022 is associated with the restart of D1203.

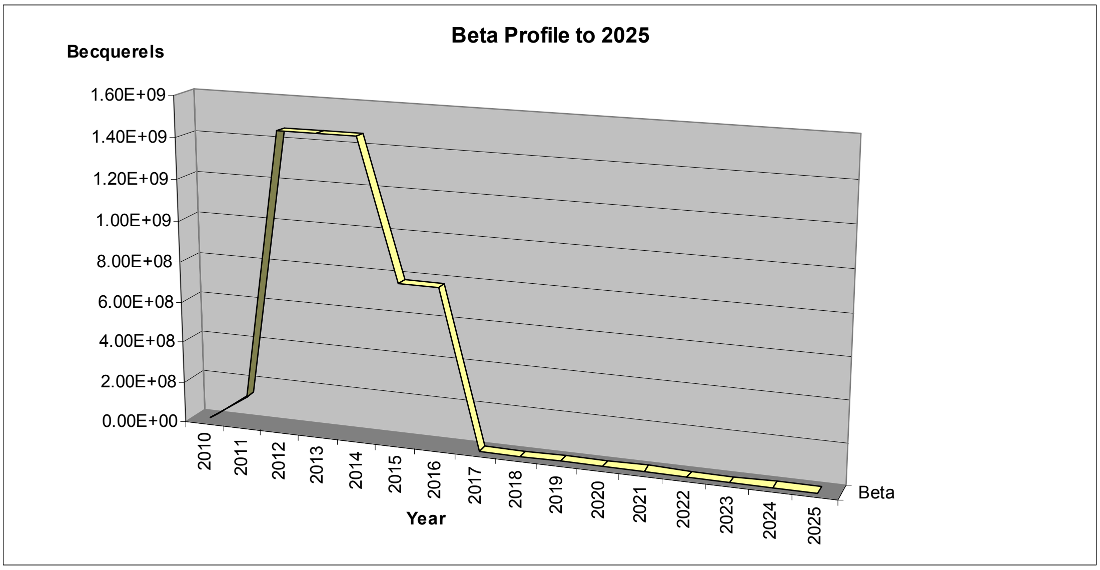

Figure 43b: Predicted Site Gaseous Beta Discharges up to 2025*
(* - Note axis values.)

408) With respect to the predicted beta discharges, the drop off are due to the fact that the gaseous discharges from D3900 and D3200 have not been fully determined and are not included.

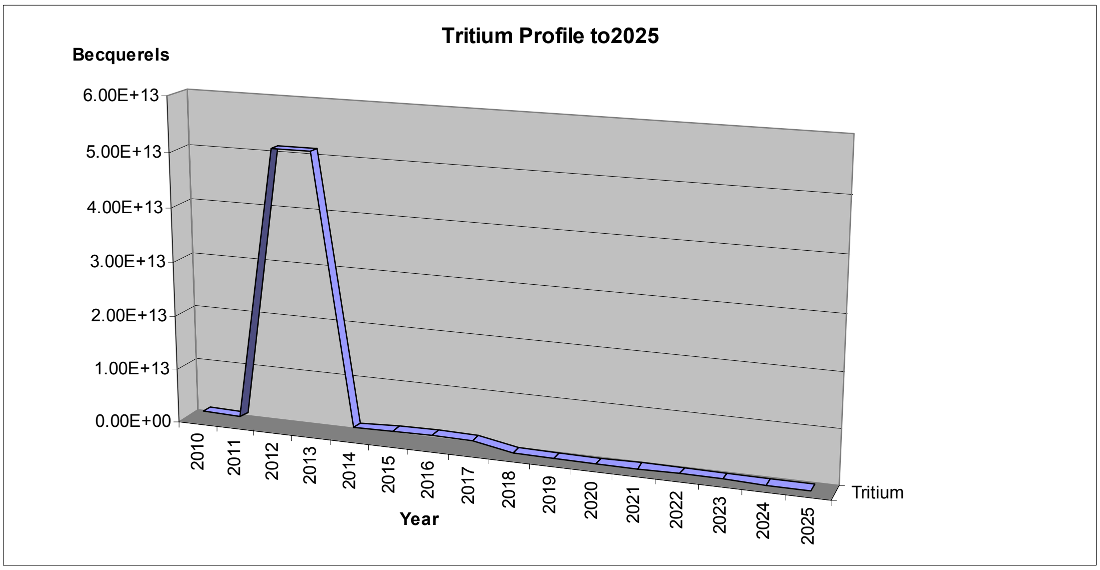

Figure 43c: Predicted Site Gaseous Tritium Discharges up to 2025*
(* - Note axis values.)

409) With respect to the predicted tritium discharges, the drop off in 2014 is due to the completion of the processing of the sodium residues.

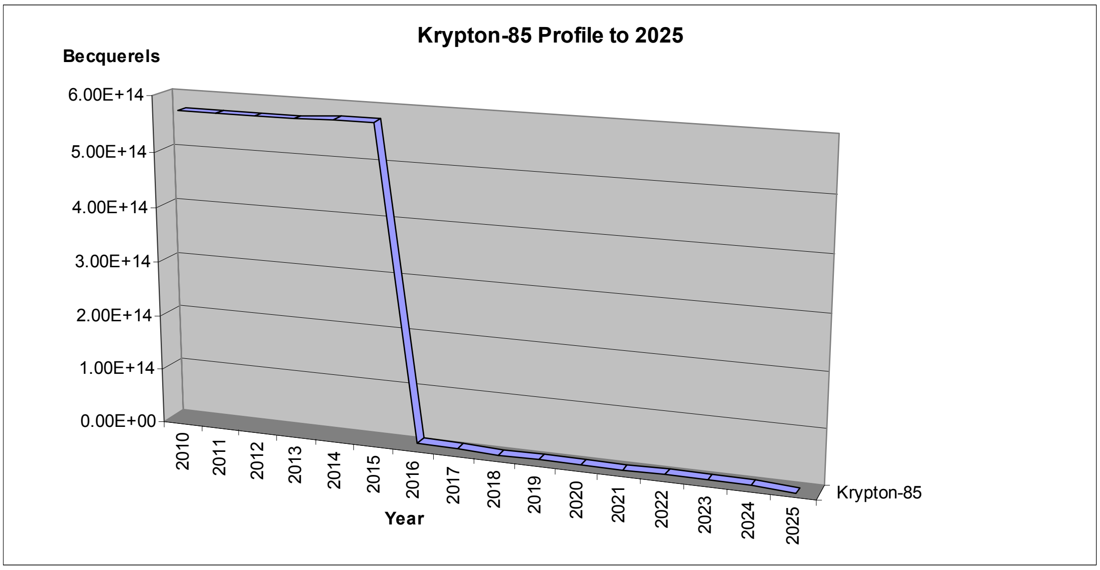

Figure 43d: Predicted Site Gaseous Krypton Discharges up to 2025*
(* - Note axis values.)

410) With respect to the krypton discharges, the drop off observed around 2016 is due to the removal of the irradiated PFR fuel from the PFR Buffer Store.

6.2 Non-radioactive Wastes (Clean and Exempt)

411) During 2007/08, SDWCU undertook an options assessment process to ascertain the best waste management option or options for its clean and exempt wastes (44). The groups reviewed were:

- Clean Inert
- Clean Non-Hazardous
- Clean Hazardous
- Exempt Inert
- Exempt Non-Hazardous
- Exempt Hazardous
- Exempt (in situ)

412) This strategy is being implemented as routes become available. Some will happen quicker than others. Following optioneering workshops, the reference strategies identified were:

6.2.1 Clean Inert

413) Inert waste typically comprises of soil/spoil and rubble. The majority of inert waste will arise from decommissioning project and this includes new build projects.

414) This stream accounts for around 66% of the volume of clean and exempt material at Dounreay. This equates to around 483,085 m^3. The increase in volume compared to last years estimate (116,269m^3) is due to a correction in the waste volume estimate for the surplus material generated during the construction of the LLW Disposal Facility vaults.

415) The strategy states:

- Waste hierarchy principles will be applied.
- Inert material (soil, spoil and rubble) will be processed for on or off-site reuse, where practicable.

- Materials not suitable for processing will be disposed of off-site via appropriate final disposal routes. This is currently landfill.
- The level of separation carried out will be determined by project specific safety requirements, industry good practice and economic factors.

6.2.2 Clean Non-Hazardous

416) Clean Non-hazardous waste will be produced from both operational and decommissioning projects which include new build projects. Operational wastes are typically predictable and consistent over time. These waste streams are very similar to any typical industrial facility, employing a medium sized workforce and are usually termed municipal solid wastes.

417) Clean Non-hazardous waste from decommissioning projects will include:

- Building fixtures and fittings
- Surplus machinery
- Scrap metal

418) This stream accounts for around 9% of the volume of clean and exempt material on the Dounreay Site. This equates to approximately 65,500m^3, similar to the volume estimate in last years LTP.

419) The strategy states:
- Waste hierarchy principles will be applied.
- Non-hazardous material will be reused/recycled where practicable.
- Material not suitable for reuse or recycling will be consigned via appropriate final disposal route, currently landfill.
- Procurement of new materials will consider their reuse/recycling potential.

6.2.3 Clean Hazardous

420) Clean hazardous wastes will be produced throughout the LTP as a result of decommissioning and routine operations across the Dounreay site. Existing disposal routes are already in place for these wastes which includes asbestos, chemically contaminated materials or items classed as under Waste Electrical and Electronic Equipment (WEEE).

421) This stream accounts for less than 1% of the volume of clean and exempt material on the Dounreay Site. This equates to approximately 1,533m^3, similar to the volume estimate in last years LTP (1,124m^3).

422) The strategy states:
- Waste hierarchy principles will be applied.
- All clean hazardous materials will be managed in accordance with legislative requirements and opportunities to either recycle or down categorise hazardous wastes will be utilised as appropriate.
- Cost benefit principles will be applied to the choice of treatment applied to chemically contaminated materials.

6.2.4 Exempt Inert

423) Exempt Inert waste typically comprises of soil/spoil and rubble for which provenance cannot be found to prove the material is clean. The majority of inert waste will arise from decommissioning projects and new build projects.

424) This stream accounts for around 9% of the volume of clean and exempt material on the Dounreay Site. This stream has increased from just under 60,000m^3 to 69,000m^3.

425) The strategy states:
- Waste minimisation will be carried out.
- Suitable exempt inert materials will be reused on-site where practicable.
- Materials not suitable for on-site reuse will be disposed of off-site via appropriate final disposal route, currently landfill.
- The processing of Substances of Low Activity (SoLA) exempt inert materials will take priority over the processing of clean inert materials due to reduced available waste routes and higher landfill costs.

6.2.5 Exempt Non-hazardous

426) Exempt Non-hazardous waste from decommissioning projects will include, where provenance cannot be found to confirm they are clean:

- Building fixtures and fittings
- Surplus machinery
- Scrap metal

427) This stream accounts for around 3% of the volume of clean and exempt material on the Dounreay Site. This stream has decreased slightly from 28,000m^3 down to approximately 25,000m^3.

428) The strategy states:
- Waste minimisation will be carried out.
- Materials will be recycled/reused on site where practicable.
- Material not suitable for on-site reuse will be disposed of via appropriate final disposal route, currently designated landfill.
- Suitable LLW will be treated to render it exempt.

6.2.6 Exempt Hazardous

429) Exempt hazardous wastes will be produced throughout the LTP as a result of decommissioning and routine operations across the Dounreay site. Existing disposal routes are already in place for these wastes which includes Asbestos, chemically contaminated materials or items classed as under WEEE. Again it is classed as exempt as its provenance as clean cannot be determined.

430) This stream accounts for less than 0.1% of the volume of clean and exempt material on the Dounreay Site. This stream has increased to 640m^3 from last years LTP estimate of 238m^3.

431) The strategy states:
- Waste minimisation will be carried out.
- Suitable materials will be treated on site for on site reuse, where practicable.
- All other hazardous exempt wastes will be consigned to an appropriate designated waste disposal facility.

6.2.7 Exempt (In situ)

432) Exempt (in situ) covers those wastes for which a case can be made to the Regulators to dispose of the material “in situ”.

433) This stream accounts for 13% of the volume of clean and exempt material on the Dounreay Site. This stream is estimated at around 167,000m^3, similar to last years LTP estimate.

6.3 SPECIFIC STREAMS

6.3.1 Asbestos

434) Asbestos is likely to be the largest single hazardous waste category produced during decommissioning. The majority of removal works in association with demolition is carried out by specialist companies who also have responsibility for the disposal and consignment of the asbestos. Small amounts of asbestos arising from maintenance are bulked and disposed of to specialist waste management contractor. As better estimates of future arising are obtained, Dounreay will look to ascertain the security of waste routes.

6.3.2 Lead

435) There is an estimated 2,600 tonnes of lead at Dounreay for which there has been a draft strategy produced (45). Most the lead on-site is categorised as LLW (1,600 tonnes).

436) The draft strategy was produced in late 2008/09 and the aim is to gain approval from senior management for the site to adopt this strategy by the end of 2009/10. The strategy recommends the following options for the management of lead on the Dounreay Site:

The clean lead draft reference strategy is:

- Clean lead with an identified re-use will be re-used on site.
- Clean lead with no identified re-use will be recycled through a specialist authorised metal recycling agent.

The exempt lead draft reference strategy is:

- A small store of exempt lead should be set-up on site to exploit re-use opportunities as soon as possible.
- Until the site's policy review on the recycling of exempt material is undertaken, all exempt lead should be stored on-site.
- Following the site's policy review, exempt lead not required for the Exempt Lead Store will either be recycled through a specialist authorised metal recycling agent or disposed of to a hazardous exempt landfill (dependent on the review outcome).

The LLW lead draft reference strategy is:

- Any LLW lead that is not suitable for treatment will be consigned to existing LLW routes with immediate effect.
- Until a decision on whether LLW lead should be treated or disposed of directly, all LLW lead suitable for treatment, should be stored on-site.

The ILW lead draft reference strategy is:

- ILW lead will be consigned to existing ILW routes.

6.3.3 Zinc Bromide

437) DSRL have around $57m^3$ of Zinc Bromide on the Site, either stored as waste stocks or contained within cell/cave windows. Previously, some material ($14m^3$), was dispatched via a specialist contractor to Fawley for disposal but the remainder of waste stocks is being stored on-site in IBCs until a waste route becomes fully determined and operational.

438) DSRL have undertaken a treatment and disposal options review for the management of existing holdings and future arisings, taking into account experience of other NDA SLCs and international experience. This report, produced in February 2009, recommended recycling and reuse of the clean material and on-site treatment for disposal as LLW for the remainder of the material. During 2010/11, this work will be

built upon and will take into account any changes the revised Exemption Orders may have on the waste volumes/categories for disposal.

6.3.4 Mercury

439) The inventory of mercury at Dounreay is estimated to be approximately 3.5 tonnes. The mercury is mainly in the metallic liquid form but there are minor quantities in other forms (e.g. solid). Clean mercury on site can be disposed of as a hazardous waste via a specialist contractor. The SoLA exempt material currently has to be stored on site. Most contaminated mercury on site will become available, through the decommissioning of facilities over the next 10 years.

440) The current strategy is not to treat and dispose of the mercury until the bulk has become available. A triple distillation mercury treatment facility will be provided to decontaminate the mercury for disposal off-site through a specialist contractor.

441) DSRL have undertaken a treatment and disposal options review for the management of existing holdings and future arisings, taking into account experience of other NDA SLCs and international experience. The recommendations detailed in this report will be built upon during 2010/11.

6.3.5 Oils and Solvents (Including PCB contaminated oils)

442) The site has an inventory of clean oils and solvents and disposing of these as clean hazardous waste is quite straightforward through a specialised contractor. The materials are always sampled and analysed for any nuclide contamination such as H3 and C14. It is recognised that some oils will come onto site with trace contamination and this is also checked to ensure that the material can be demonstrated as clean.

443) There are some transformer oils containing Poly Chlorinated Bi-phenyl (PCB) on site, but disposal routes exist for clean, PCB-contaminated oils again through licensed contractors.

6.3.6 Non-Radioactive Discharges

Liquid Waste Discharges

444) Dounreay has set out its goals and objectives for the management of both radioactive and non-radioactive discharges. It states: “UKAEA (DSRL) will strive to reduce the content of its inactive waste discharges at Dounreay so that they are as clean as possible, by employing a holistic waste management approach to minimise environmental damage and using the best available techniques and practices, where this does not incur excessive costs.”

445) Non-radioactive discharges are via 6 outfalls along the northern shoreline of the Dounreay Site. The outfalls are licensed under the CAR and are routinely checked for pH, flow, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and radioactivity. In addition, as part of its obligations under a PPC Part A Permit for Non-Ferrous Metals Processes, the site records trace metals and nitrates discharged via the radioactive aqueous effluent discharges from LLLETP (Outfall 10).

446) The records made for Outfall 10 under the PPC Permit will, in 2010, be made in compliance with a Schedule 5 variation of the RSA Certificate of Authorisation number RSA/N/50011/99 subsequent to the surrender of the PPC Permit.

Gaseous Discharges

447) DSRL hold a PPC Part A Permit that places limits on the non radioactive process gases from the Uranium Processing Facility. Since this facility is no longer planned to

be operated, DSRL has applied to SEPA to surrender the PPC permit. If SEPA agree, then the permit may be surrendered in 2010.

448) DSRL holds a PPC Part B Permit in relation to the handling of cement powders and fuel ash used in the immobilisation of high activity aqueous wastes. The PPC Permit places controls, via BAT consideration, on the concentration of dusts that enter the environment through visual judgement and physical measurement.

449) In terms of future gaseous discharges, the only operation likely to be covered is related to the discharge of ammonia gases from the treatment of ADU Floc in either the ILW Liquor Storage Facility or the RHILW-IEP. As the process flowsheet is still under development, details of the process are not yet available. However, whichever process flowsheet is chosen it will undergo a BPM assessment and will need to be licensed under PPC.

450) The site operates an oil fired boiler house for raising steam for heating and process operations. The emissions from the boiler flue are regulated under the provisions of the Clean Air Act 1993 in that dark smoke is only permitted for a maximum period of 60 seconds from the time of start-up.

6.3.7 Liquid and Gaseous Disposal Routes

6.3.7.1 Radioactive Liquid Discharges

451) Dounreay discharges its radioactive liquors direct to sea via its own dedicated pipeline via the LLLETP. Discharges utilising this route will continue until 2022 when LLLETP will be decommissioned. Thereafter, it is assumed that radioactive liquor arisings will be minimal and conditioned as solid waste for disposal.

6.3.7.2 Radioactive Gaseous Discharges

452) Dounreay discharges its radioactive gaseous wastes through a number of major and minor stacks. The bulk of these will be decommissioned by the IEP in 2025. Thereafter, there will continue to be radioactive gaseous discharges on the Dounreay site until all the conditioned ILW and nuclear material are transported from the Site and the facilities decommissioned. This is programmed to be completed by 2078.

6.3.7.3 Non-Radioactive Liquid Waste Discharges

453) Up until the IEP in 2025, non radioactive liquors will either be discharged via milliscreen systems (currently under process review by SEPA) and designated outfalls or as part of the radioactive discharges via the LLLETP system.

454) Between 2025 to 2078, there will still be a requirement to manage non-radioactive liquors. These will essentially be trade effluents associated with staff still involved on the Site. It is planned that these will be discharged via licensed/authorised outfalls.

6.3.7.4 Non-Radioactive Gaseous Waste Discharges

455) Dounreay currently has only one facility, the site's Boiler House, known to discharge only non-radioactive gaseous waste. The Boiler House provides steam heating for the Dounreay site.

456) Otherwise gaseous discharges are monitored for compliance purposes for both radiological and non-radiological content. This would continue until 2078, when the last stack will be dismantled.

6.4 WASTE DISPOSAL ROUTES

6.4.1 Waste Disposal and Transfer Routes

457) The preceding sections have identified a considerable number of waste disposals and transfer routes currently in use by Dounreay, see Figure 44 below. These are discussed further in the following sections. Due consideration is given to the selection of waste disposal routes through either optioneering where appropriate or may be based purely on available contractors:

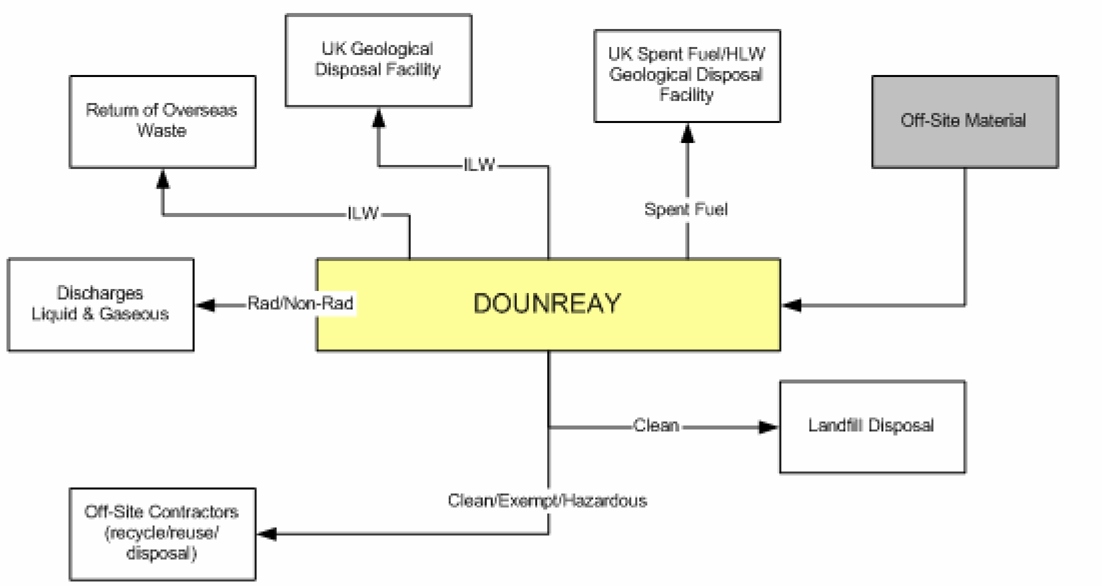

Figure 44: Waste Disposal and Transfer Routes

6.4.2 Waste Disposal Routes – Off-Site – Clean, Exempt and Hazardous:

458) The waste disposal and transfer routes from the site identified in the LTP are tabulated in Annex 2. All transfers will be integrated with the receipt programme of the operators in order to minimise the safety, environmental and cost impacts.

459) Dounreay currently has contracts in place for the disposal of clean, exempt and some hazardous material with local and national specialist contractors. These are assumed to remain in place through the lifetime of the Dounreay LTP although they will be under regular review.

460) Dounreay will continue to review opportunities for changes to the strategy including reuse and recycling if appropriate or should a disposal route to landfill become unavailable. Clarifications of SEPA's policy on RSA material may see opportunities open up for LLW materials.

6.4.3 Transfer Off-Site – Return of ILW to Overseas Customers

461) Dounreay is working to meet its contractual obligations in returning waste to customers for whom it reprocessed reactor fuels. At this time it is estimated that there will be approximately 330 500 litre drums of cemented MTR raffinate to be returned to Germany, Belgium and Australia. There may also be an additional 97 drums if an exchange agreement is signed for reprocessing work which has not been undertaken.

462) This requirement is enshrined in the current disposal authorisation for the Dounreay Site. Shipments are scheduled to start around 2010 and due to be completed by 2016. Transport studies are being undertaken by the various customers.

6.4.4 Transfer Off-Site – ILW to UK Geological Disposal Facility

463) At the IEP, all ILW will have been conditioned and placed in on-site storage.

464) Dounreay has assumed that conditioned ILW will be transferred off the Dounreay Site to a National Facility in the Period 2050 to 2060. This will involve transporting the waste by road to the nearest railhead, which is assumed to be Georgemas junction.

465) The graph below shows the export of conditioned ILW from the Site.

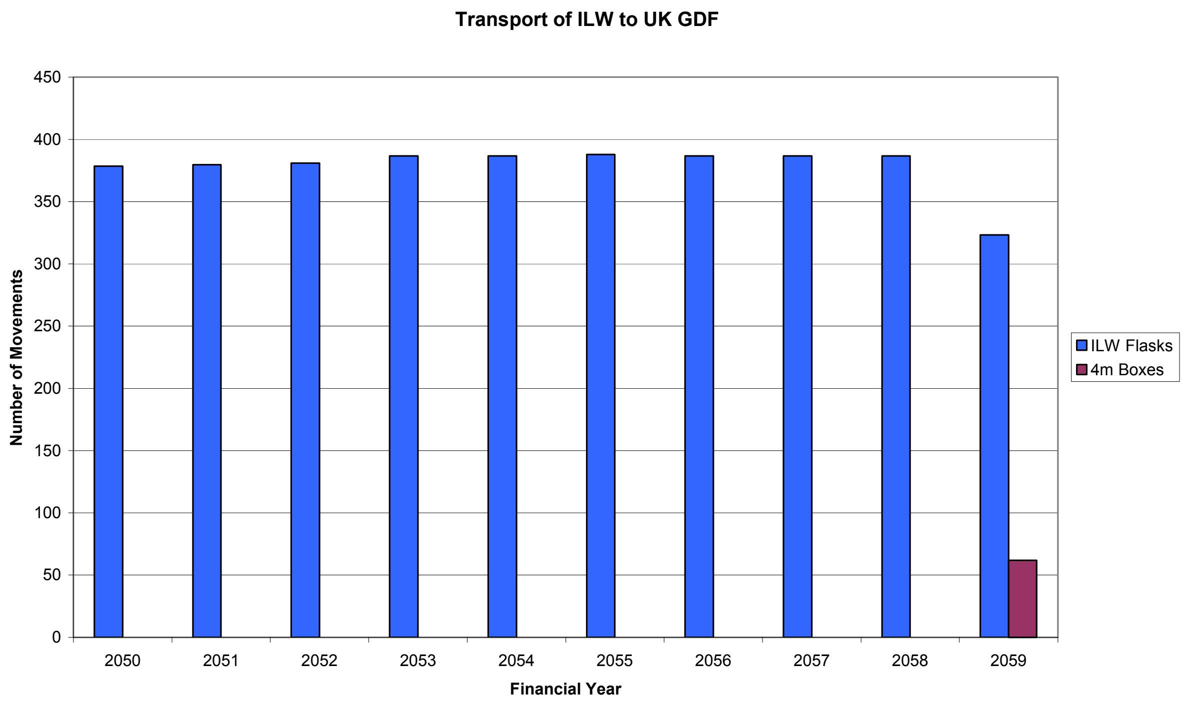

Figure 45: Predicted ILW Moves to UK GDF

466) DSRL will be responding to the Scottish Government consultation on its HAW Policy which closes in early April 2010. It will then await its formal publication and any instruction it may then receive from the NDA with respect to implementing work to change the Dounreay baseline.

6.4.5 Transport Off-Site – Fuels to National Disposal Facility:

467) At the IEP, Dounreay will have packaged its irradiated fuel inventory and other items into storage casks or into a new nuclear material store.

468) The current assumption is that the casks will be transported off-site during 2075/76 and the associated facilities then decommissioned by 2078.

469) The remaining nuclear material will await a decision on National Policy.

7 AREAS REQUIRING FURTHER DEVELOPMENT AND ACTION PLAN

470) The following section outlines work which will assist and improve the Site waste strategy and its integration. Only those actions taking place in the next one to two years are presented.

471) Revision to Higher Activity Waste Strategy following re-alignment of funding resulting in changes to the New Build programme.

472) SDWCU to continue to open up waste routes for clean and exempt wastes.

473) Working with SEPA to allow retention of clean/exempt spoil for more than 3 years where a future use can be demonstrated.

474) Reviewing potential opportunities to utilise waste treatment facilities outside Scotland for the possible treatment of exempt or LLW where there is a cost benefit.

475) Ongoing improvements to near time data management and predictions, through the PSWP system and working with the NDA on improving confidence in Waste and Fuel estimates.

476) Work with the regulators to develop a programme for the production of Radioactive Waste Management Cases for HAW on the Dounreay Site. In parallel develop internal DSRL systems to manage the production, review and approval of such cases.

477) Work will be undertaken on the development of a flask strategy for the Dounreay site. This is an area which requires to be addressed in order to improve integration of the ILW strategy.

478) Continue to progress the construction of the New LLW Disposal Facility

479) Undertake identified LoC submissions and associated development work.

480) Continue to work with the NDA and other SLCs on waste strategy and treatment initiatives and sharing of information where appropriate.

7.1 Action Plan and Programme

481) Key areas of the IWS requiring further development in the next 1 to 2 years are tabulated below:

Development Requirement	Action Plan and Status
Site Strategy & Waste Strategy	Review of Funding Impacts on the Waste Strategies at Dounreay. Subsequent revision of such strategies as appropriate and look for opportunities.
Fuels Strategy.	A number of BCPs will be submitted in 2009/10/11 to support changes in Fuels strategy. These will include impacts on waste routes.
CHILW Strategies	Conceptual LoC submissions for a number of CHILW streams will be submitted in 2010/11. The assessment of those by NDA RWMD will result in further packages of work to be undertaken.
Continuous Improvement of Waste estimates and Strategies	Implementation of a standard approach to characterisation and ensure that potential wastes are integrated into the existing waste routes, or new routes identified.
Flask Strategy	Review of flask availability, lifetime and possible use. Production of a strategy to underpin the LTP and avoid bottlenecks.
ILW Packages	Complete work to establish an underpinned reference 3m3 box design for DSRL and also establish a prototype 4m box design.

Table 13: Action Plan

482) The IWS document. the areas requiring further development and the action plan are monitored on an ongoing basis by SDWCU. Formal update of the IWS will take place as part of the next LTP submission.

8 CONCLUSIONS

483) The Dounreay IWS has been produced in accordance with NDA procedures and submitted as part of LTP10.

484) The IWS remains in "interim" status as further work is required to fully integrate, optimise, the waste strategies on the Dounreay Site.

485) Considerable work has been completed in the past year with notable achievements being:

- Interim End Date remaining at 2025
- Site Waste BPEO issued.
- Strategy work has taken place for CHILW Strategy, THTR Graphite and Thorium Nitrate.
- Ongoing improvements on future waste estimates by undertaking detailed walkdown surveys of active facilities.
- Improvements to the Waste Compliance process including PSWPs.

486) The main challenges to underpin the Dounreay IWS during LTP10 are:

- Review of Site and Waste Strategy in light of revised Funding levels.

- Implementing a revised fuels strategy and assessing the impact of associated waste arisings on the Waste Strategy.

- Continued initiatives to improve facility and waste characterisation and hence better define treatment, packaging and disposal strategies.

- Alignment of DSRL strategies with NDA Strategy Management System.

- Whilst every attempt has been made to put in place a reference strategy for a number of smaller waste streams these still require to be underpinned with specific strategy documents.

- Further work is still required in refining the non-radioactive waste strategy at Dounreay in order to maximise the opportunities for re-use and recycling of waste.

- Work is also required to better understand the capacity of non-radioactive waste routes and facilities and demonstrate BPM.

- Agreeing clean up levels for the remediation and restoration of the site, along with the management of clean and exempt decommissioning rubble and its use in the capping and landscaping the site.

487) Overall, the waste strategies detailed in this document have been integrated into the 2010 LTP schedule for the Dounreay Site.

9 GLOSSARY

ALARA (As Low As Reasonably Achievable)
To satisfy the ALARA Principle, radiological doses and risks are kept as low as reasonably practicable, taking a proportionate approach, whereby priority is given to reducing discharges which have greatest radiological significance or which present most risk of damaging the marine environment, whilst ensuring that the costs of such reductions are not grossly disproportionate to their benefits in line with current Government guidance on better regulation.

ALARP (As Low as Reasonably Practicable)
To satisfy the ALARP Principle, measures necessary to reduce risk are undertaken until or unless the cost of these measures, whether in money, time or trouble, is disproportionate to the reduction in risk.

Best Practicable Environmental Option (BPEO)
This is the waste management option, which is the outcome of a systematic and consultative decision-making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefit or least damage to the environment as a whole, at acceptable cost, in the long term as well as in the short term.

Best Practicable Means (BPM)
BPM is a term used by EA and SEPA in authorisations issued under the RSA. Essentially, it requires operators to take all reasonably practicable measures in the design and operational management of their facilities to minimise discharges and disposals of radioactive waste, so as to achieve a high standard of protection for the public and the environment. BPM is applied to such aspects as minimising waste creation, abating discharges and monitoring plant, discharges and the environment. It takes account of such factors as the availability and cost of relevant measures, operator safety and the benefits of reduced discharges and disposals. If the operator is using BPM, radiation risks to the public and the environment will be ALARA.

Brownfield
See **Site End Point**

Characterisation
Characterisation of radioactive materials involves analysing the materials in terms of their physical and chemical form, radioactive content, origin, present state, current storage conditions and other relevant information and properties. This radiological characterisation may involve obtaining data from several sources:

- Reviewing existing information. Such as historical facility usage records and radiological survey data.
- Calculations using codes for activation, nuclear fuel burn-up, and radioactive decay.
- In situ measurements e.g. taking swabs and measuring using a dose rate counter.
- Sampling and analysis – accurate characterisation requires representative sampling of materials (for example non-homogeneous samples (e.g. concrete) require careful sampling and homogenisation to ensure that representative samples are taken for analysis. If contamination is not uniform, but an “averaged” value of activity is required, then some form of systematic sampling (e.g. using a grid) and homogenisation of the samples should be used.
- Documentation.

Characterisation is an essential step at the beginning of the decommissioning process and may need to be repeated at different stages during the decommissioning. For more information, refer to “Radiological Characterisation of Shutdown Nuclear Reactors for Decommissioning, International Atomic Energy Authority (IAEA) Technical Report Series No. 389, IAEA, Vienna (1998) (41)

Clean
An article or substance which has had no reasonable potential to have become contaminated or activated, or upon or within which no radioactivity other than normal background is detectable when suitable comprehensive measurement (monitoring and sampling) is practicable and has been undertaken

Clearance
The process to confirm that an article or substance is **clean** (free from radioactivity), or **excluded** or **exempt** from further control under all relevant legislation on the basis of its radioactivity

Clinical Waste
This is controlled waste that includes any waste which consists wholly or partly of human or animal tissue, blood or other bodily fluids, swabs, needles, or sharp instruments. Clinical waste is classified as industrial waste for legislative purposes; however it is also subject to the Hazardous Waste Regulations.

Commercial Waste
Commercial Waste includes wastes from premises used for a trade or business or for the purposes of sport, recreation or entertainment e.g. general office wastes.

Controlled Waste
This includes industrial and commercial waste (s.75 of Environment Protection Act (EPA) 1990 as modified by the Waste Management Licensing Regulations 1994) both of which are subject to control by the Environment Agency under waste management regulations. Controlled waste can be inert, hazardous or non-hazardous.

Directive Waste
This is any substance or object which the producer or the person in possession of it discards or intends or is required to discard. This forms the basic definition of waste in the UK. Other categories of waste are subsets within Directive Waste.

Designation
Under the Energy Act 2004 the NDA has responsibility for, amongst other things, the decommissioning of designated nuclear installations and the cleaning-up of designated nuclear sites. The designation of installations, sites and facilities is subject to the form of a direction to the NDA given by the Secretary of State for Trade and Industry.

De-designation
De-designation is the revocation of a direction by the Secretary of State to the NDA for the designation of an installation, site or facility. The direction can only be revoked once the Secretary of State (jointly with Scottish Ministers for installations, sites and facilities in Scotland) is satisfied that the NDA has discharged all its responsibilities in relation to the decommissioning or cleaning-up of the installation or site.

Delicensing
Delicensing is referred to by the NII as meaning “ending of the period of responsibility under The Nuclear Installations Act”. This is defined in section 5(3) of the Nuclear Installations Act and can only happen when the HSE gives notice in writing to the licensee that it its opinion there has “ceased to be any danger from ionising radiations from anything on the site or, as the case may be, on that thereof”. Before delicensing any land on nuclear site, HSE must satisfy itself that delicensing is appropriate and that licensable activities are no longer being carried out on the

site or that part of the site to be delicensed. This means that no radioactive waste remains on the site or the part of the site to be delicensed.

The HSE has indicated that for practical purposes the criterion of 'no danger' for the purpose of delicensing is an additional risk of death to an individual of one in a million per year (10^{-6}). Compliance with this criterion would normally mean that HSE can remove the site from regulatory control under NIA65.

Excluded
An article or substance that is not radioactive under the RSA 93 (and not subject to any control under the Act) because it does not contain levels of any of the specified radioelements above the limits in Schedule 1 of RSA 93 or any non-specified radioelements at levels above normal backgrounds. An excluded article or substance is unlikely to be subject to control as radioactive under other legislation

Exempt
An article or substance that is radioactive or contaminated under the RSA 93 because it contains levels of specified radioelements above RSA 93 Schedule 1 exclusion limits or because it contains other radioelements wholly or partly attributable to either an artificial process or as a result of the disposal of radioactive waste, but in both cases at levels below relevant limits in Exemption Orders under the Act. These exemptions are from the requirements of registration or authorisation under RSA 93. An (RSA) exempt article or substance may be subject to control as radioactive under other legislation (mostly due to the presence of exempt levels of RSA 93 Schedule 1 radioelements).

Final End State
See **Site End Point**

Greenfield
See **Site End Point**

Handoff
Waste stream for which an agreement has been made for transfer to a third party for treatment/processing/storage and/or disposal

Hazardous Wastes (formerly also known as Special Wastes)
Hazardous waste is controlled waste that contains any substance specified in The Hazardous Waste (England and Wales) Regulations 2005, ISBN 0110726855. Radioactivity does not in itself make waste hazardous waste. However radioactive waste may posses other properties, such as toxicity due to the presence of uranium, which bring it within the definition of hazardous waste and therefore subject to the requirements of the Hazardous Waste Regulations, in addition to the requirements of the Radioactive Substances Act 1993.

Examples of typical hazardous wastes are

- Scheduled poisons - *(Schedule 1 of the Appendix to the Poisons Rules, 1982, Statutory Instrument No 218)*. This Schedule includes, amongst others, cyanides and compounds of barium, arsenic, thallium and mercury. Also includes significant quantities (greater than 10 grams per day) of copper, chromium, lead, cadmium, nickel, vanadium, zinc and other heavy metals.
- Laboratory and other chemicals;
- Drugs and/or medicines;
- Aerosols containing paints, adhesives, lubricants and cleaners;
- Asbestos;
- Bio-hazardous waste;
- Batteries, other than household;
- Pesticides and weed killers;

- Solvent based resins, paints and adhesives, paint strippers or similar materials from photographic or copying processes;
- Waste oils, oil filters, oil water mixtures and crude oil.

Note - The methodology for classifying wastes as hazardous is based, in part, on deciding whether waste possess hazardous properties which requires a knowledge of the chemical composition of the waste. Assessing the hazardous properties is based the classification procedure for chemical products under the Chemicals (Hazard Information and Packaging for Supply) Regulations 1994 (as amended) (CHIP), although there are some modifications introduced by the Hazardous Waste Directive.

High Volume Low Activity (HVLA) Waste
HVLA waste is a label given by DSRL to a category of solid LLW, where the waste contains radioactivity that is only just above the legal limits which would otherwise allow the waste to be exempted from being LLW. HVLA waste is only just radioactive enough to be treated as a radioactive waste. HVLA waste is not legally defined but there is an emerging UK and European dialogue concerning HVLA type wastes.

Higher Activity Radioactive Waste
Waste as defined as Intermediate Level Waste under current UK categorisations and certain wastes categorised as LLW which by their nature are not currently suitable for disposal in existing LLW facilities as they may, for example contain longer lived radionuclides.

Industrial Wastes
This is controlled waste that includes wastes from a factory, wastes from laboratories, workshops, construction and demolition works, and clinical waste.

Inert Wastes
Inert waste is controlled waste that is defined in the Landfill Directive as waste that does not undergo any significant physical, chemical or biological transformations. Inert waste will not dissolve burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm human health. The total leachability and pollutant content of the waste and the ecotoxicity of the leachate must be insignificant, and in particular not endanger the quality of surface water and/or groundwater.

Interim End State
See **Site End Point**

Intermediate Level Waste (ILW)
ILW is defined as waste with a radioactivity level that exceeds the upper boundaries for LLW (4GBq/te α and 12GBq/te β/γ) but which does not require heating to be taken into account in the design of storage or disposal facilities (Cm2919).

Letter of Compliance (LoC) (formerly Letter of Comfort)
Under its LoC system, in the context of a phased approach to disposal, NDA RWMD provides guidance to the nuclear industry on its requirements for the packaging and transport of ILW. LoCs are issued in three stages, which successively assess the suitability of the proposals against the requirements for safe disposal against the phased disposal concept.

Low Level Waste (LLW)
LLW is defined as waste containing radioactive materials other than those acceptable for disposal with ordinary refuse, but not exceeding 4GBq/g α or 12GBq/g β/γ activity (Cm2919).

Non-Hazardous Wastes

This is controlled waste which is not covered by the definition of hazardous waste. It comprises both inert waste and putrescible waste. Putrescible waste is controlled waste that will decompose readily under microbial attack. It includes green waste and wastes arising from residential, commercial and industrial sources.

Passive Safety
NII's guidance to its inspectors defines passive safety in the following way:
"Passive safety…..requires…..radioactive wastes…..to be immobilised in a form that is physically and chemically stable and stored in a manner which minimises the need for control and safety systems, maintenance, monitoring and human intervention. The wastes…..should be stored in discrete packages which are resistant to degradation and hazards and which can be inspected and retrieved for final disposal."

Proximity Principle
The proximity principle requires waste to be disposed of as close to the place of production as possible. This avoids passing the environmental costs of waste management to communities which are not responsible for its generation, and reduces the environmental costs of transporting waste. In considering waste management options there should be assessment of where environmental burdens fall in relation to particular sectors of society and recognition of potential adverse impacts on health and quality of life, in relation to other potential benefits to the social and economic needs of the area. The proximity principle has been defined primarily for non-radioactive wastes. For radioactive wastes it is a consideration to be taken into account, rather than an absolute principle. Most radioactive wastes that exist or will arise in the future will be owned by a small number of mainly public bodies (such as the NDA). For practical purposes radioactive waste creation and waste management are as closely linked as possible. Consideration needs to be given to balancing the impacts of waste transport against the concentration of radioactive wastes to ensure they can be securely and safely managed.

Secondary Waste
This is waste produced as a by-product of processing the primary waste stream.

Site End Point and Site End State
The 'end state' of a site is the physical condition at the point when the NDA has finished its business. The 'end point' of a site is the time at which this 'end state' is reached.

Site end states have previously been described as 'Greenfield' or 'Brownfield'. It is now accepted that these terms are not appropriate mainly because there is no agreed definition of what they mean and hence they cannot be recommended. It is likely that specific site end states will be defined as a result of a BPEO or an options study with appropriate stakeholder involvement. The current terms that are used to define end states are 'de-licensed' and 'de-designated', they are described above.

For some sites, reaching the **Final End State** is achieved after a long period of institutional care. An **Interim End State** is therefore defined which enables these sites to be decommissioned to a state which enables any residual hazards to be controlled by land use restrictions so that risks to human health and the environment are minimised to an acceptably low level.

Special Nuclear Material (SNM)
SNM is defined by Title I of the Atomic Energy Act of 1954 as plutonium, uranium-233, or uranium enriched in the isotopes uranium-233 or uranium-235. The definition includes any other material that the Commission determines to be SNM, but does not include source material. The IWS will cover SNM that is currently identified as a waste or where it may be destined for a waste route in the future.

Sustainability – Sustainable development
This has been widely defined as 'development which meets the needs of the present without compromising the ability of future generations to meet their own needs. The following requirements should be met:

- Waste management should not impose undue burdens on future generations and their environment such that it compromises their ability to meet their needs.
- Even given a legacy of appropriate financial resources, future generations should preferably not have to divert time and effort to managing wastes generated by present and past generations. They should be free to pursue their own preoccupations.
- Decisions should be based on the *best possible scientific information* and analysis of risks
- Where there is uncertainty and potentially serious risk exists, *precautionary* action may be necessary
- Ecological impacts must be considered, particularly where resources are *non-renewable* or effects may be *irreversible*
- The underlying principle of "polluter pays" should be recognised in assessing cost implications (the 'polluter pays' principle requires producers and owners of wastes to bear the costs imposed by those wastes, including the costs of regulation and those of related research undertaken both by themselves and by the regulatory bodies. The evaluation of environmental and human costs of waste production, treatment and disposal should also be taken into account).

Sustainable development should be taken into account as one of the relevant considerations in considering the development of the Site IWS and of waste management policy.

Very Low Level Waste (VLLW)
Although still categorised within the scope of LLW, VLLW contains less than 400 kBq of beta/gamma activity for each 0.1 m^3 of material, or single items containing less than 40 kBq of beta/gamma activity.

Waste Hierarchy
The Waste Hierarchy encourages the adoption of options for managing waste in the following order of priority:

- Waste should be prevented or reduced at source as far as possible
- Where waste cannot be prevented, waste materials or products should be reused directly or refurbished then reused
- Waste materials should then be recycled or reprocessed into a form that allows them to be reclaimed as a secondary raw material
- Where useful secondary materials cannot be reclaimed, the energy content of waste should be recovered and used as a substitute for non-renewable energy resources
- Only if waste cannot be prevented, reclaimed or recovered, should it be disposed of into the environment and this should only be undertaken in a controlled manner.

10 ACRONYMS

A

ADU Floc	Ammonium DiUranate Floc
ALARA	As Low As Reasonably Achievable
ALARP	As Low As Reasonably Practicable
ASFL	Annual Site Funding Limit
ATO	Authority To Operate

B

BAT	Best Available Technique
BCP	Baseline Change Proposal
BOD	Biological Oxygen Demand
BPEO	Best Practicable Environmental Option
BPM	Best Practicable Means

C

CAR	Controlled Activities Regulations
CEWG	Clearance and Exemption Working Group
CFA	Conditions for Acceptance
CHILW	Contact Handleable Intermediate Level Waste
COD	Chemical Oxygen Demand
CoPA	Control of Pollution Act
CoRWM	Committee on Radioactive Waste Management

D

DAM	Dounreay Accountability Meeting
DCO	Discharge Control Objectives
DCP	Dounreay Cementation Plant
DCP-IDS	Dounreay Cementation Plant - Interim Drum Store
DCP-SE	Dounreay Cementation Plant - Store Extension
DDL	Derived Discharge Limits
DEC	Dounreay Environment Committee
DFR	Dounreay Fast Reactor
DMTR	Dounreay Materials Test Reactor
DNI	Dounreay Fuels Inventory
DRWI	Dounreay Radioactive Waste Inventory
DSG	Dounreay Stakeholder Group
DSRL	Dounreay Site Restoration Limited
DSRP	Dounreay Site Restoration Plan
DSRS	Dounreay Site Restoration Strategy
DSSWP	Dounreay Site Safety Working Party

E

EA	Environment Agency
EARWG	Environment Agency Requirements Working Group
EPA	Environment Protection Act
EURATOM	European Atomic Energy Community

F

FCA	Fuel Cycle Area
FEP	Final End Point

G

GDF	Geological Disposal Facility
GIS	Geographical Information System

H	
HAW	Higher Activity Waste
HEPA	High Efficiency Particulate in Air
HHISO	Half Height ISO container
HLW	High Level Waste
HSE	Health and Safety Executive
HVLA	High Volume Low Activity
I	
IAEA	International Atomic Energy Authority
IBC	Intermediate Bulk Containers
ICCM	Investment and Change Control Meeting
IEF	Import/Export Facility (DCP Store)
IEP	Interim End Point
IFC	Irradiated Fuel Cave
IIGCL	Inter-Industry Group on Contaminated Land
ILW	Intermediate Level Waste
IMAGES	Information Management and Geographical Evaluation System.
IRR	Ionising Radiations Regulations
ISO	International Organisation for Standardisation
IWS	Integrated Waste Strategy
L	
LAW	Lower Activity Waste
LLLE	Low Level Liquid Effluent
LLLETP	Low Level Liquid Effluent Treatment Plant
LLW	Low Level Waste
LoC	Letter of Compliance (formerly Letter of Comfort)
LSA	Low Specific Activity
LTP	Lifetime Plan
M	
MEP	Member of the European Parliament
MoD	Ministry of Defence
MP	Member of Parliament
MSP	Member of the Scottish Parliament
MTR	Materials Test Reactor
N	
NaK	Sodium/Potassium alloy
NDA	Nuclear Decommissioning Authority
NDP	NaK Disposal Plant
NIA	Nuclear installations Act
NII	Nuclear Installations Inspectorate
NISR	Nuclear Industries Security Regulations
NWRF	Nuclear Waste Research Forum
O	
OCNS	Office for Civil Nuclear Security
OSPAR	Oslo Paris Convention
P	
PBI	Performance Based Incentive
PBO	Parent Body Organisation
PCB	Poly Chlorinated Bi-phenyl
PCCB	Police Command and Control Building

PCD	Primary Circuit Decontamination
PCM	Plutonium Contaminated Waste
PCSC	Post Closure Safety Case
PFR	Prototype Fast Reactor
PIE	Post Irradiation Examination
POCO	Post Operational Clear Out
PPC	Pollution Prevention and Control
PPG	Pollution Prevention Guidance
PSWP	Project Specific Waste Plan
PWT	Plant Washings Tank
Q	
QA	Quality Assurance
R	
R&D	Research and Development
RDF	Reactor Dismantling Facility
RHILW	Remote Handleable Intermediate Level Waste
RHILW-IEP	Remote Handleable Intermediate Level Waste Immobilisation and Encapsulation Plant
RMD	Risk Management Database
RSA	Radioactive Substances Act 1993 (as amended)
RWDTG	Radioactive Waste and Decommissioning Technology Group
RWMD	Radioactive Waste Management Department
S	
SAGTA	Soil and Groundwater Technology Association
SD:SPUR	Site Decommissioning: Sustainable Practices in the Use of Resources
SDWCU	Site Decommissioning Waste and Characterisation Unit
SED	Safety and Environmental Detriment
SEPA	Scottish Environment Protection Agency
SLC	Site Licence Company
SNM	Special Nuclear Material
SoLA	Substances of Low Activity
SRF	Size Reduction Facility
T	
TBuRD	Technical Baseline and Underpinning Research Document
TCM	Thorium Contaminated Material
THTR	Thorium High Temperature Reactor
U	
UCM	Uranium Contaminated Waste
UK	United Kingdom
V	
VLLW	Very Low Level Waste
W	
WAC	Waste Acceptance Criteria
WEEE	Waste Electrical and Electronic Equipment
WPC	Waste Posting Cell
WPEP	Waste Product Encapsulation Plant Flask
WRACS	Waste Receipt, Assay, Characterisation and Supercompaction Facility
WTP	Waste Treatment Plant

11 REFERENCES

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(30) - DFR Raffinate Conceptual Letter of Compliance.

(31) - DFR Raffinate Interim Letter of Compliance Submission.

(32) - ADU Floc Conceptual Letter of Compliance.

(33) - Solid RHILW Interim Letter of Compliance.

(34) - Ion Exchange Columns Conceptual Letter of Compliance.

(35) - Shaft and Silo Waste Conceptual Letter of Compliance Submission.

(36) - Supercompacted PCM Conceptual Letter of Compliance.

(37) - DFR Reactor Metals Conceptual Letter of Compliance.

(38) - DFR Graphite Conceptual Letter of Compliance.

(39) - Oils and Solvents Best Practicable Environmental Option.

(40) - Tank Thorium Nitrate Liquors Conceptual Letter of Compliance.

(41) - Mixer Breeder Conceptual Letter of Compliance.

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(43) - Specification for the Management, Control and Release of Radioactive and Non-Radioactive Gases to Air at Dounreay, RMD/QS/06.

(44) - Dounreay Clean and Exempt Solid Waste Strategy, WSU/Strategy/P028(07), Issue 1, December 2007.

(45) - Strategy for Lead at Dounreay, WSU/Strategy/P042(08), January 2009.

Annex 1: Regulatory Constraints and Dependencies

Legislative Framework

The main legislation concerning the safety of nuclear installations is the Health and Safety at Work etc. Act 1974 (HSWA74), the associated relevant statutory provisions of the Nuclear Installations Act 1965 (as amended) (NIA65) and the Ionising Radiations Regulations 1999 (IRR99). These Regulations set the maximum permissible dose to a member of the public at 1mSv/year and to a radiation worker at 20mSv/year, and also requires the dose to be as low as reasonably practicable (ALARP). These limits require processes with high activity materials to be undertaken using remote handling techniques.

The main legislation for the regulation of radioactive materials and radioactive waste is NIA65 and the Radioactive Substances Act 1993, as amended (RSA93).

Non radioactive wastes will be managed and disposed of in accordance with the Environmental Protection Act, Duty of Care Regulations (as amended), Special Waste Regulations 1996 (as amended) and 'The Landfill Directive'. Application of the Waste Management Licensing Regulations 1994 will depend upon the management option(s) selected.

RSA Authorisations

Authorisations under RSA93 are required for discharge of gaseous and liquid wastes to the environment and for the disposal of solid wastes. Conditions imposed in such authorisations require holders to demonstrate BPEO and use BPM to minimise discharges and to ensure that discharges of radionuclides are kept within prescribed limits. Regulatory control for discharges from nuclear licensed sites is exercised by the Scottish Environment Protection Agency in Scotland. NII has statutory powers under NIA65 for the regulation of the safe management of radioactive material, including radioactive waste, on nuclear sites, prior to disposal, taking into account the views of the environment agencies as required. Discharge authorisations are considered during the development of waste strategies at Dounreay.

Site Licence Conditions

Dounreay operates in accordance with the 36 Nuclear Site Licence conditions. Those of particular relevance to the management of radioactive waste are 4-6, 11, 14, 15, 17, 23, 25, 26, 28, 32-35. These, among others, require operations to be supported by safety cases and records to be maintained of the amount and location of all radioactive materials.

EURATOM (European Atomic Energy Community) Treaty

Two Articles of the Euratom Treaty are of particular significance to radioactive waste management. They are:

- Article 35: Member Countries must establish facilities to monitor continuously the levels of radioactivity in the air, water and soil, and to ensure compliance with standards.
- Article 37: Member States to provide the Commission with such general data relating to any plan for the disposal of radioactive waste in whatever form as will make it possible to determine whether the implementation of such plan is liable to

result in the radioactive contamination of the water, soil or airspace of another Member State.

In addition the European Union Council has issued a Directive[i] laying down basic safety standards for the protection of workers and the general public against the dangers arising from ionising radiation. The Basic Safety Standards Directive is implemented in the UK by IRR99, RSA93 and other national legislation.

OSPAR Convention

OSPAR is the current instrument guiding international cooperation on the protection of the marine environment of the North-East Atlantic. It combined and up-dated the 1972 Oslo Convention on dumping waste at sea and the 1974 Paris Convention on land-based sources of marine pollution. Two of the strategies identified by OSPAR[(ii)], one for hazardous substances and one for radioactive substances need to be considered. The goal of both these strategies is to prevent pollution of the maritime area by continuously reducing discharges, emissions and losses of hazardous\radioactive substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances.

As its timeframe, the Radioactive\Hazardous Substances Strategies further declares that by the year 2020 the Commission will ensure that discharges, emissions and losses of radioactive\hazardous substances are reduced to levels where the additional concentrations in the marine environment above historic levels, resulting from such discharges, emissions and losses, are close to zero.

Requirements of the Office for Civil Nuclear Security (OCNS)

The regulation of security in the civil nuclear industry to protect against the threats of terrorism and nuclear proliferation is the responsibility of the Secretary of State for Trade and Industry. This role is carried out by the Office for Civil Nuclear Security (OCNS), which operates as an independent unit within the Health and Safety Executive. OCNS sets requirements for the protection of nuclear material on sites or in transit, against the risks of theft or sabotage, and for the protection of sensitive nuclear information, such as site security arrangements. OCNS ensures compliance with the relevant requirements of the Anti-Terrorism, Crime and Security Act 2001 and the Nuclear Industries Security Regulations 2003 (NISR 2003). The core requirement of NISR2003 is for operators to submit a security plan for each site to OCNS for approval, setting out the proposed security arrangements, and to comply with the provisions of the plan once approved.

[(i)] 96/29/Euratom of 13 May 1996

(ii) OSPAR 2003 Strategies of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (Reference number: 2003-21)

Annex 2:

Current Waste Authorised Transfer and Disposal Routes

Radioactive Waste Type	Authorised Transfer/Disposal Route
Gaseous Waste	Discharge to the environment.
Aqueous Waste	LLW - Discharge to sea via LLLTEP. ILW - Condition into solid form and store on site until national solution for ILW is determined.
Organic Liquid Waste	LLW and ILW - Dispose on site once incinerator is available (strategy currently under review).
Organic Waste	LLW and ILW – Condition as appropriate and store on site until new disposal facility is available.
Solid Waste	LLW – Condition as appropriate and store on site until new LLW Disposal Facility is available. ILW – Condition as appropriate and store on site until national solution for ILW is determined.
Non-Radioactive Waste Type	**Authorised Transfer/Disposal Route**
Organic Liquid Waste	Transferred to specialist contractor for disposal.
Solid Waste	Inert – Stored and reused (on or off site) where possible or disposed of to landfill. Non-Hazardous – Reused (on or off site) where possible, recycled via specialist authorised contractor or disposed of to landfill. Hazardous – Reused where possible, recycled via specialist authorised contractor or disposed of to suitable landfill.
Inter-Site Transfers	**No Plans for Inter-Site Transfers at this Time**

Annex 3:
High Level Wiring Diagrams
(Restricted Annex when Included)

Annex 4:
Waste Stream Data from DRWI
(Restricted Annex when Included)