Sellafield Ltd

Sellafield Integrated Waste Strategy - 2009 Report

June 2009

This Page Intentionally Left Blank

Executive Summary

The development and subsequent annual reporting of an Integrated Waste Strategy (IWS) for Sellafield addresses specific requirements within the Radioactive Substances Act 1993 Authorisation for Sellafield site, Nuclear Site Licence Condition 32, and the contractual arrangements between Sellafield Limited and the Nuclear Decommissioning Authority (NDA).

This report provides an update in the steps which continue to progress towards a fully integrated and optimised waste strategy. It is written as an annual update and the reader should refer to the 2008 and 2007 IWS Reports for further context and background.

Vision, Aims and Objectives

The Sellafield IWS is a live strategy, subject to annual review and update, which provides the rationale behind the waste strategy aspects of the Sellafield site Lifetime Plan (LTP). It is a subset of the Integrated Strategy for Sellafield which considers a wider range of factors such as hazard and risk reduction, commercial goals, national policy and available prioritisation of funding. The Vision of the IWS for Sellafield was described in the June 2006 IWS report as:

An IWS will deliver an operating site that has minimised waste generation and where waste is generated, it is contained in a manner that achieves sustainability; where sustainability is waste in a form that requires ideally nil, but probably minimal, management to safely protect people and environment including the remediation of historical impacts.

To support this vision, the site aims to annually update an IWS and pursue Waste Minimisation and Sustainability.

The IWS achieves these aims by:

- Providing an overview of wastes on the Sellafield site
- Providing a methodology for practicable application of the Waste Management Hierarchy (WMH)
- Enabling the site to envisage and develop waste routings
- Identifying opportunities and challenges within future waste routings
- Facilitating holistic management of wastes and making waste management arrangements more transparent
- Informing site strategies and enabling top-down direction setting to drive the business

The rate of progress in implementing the IWS is influenced by:

a) The need to be consistent with a higher strategic driver for the site of ‘hazard and environmental risk reduction’
b) Funding made available to implement the strategy

Scope

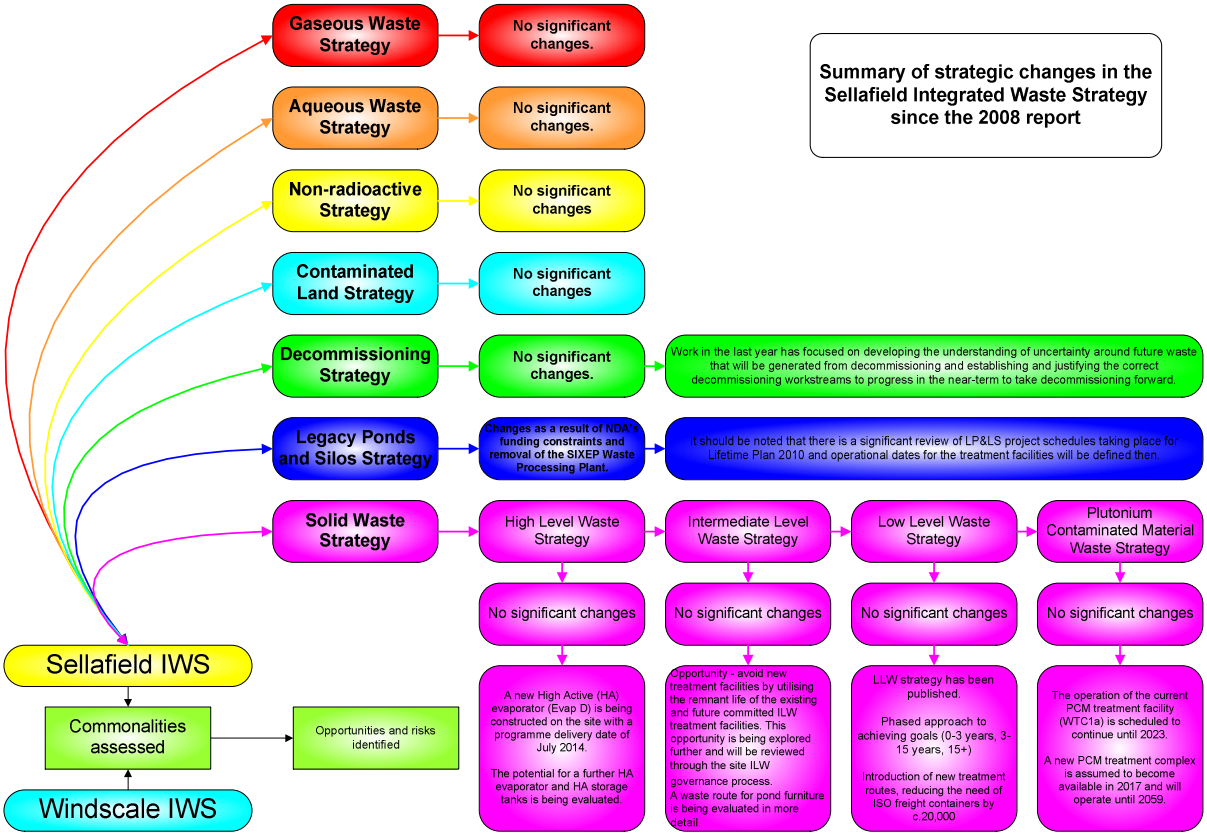
This report summarises the progress and developments to Waste Strategy on the Sellafield site since the IWS was last reported in June 2008. It addresses:

- How component waste strategies have developed since June 2008
- The incorporation of the Windscale Licensed site with Sellafield and the potential benefits to waste treatment, waste routes, and waste strategy from the integration of the two sites.

As such, this report is considered to be an “annual update” of the IWS that summarises the current state of implementation of the waste management strategies covering radioactive and non-radioactive solid, aqueous and gaseous wastes and any material which has the potential to become waste in the future.

The strategic changes in the component waste strategies of the IWS are summarised in the diagram below.

The majority of component strategies have remained unchanged since the 2008 IWS report as effort has concentrated on implementation on projects and operations.



Opportunities

The primary focus of this update report is the review of commonalities between the Windscale and Sellafield approach to waste management and identifying the opportunities that it presents.

This has identified a number of opportunities, which if realised have the potential to further integrate and optimise the IWS. These include:

- Windscale to route its oil inventory to Sellafield in order to free up limited space;
- Windscale oils could be used as the trial media as part of aligned Research and Development (R&D) work, thus eliminating a waste stream;
- Opportunity for a combined interim storage facility for Low Level Waste (LLW) lead in order to avoid separate stores being set up;
- Opportunity for Windscale bulk metal wastes to be incorporated into Sellafield trials for processing ferrous, stainless steel and lead;
- Opportunities for Windscale to route Intermediate Level Waste (ILW) concrete & graphite to future Sellafield waste treatment facilities and Sellafield stores;
- Centralised & common capability for waste sorting, segregation and size reduction;
- Opportunities to develop common strategies for flask maintenance and disposal, ILW waste package design, ILW Lead, decontamination of metals & concrete;
- Opportunity to apply Windscale polymer encapsulation research and development trials to Sellafield wastes where encapsulation in cement is problematic due to the presence of reactive species.

The opportunities are being progressed through the appropriate strategy steering groups for a more detailed evaluation and implementation where appropriate.

Exclusions

In agreement with the NDA this annual update specifically excludes a full scale revision to the full document format as prescribed by the NDA procedure ENG 01. Rather, this report is intended to provide a fit-for-purpose update to the current status of the IWS for Sellafield. This report specifically considers the commonalities with Windscale. However, it excludes the National Nuclear Laboratory Central Laboratory; spent or irradiated fuel, and uranium and plutonium, as these are not classified as wastes.

Progress

The IWS has developed from being a statement of the baseline waste management strategy at Version 1 (June 2006), to an integrated strategy for the future in Version 2 (June 2007). An update to Version 2 was produced for June 2008.

Since the 2008 IWS report was published the Sellafield and Windscale licensed sites have integrated and considerable progress has been made in assessing the commonalities between the waste management strategies of the two sites and the opportunities from that.

Uncertainties

There remain uncertainties which could further influence the integration and optimisation of the IWS. These include national strategies for; LLW, Spent Fuel management, Plutonium Disposition, and timings design and location of the national geological disposal facility (GDF).

Risks

The IWS can be potentiality impacted by a number of risks, which can be grouped under three high-level categories:

- LLW – Risks are dominated by the uncertainty that surrounds the Low Level Waste Repository (LLWR) regarding potential changes in waste acceptance criteria, future capacity and the potential for disposal costs to rise.
- ILW – Many of the risks for ILW arise from the current uncertainties surrounding the national GDF, including delays in availability, which would extend current store lifetimes, and changes in acceptance criteria which may lead to rework or over-packing for existing packages.
- Site Wide – These include risks associated with the major operations of the site, such as concern about the High Activity evaporative capability, fuel reprocessing throughput and funding that will be made available by NDA.

Work is being done to mitigate these risks within the individual Operating Units (OUs) on site.

Significant risks to the IWS and associated mitigating actions have been identified and are being managed through the Sellafield risk register.

Future Development

The IWS will continue to develop for the foreseeable future as:

- The component strategies develop and progress
- Other external influences affect the strategic direction of the site and the timing of certain key decisions
- The interactions between strategies and the opportunities they create continue to be optimised.

In the near term, the following will influence the development of the Sellafield IWS:

1. Development of national strategies
2. Requirement for a combined Sellafield and Windscale IWS in the future
3. Financial provision for work and projects required by the site strategy
4. The creation of the new “Waste & Effluent Disposition Directorate” to form a central function for all waste management programmes across the company that focuses on the challenges surrounding waste management, processing, disposal and storage.

This update of the IWS reports on the strategic changes of the component waste strategies that are within the IWS. The component strategies will continue to implement the principles of the IWS and hence the future development of the IWS will primarily be as a ‘flankguard[1]’ role to:

- Ensure the general strategic direction is maintained, regardless of changes to tactics that may be needed in the future

[1] ‘Flankguard’ – The role of flankguard to is continuously assess all internal and external changes arising after delivery of a strategy and their impact on the strategy and associated projects i.e. to keep the strategy “live”. It is also to ensure that the intent of the strategy is preserved during all subsequent implementation phases. The flankguard must also ensure the strategy is communicated to and understood by the teams carrying out the implementation phases.

- Undertake assessment of potential strategic changes initiated by resolution of uncertainties or changes in assumptions

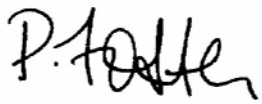
Since last year's IWS report the Site Licence Company (SLC), Sellafield Ltd, that operates Sellafield on behalf of the NDA has been subject to competition for a new Parent Body Organisation (PBO) to replace British Nuclear Fuels Limited (BNFL). The successful bidders of the competition process were Nuclear Management Partners (NMP) which comprise three major corporations – URS Washington Division, AREVA, and Amec. NMP took ownership of the shares in Sellafield Ltd in November 2008. Since then NMP have been undertaking an evaluation of the status of Sellafield Ltd and identifying areas of best practice and areas for improvement, together with plans to make the required improvements. This is likely to lead to significant opportunities in improvements in waste management. The business is therefore undergoing restructuring to reflect the changes being made and one aspect of this is the direction and ownership of the IWS within the company. It has been recognised as a key aspect of the future mission of the Sellafield Site as the site moves towards decommissioning and waste management.

The Sellafield IWS will therefore transfer from the Director-level ownership by the 'Strategy & Programmes' Directorate to the newly-forming 'Waste & Effluent Disposition' Directorate, though site strategic direction and coordination will still be provided through the 'Strategy & Programmes' Directorate.

Therefore the purpose and benefit of an IWS has been subject to a high-level business review, and the following actions are planned to take place over the forthcoming year:

- A high-level document is required, endorsed by the Sellafield Executive, that is stand-alone and does not require frequent updates containing:
  - How national, NDA & corporate policy are taken into account in the IWS
  - A set of Principles that provide robust waste management direction for waste producers and managers to use.
- A document is required that provides the Scope of the component waste strategies (to enable their appropriate development)
- A Review of the Component Waste Strategies and their Integration (and optimisation) – it is intended that this part could form the majority of future 'annual updates' of the Sellafield IWS

Note: This proposed forward process is a recent development and as such is all subject to consultation and agreement with all relevant stakeholders and customers



Paul Foster
Director Strategy and Programmes
Chair of IWS Steering Group

Contents

1.0 Introduction

1. This report is the fourth annual issue of the Integrated Waste Strategy (IWS) for Sellafield. It reports progress made towards an integrated and optimised waste management strategy since the 2008 IWS report. It also notes recent developments in strategic governance arrangements for the Sellafield site, the latest Sellafield waste strategies, and waste and effluent arisings data. It should be read with knowledge of the 2008 and 2007 IWS Reports in order to fully understand the context of the information presented herein.

2. The delivery of an IWS for the Sellafield site is a formal requirement of Schedule 9 of the Radioactive Substances Act Authorisation (RSA 93) and helps demonstrate compliance with the Nuclear Site Licence, in particular Condition 32.

3. The NDA is responsible for the liabilities of the United Kingdom (UK) public sector civil nuclear sites. The NDA requires each Site Licence Company (SLC) to produce an IWS; this should act as a tool for the site operators to optimise their site-wide approach to waste management. The NDA aims of the IWS are to:

- Protect people and the environment and respond to stakeholder concerns
- Make the most effective use of existing waste management facilities
- Provide value for money for the UK taxpayer
- Provide the link to the rationale behind the waste aspects of the site's LTP submission
- Provide a framework for optimising the approaches to waste management on a site-wide basis.

1.1 Background to the Sellafield Site

4. The Sellafield site covers an area of approximately four square kilometres and is located on the West Cumbrian coast, just north of the village of Seascale and south of the major population centres of Whitehaven and Workington. After the World War II, the British Government decided that Britain should have its own nuclear weapons programme which would require the production of plutonium and Windscale, now part of the Sellafield site, was selected as a suitable location for running nuclear reactors for this purpose. Construction work began in 1947 on the Windscale piles solely to produce plutonium for military purposes at that time. Initial fuel loading into the piles began in 1950 and the piles were operational until 1957, when a fire in pile 1 resulted in them being shut down.

Figure 1: Windscale Piles following completion of construction

5. In 1953 work began at Sellafield to build Calder Hall, the world's first civil nuclear power station. Reactor 1 was officially opened by Her Majesty the Queen in 1956, and by 1959 there were four nuclear reactors up and running, producing electricity which fed into the National Grid for domestic and industrial use.

Figure 2: Her Majesty the Queen opening Calder Hall, 1956

6. The Sellafield site now comprises more than 200 nuclear facilities, in various different stages of building life – from operations to decommissioning and with some new plants under construction to enable the site to deal with legacy wastes. Sellafield continues to perform key parts of the nuclear fuel cycle through the receipt and storage of spent fuel from across the world and the reprocessing of nuclear fuel at the Sellafield Mox Plant (SMP) and Thermal Oxide Reprocessing Plant (Thorp).

Figure 3: Recent aerial photograph of the Sellafield site

1.2 Sellafield Integrated Waste Strategy (IWS)

7. The Sellafield IWS Vision is:

An IWS will aid delivery of an operating site that has minimised waste generation and where waste is generated, it is contained in a manner that achieves sustainability; where sustainability is waste in a form that requires ideally nil, but probably minimal, management to safely protect people and environment including the remediation of historical impacts.

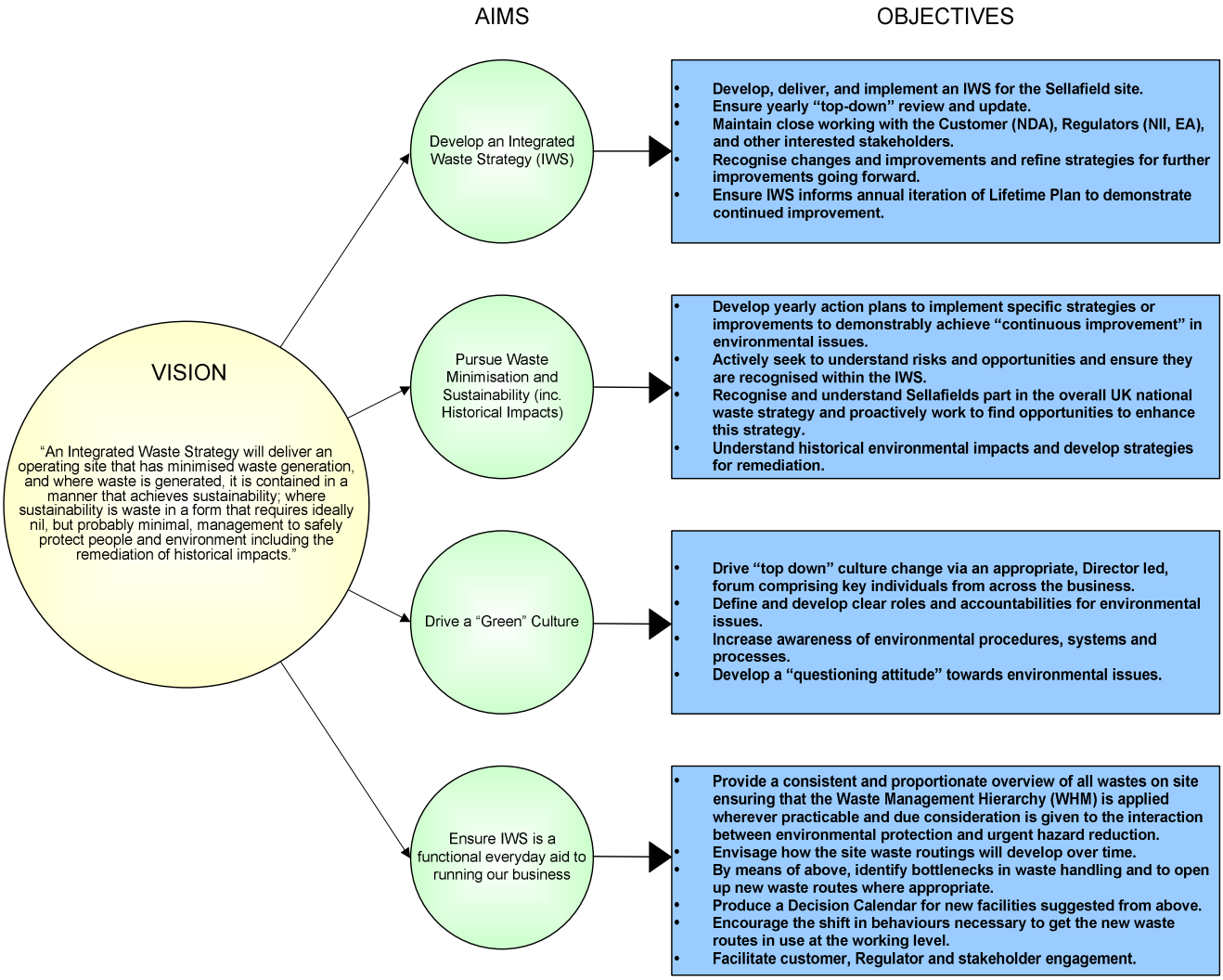


Figure 4: Vision, Aims & Objectives of the Sellafield IWS

8. In addition to fulfilling the aims of the NDA given in paragraph 3 above, the IWS provides the mechanism by which government policy on waste management, in particular the WMH, is translated and applied across the site and into the Lifetime Plan for Sellafield. The IWS issued in June 2007 (Version 2) was therefore developed with the following aims:

   a) To provide a consistent and proportionate overview of all wastes on site ensuring that the WMH is applied wherever practicable and due consideration is given to the interaction between environmental protection and urgent hazard reduction;

   b) To envisage how the site waste routings will develop over time;

   c) By means of b), to identify bottlenecks in waste handling and to open up new waste routes where appropriate;

   d) To produce a Decision Calendar for the new facilities suggested by c);

   e) To encourage the shift in behaviours necessary to get the new waste routes in use at the working level;

f) To facilitate customer, Regulator and stakeholder engagement.

9. The rate of progress in implementing the IWS is influenced by:

- The need to be consistent with a higher strategic driver for the site of 'hazard and environmental risk reduction';
- Available funding and priorities of the implementation plan in any given period.

10. The 2007 IWS addressed these aims via a structured process of applying the WMH and using Sankey Diagrams[2] to identify areas for improvement. The process inherently recognises the priorities of safety and risk reduction and applies the NDA Prioritisation Logic[3], the WMH and the principles of Engineered Destinations[4]. Full details of this process can be found in section 7 of the IWS issued in June 2007 (Version 2).

11. By continuing with this structured process during 2008/09 and embedding the outputs of this into the new LTP the site has continued to progress towards its goal of transforming the IWS into a functional everyday aid for Sellafield Ltd and hence to the site for running our business and addressing the aims a) – f) given above.

12. The size and complexity of the site and the wide range of wastes inevitably means that the corresponding waste strategies and management arrangements are multifaceted, requiring significant effort to become truly integrated and optimised. The IWS is a component part of the Integrated Strategy for Sellafield, Figure 5 below highlights the internal component strategies that come under the 'IWS' banner.

[2] Sankey Diagrams have been used to illustrate the waste arisings at key snapshots in time and the currently identified routings for these wastes. The concept of Sankey Diagrams is described as; the thickness of the lines is representative of the (volumetric) flows of the waste, and the relative size of the 'arrows' on the diagrams represents the waste treatment plant throughput capacity for the given year. From this, bottlenecks and waste routes are visually easy to assess.

[3] The Energy Act, and the NDA Management Statement and Financial Memorandum, places requirements on the NDA in respect to performance reporting, openness and transparency, and for ensuring that the rationale for major decisions, and the processes by which they are reached, are clear to stakeholders and the wider public. One of the ways in which the NDA achieves this is by a national process for work prioritisation. This is used as an aid to the effective scheduling of remediation work optimising the SLC delivery against the Site Funding Limit (SFL), and to assess alternative delivery strategies. As such the Prioritisation Process has been designed as an aid to decision making, which supports the development of the Life Time Plan (LTP). For further information refer to the NDA website, www.nda.gov.uk

[4] Engineered Destinations: The final form (solid, aqueous, gaseous) of radioactivity determines the environmental impact arising from that waste. Ideally the activity is retained within a form that offers maximum 'barriers to the biosphere' i.e. an engineered form that limits the pathways for discharge to the environment. In practice this means that generally the preference is for activity to be captured in the solid form rather than aqueous form which is in turn preferred to the gaseous form. Unintentional, uncontrolled discharge to ground must be avoided.

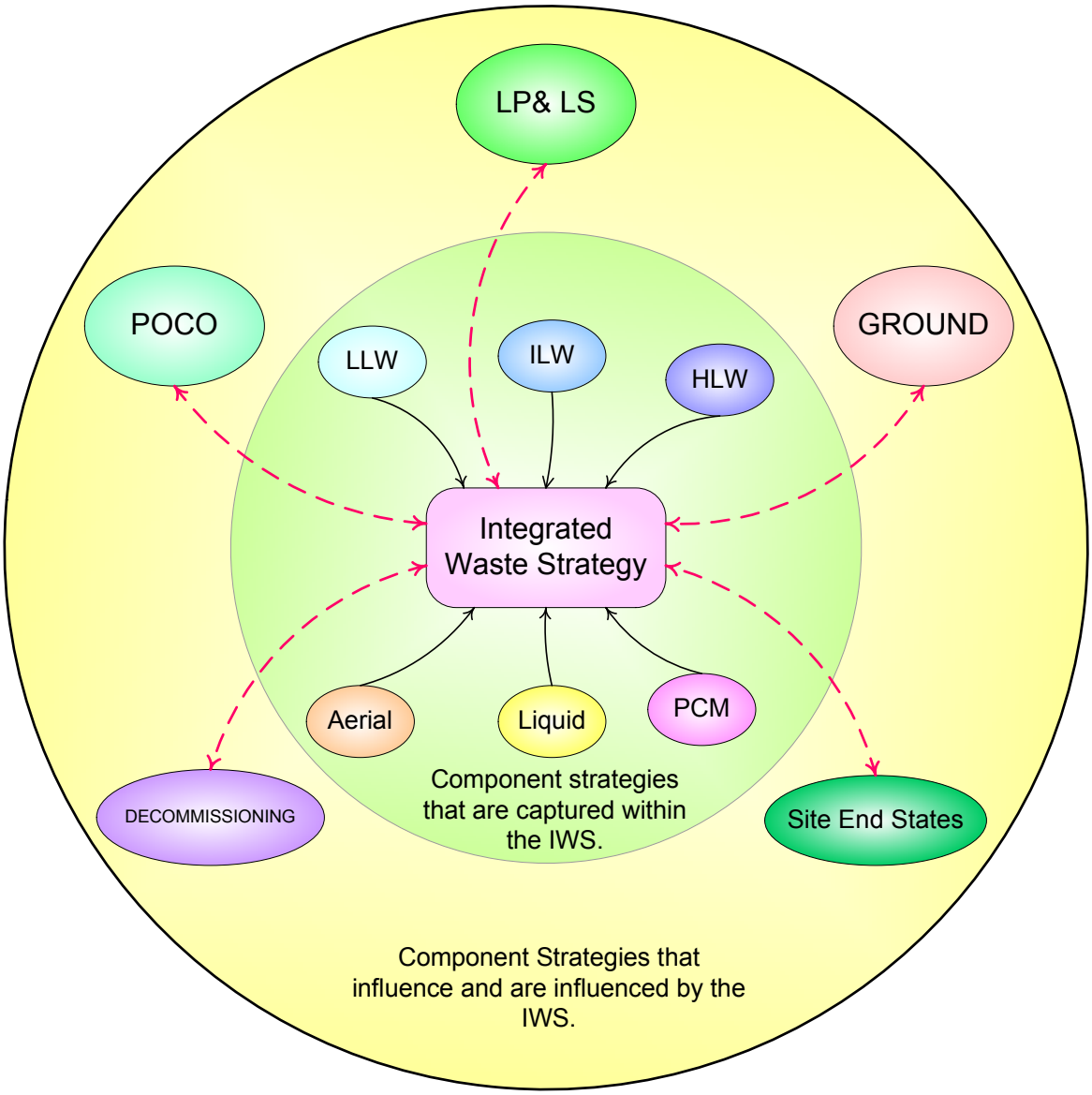


Figure 5 – The interaction between site strategies and the IWS

13. The methodology followed in the 2007 IWS, that was built on the baseline position established in 2006, has given the site confidence that based on current assumptions it has successfully identified:
    - Its wastes inventory and arisings profile
    - Their routings and any potential bottlenecks
    - The potential new plants and routes required to appropriately treat and dispose of these wastes
14. These findings have been implemented as appropriate into the LTP developed for the site.
15. The Sellafield IWS is still progressing towards being fully integrated and optimised and will continue to do so for the foreseeable future as:
    - The component strategies develop and progress
    - Other external influences affect the strategic direction of the site and the timing of certain key decisions
    - The interactions between strategies and the opportunities they create continue to be optimised
16. It has been recognised that owing to the complexity of the Sellafield site and associated wastes and waste routes that it will take a number of years to produce an optimised and fully integrated strategy for wastes. This report therefore provides an update in the steps taken over the past twelve months towards a fully integrated and optimised waste strategy.

17. This IWS document reports the progress since the issue of the 2008 IWS and discusses:
    - If and how component waste strategies have developed since the 2008 IWS;
    - New drivers that have gained prominence since the IWS was last reported;
    - The integration of the Windscale IWS and the Sellafield IWS;
    - Proposed details on how the structure of the IWS will develop following this current publication.

1.3 Successes in Waste Management on Sellafield Site since the 2008 IWS

18. Significant amounts of waste have successfully been treated at Sellafield, thus greatly reducing hazard, volume, and risk, resulting in a much lower environmental impact.

19. Examples of recent successes in waste management include:

Waste Avoidance:

- Continuous improvements by teams at the Enhanced Actinide Removal Plant (EARP) has increased the concentration of waste in the EARP process so that it produces a lower volume of material for encapsulation, saving a significant number of waste drums – and substantial cost – over the plant's lifetime.

Optimise Site Waste Management Arrangements:

- Creation of a Waste & Effluent Disposition Directorate that will group the waste and effluent treatment plants and stores into a single entity to improve co-ordination, integration and optimisation of wastes at Sellafield.
- Reviewed LLW disposal practices at the Metals Recycling Facility resulting in a reduction in the number of LLW containers consigned to the LLWR (a reduction of four containers per year – where each container is around 19m^3), thus preserving a national asset.
- Provided an extensive Best Practicable Means (BPM) case to justify the disposal of Calder Hall heat exchanger asbestos to landfill rather than as LLW to LLWR (currently consigned 1100te of asbestos with approximately 500te still to consign).
- A standard Solid Waste audit template has been produced that focuses on the WMH. This is being piloted in the Decommissioning and LP&LS OUs before being finalised and rolled out across other OUs.
- A Sellafield Site LLW Management Strategy has been developed and issued that outlines the forward LLW strategy for the site. It is founded on the hierarchy of waste management, focussing on waste avoidance and minimisation and the implementation of a range to techniques and approaches to process and dispose of waste.
- A Plutonium Contaminated Material (PCM) Strategy Implementation Plan has been developed and issued that defines the high-level plan for implementing the site PCM Strategy and summarises the position against relevant metrics.
- Formation of a PCM stakeholder group to support the waste operations of PCM waste consignors on site.
- Successfully extended the Waste Treatment Complex (WTC) feedstock envelope to include Thorp and some decommissioning PCM wastes to progress further passivation of PCM wastes and progress towards Nuclear Installations Inspectorate (NII) Licence Instrument targets.
- Currently commissioning monitoring equipment for waste bags at Calder Hall to improve on the exemption of waste, increase disposals of Very Low Level Waste (VLLW) rather than disposing as LLW, and improve the accuracy of radioactivity assessments in LLW.
- Acceptance at the working level of the Decommissioning teams as the site team of choice for much of the work in collection, segregation and disposal/consignment of waste. With the new financial year and the move into the new Waste & Effluent Disposition Directorate, this means the site has an established mature team that waste producers can turn to for the logistics of Low Level and Clean/Exempt Wastes movement across site.
- £17.6m has been saved through the development of a single, fixed price contract for the current bulk asbestos removal project under way at Calder Hall. The three-year, fixed price contract was awarded to Hertel UK in 2007 for £13.4m, saving £17.6m from the LTP estimated cost of £31m.

Characterisation, Sorting, Segregation & Size Reduction:

- An alternative waste disposal route for filter cartridges used in EARP has been established. Eight cartridges had been sent as ILW to the Miscellaneous Beta-Gamma Waste Store (MBGWS), however, through work carried out, 41 cartridges have been sent to the LLWR, resulting in a major cost saving.
- Teams dismantling redundant flatrolls at Sellafield have completed the decommissioning of six transporters two years ahead of schedule. Dismantling work which enables better monitoring and characterisation of the waste has allowed most of the waste to be sent for free release rather than sending waste material to the LLWR.
- The Metals Recycling Facility successfully supported Thorp's business need to clear pond space by receiving and size-reducing the Multi Element Bottle (MEB) racks, and also supported Calder Hall heat exchanger decommissioning by providing storage and exemption of redundant steelwork.
- A total of 28.45% of non-active waste was recovered/recycled by the end of March 2009
- 5 more waste streams have been reviewed and bag-monitoring methodologies have been incorporated into the approved waste stream characterisation documents.
- 600+ tonnes of crushed concrete has been re-cycled and used to refurbish contractors and Sellafield Ltd compounds across the site.
- The segregation of Clean Wastes (paper, cardboard, concrete and metals) in the transit stores for the Sellafield site has been rolled out as the start of a partnership programme with recycling companies this financial year

Waste Processing:

- Sellafield Ltd and International Nuclear Services (INS) have successfully returned ILW and uranium product to its Swedish customers AB SVAFO. This impressive project began in October 2007 when 4.8tU of spent fuel from Sweden's first research reactor was transported from the Studsvik site, where it had been stored since the early 1970s. The fuel was reprocessed in the Magnox reprocessing plant at Sellafield in 2008, where the useful uranium and plutonium products were recovered from the spent fuel.
- A way of permanently immobilising a range of plutonium wastes is being investigated which has the potential to reduce the Sellafield lifetime baseline costs by around £100m.
- De-sludging activities in the Windscale Pile Fuel Storage Pond have begun where this first stage of remediation will see sludge retrieved from two of the original 12 bays within the pond, in which fuel was decanned and exported for reprocessing. In parallel, the team has successfully started up a Local Effluent Treatment Plant to treat the pond water.
- The floc retrieval project has recovered and encapsulated over 1,000m^3 of historic waste in the form of sludges in the past three years.
- WTC exceeded PCM waste compaction targets (1222 drum compactions against a target of 1215) and also exceeded targets for the number of product drums consigned to the Engineered Design Stores (EDS) (212 containers against a target of 202).

Waste Disposal:

- The waste team at Calder Hall has invested in specialist equipment to separate waste oil from water, therefore creating two waste streams. A route for the treatment of the water through the Segregated Effluent Treatment Plant (SETP) was found, reducing the waste oil stocks by 70% and increasing capability for the storage of contaminated oils.
- Six shock absorbers from Thorp's fuel transport flasks have been sent to a local scrap merchant to be recycled into the metals market, having been proved to be exempt from treatment as nuclear waste. £1m could potentially be made through the sale of the 200 or so remaining shock absorbers.
- The decommissioning team at the Solvent Recovery and Thorp miniature Pilot Plant has successfully removed two stainless steel vessels containing Magnox swarf from the remote handling cave. This has resulted in the removal of a significant radiological inventory from the plant.
- The Metals recycling facility has exceeded production targets for processing and recycling redundant steel (650 tonnes of metal through the Separation Area "Wheelabrator" against a target of 500 tonnes).
- 1,104 tonnes of metals released as scrap metal from the site for recycling.

- Since the re-start of the bag monitoring system on 22/08/08, 1750 bags have been processed to date, of which 969 bags were sentenced as RSA Exempt and 781 were returned back to LLW sentencing.

1.4 What has changed since the previous IWS was issued in June 2008

20. Since the previous IWS update was issued in June 2008 (update to Version 2), there have been significant influences upon the Sellafield site and subsequently upon the IWS.

21. On the 24th November 2008 NMP signed an agreement with the NDA which will see it responsible for providing executive leadership to Sellafield Ltd for the next five years. Shares in Sellafield Ltd were transferred from BNFL to NMP, which is a consortium of URS' Washington Division, AMEC and AREVA. NMP will own the shares in Sellafield Ltd for up to 17 years, the potential length of new and updated contracts between the NDA, NMP and Sellafield Ltd. The value of the work covered is worth £1.3bn in its first year and over the full lifetime of the contract approximately £22bn.

22. Since NMP have taken ownership of Sellafield Ltd, several changes have taken place that will affect the IWS, including:

- A revised vision of Sellafield Ltd to now be "*The Sellafield Site License Company and its people will achieve the NDA-assigned missions through safe, sustainable, world-class performance and open, transparent partnering with all stakeholders to become the site and workforce choice for potential new missions.*"
- The concept of "reachback" to transfer skills and knowledge from the parent companies of NMP into Sellafield Ltd where appropriate.
- PAIS (Partner, Assess, Innovate, Sustain) team reviews have taken place to independently assess and review the current operations and performance of the site and benchmark it against experience of NMP parent companies in the US and Europe at similar sites. The aim of the PAIS teams is to serve as a tool for helping to develop efficiency improvements across Sellafield Ltd to drive towards achieving the company vision by:
    i. Identifying gaps and shortcomings that might exist in the Sellafield Ltd programmes;
    ii. Discussing improvements to bring to Sellafield Ltd that the parent companies have implemented elsewhere.
- "Reachback" into the parent companies that comprise NMP has been used to provide 68 of the 124 people involved in the PAIS review of the site, with the remainder coming from the Sellafield Site License Company (SLC).
- Work has also started to build and assure the 2010 LTP as the Management and Operator (M&O) contract specifies a requirement for the SLC led build and assurance process for the inherited baseline within 18 months of the contract placement. The purpose of this exercise is to ensure the plan is robust and appropriate.

23. The new Sellafield executive has recognised that one of the key missions of the business is Waste Management and is therefore in the process of creating a new directorate within the business: "Waste & Effluent Disposition Directorate". Its remit is to integrate all waste and effluent programmes into a single Directorate to form a central function for all waste management programmes across the SLC. Integrating waste management programmes will allow for more focus on the challenges surrounding waste management, processing, disposal and storage.

1.5 Impact of the IWS on the Sellafield Site

24. The IWS can be said to have the following impact upon the Sellafield site:

- It is an important part of the Integrated Strategy for Sellafield as it provides a site waste management strategy that is consistent with the aims of the Integrated Strategy for Sellafield;
- Has demonstrated compliance with and successfully and safely met the requirements of the Environment Agency (EA) discharge authorisation;
- Met the NDA requirement on all Site Licence companies under the contract, and the 2007 Sellafield IWS scored the highest of all NDA sites, hence demonstrating good practice in waste management;

- Provided against NII Site Licence Condition 32 concerning the waste management on the site to avoid accumulation of waste;
- Has enabled the site to respond to regulators in a more coherent manner on waste management as there is now a defined long-term plan for waste matters;
- Has helped the site's component waste strategies (e.g. LLW, ILW, Effluents) with their definition through ensuring they are coherent and integrated. It also contributes to NDA led national strategic waste development e.g. LLW & ILW;
- Has provided an overview of the changing requirements of the site over time – intending to enable the site to prepare in time for significant cultural changes (and hence reducing unforeseen costs on the LTP) e.g. preparing for a change in site focus from reprocessing operations to waste management excellence once reprocessing ceases;
- Defined high level risks to integrated waste management and risk mitigation plans are in place;
- helps internal (Sellafield Ltd) understanding of waste strategy & routes, and clarity of purpose has been improved;
- Has resulted in an expectation that some cost savings will be realised from the Commonalities assessment with Windscale's IWS (rationalisation of waste routes & new build);
- Ensures governance via the IWS Steering Group, which provides the oversight and checks on component waste management strategies and projects.

1.6 Progress against the 2008 IWS Action Plan

25. This section reports on the progress made against the 2008 IWS action plan.

Table 1 – 2008 IWS Action Plan showing completion of actions

Area	Action Plan	Timescale	Action Taken
IWS Improvement Plan (requirement of RSA 93 schedule 9 requirement 1)	➢ Produce an IWS 'improvement programme', addressing the improvement of the IWS for Version 3 and beyond to manage the risks and opportunities identified in Version 2.	End August 2008	COMPLETED – GEN-2301A
Integration of Windscale with Sellafield	➢ Assess the commonalities between the Windscale and Sellafield Integrated Waste Strategies Produce metrics	End June 2009	COMPLETE – see this document
Integrate and Optimise the Component Waste Strategies	➢ Develop monitoring system for the Integrated Waste Strategy Steering Group (IWSSG) to improve the integration and optimisation of component waste strategies	March 2009	COMPLETE
	➢ Trial the monitoring system	December 2009	ONGOING

26. The opportunities identified in the 2008 IWS Report have been subject to further assessment in order to determine whether it is appropriate to incorporate these changes into the strategic baseline. It should be noted that the opportunities that were identified in the 2008 IWS report can't simply be realised 'overnight' as they must be appropriately underpinned both technically and economically. Resources for progressing opportunities are made available on a priority basis, depending on when the relevant waste will be arising and the urgency of realising the opportunity. The progress made on the 2008 opportunities is given in the table below.

Table 2 – 2008 IWS Opportunities & Progress made

Opportunities identified in 2008 IWS	Progress made against opportunities
LLW	
Potential for treatment plants to become available earlier than scheduled in 2008 LTP if a Private Finance Initiative (PFI) arrangement is used.	Currently within the scope of the LLW Strategy Steering Group and the Innovation Team. It is scheduled in the LLW Strategy implementation plan in the '0-3years' section.

Opportunities identified in 2008 IWS	Progress made against opportunities
Significant increase in decontamination if chemical techniques are employed.	The Decontamination Strategy is currently being developed and is due for discussion at IWSSG in 2010. Further work is scheduled in the LLW Strategy implementation plan.
Significant opportunity to recycle and reuse any High Volume Very Low Level Waste (HVVLLW) on-site if demonstrated to be within acceptable radiological limits.	Recycle and reuse of HVLLW is currently being developed by the LLW & VLLW Strategy Steering Group.
Cracking and crushing LLW concrete may allow for better packing efficiency and recovery of steel reinforcement material (re-bar).	Currently being developed by the LLW & VLLW Strategy Steering Group.
Investment in cable stripping would offer significant recovery and sale of valuable materials such as copper and aluminium.	Currently being assessed within the LLW Strategy Steering Group and by the Innovation Team.
ILW	
Utilisation of existing and planned ILW treatment facilities (e.g. MEP), Waste Encapsulation Plant (WEP), Box Encapsulation Plant (BEP), etc) which may obviate the need for the 1st ILW conditioning plant - Decommissioning Intermediate Level Waste Encapsulation Plant (DILWEP) – identified in the Final Treatment and Disposal of ILW OU as being currently required. There may be an opportunity to instead use existing spare capacity and future LP&LS treatment plant spare capacity to treat decommissioning waste. This requires significant scheduling work and there is a potential delay to decommissioning. Risk management will be a significant burden.	Potential utilisation of existing and planned ILW treatment facilities where practicable has been incorporated into the ILW strategy. However, at present the full scope of the DILWEP plant is still required to meet decommissioning requirements. Consideration of this opportunity is ongoing within the ILW Strategy Steering Group (ILWSSG) – specifically, a working party ("ILW Treatment Working Party") has been set up within the ILWSSG to assess opportunities like this. A high-level assessment of this opportunity will have taken place by the end of financial year 2009/2010.
Potential to use larger packages (than $3m^3$ boxes) for decommissioning wastes – this will allow for more efficient packing of waste and the improvement of decommissioning schedules.	The Decommissioning Strategy has identified a package of work to assess the use of larger waste containers in their implementation plan. This programme of work will be prioritised appropriately to support the developing strategy.
Decontamination and volume reduction of bulk metals to reduce disposal volumes, costs, and apply the waste hierarchy more effectively.	Currently being assessed within the ILW Strategy Steering Group and by the Innovation Team together with the Decontamination Strategy currently being prepared. Due for discussion at IWSSG in 2010.
Increased rate of ILW exports to the repository thereby reducing the overall duration of site storage and export – cost savings and reduced likelihood of store replacements.	Discussions between the ILWSSG, Stores Strategy, and the Radioactive Waste Management Directorate (RWMD) of the NDA are ongoing to develop the optimum strategy for the UK for rate of ILW exports to the national repository, and how Sellafield wastes fit in with this. Initial discussions imply that the rate of Sellafield Wastes may increase significantly after an initial period to allow other civil waste producers to dispose of the entirety of their wastes.
Consolidate final ILW treatment facility with that required for Calder Hall Final Site Clearance.	Package of work identified within Sellafield OU 35240 "Final Treatment and Disposal of ILW". Work to take place in financial year 2010/2011.
Decay store significant quantities of lower order decommissioning ILW and remove requirement for disposal.	Currently being assessed within the ILW Strategy Steering Group. Output recommendation expected by March 2010.
Improved characterisation of waste may enable re-categorisation of some waste to a less onerous waste category.	The PCM Strategy has identified this as a key element in their implementation plan. This is scheduled for reporting by the end of the 2011/12 financial year. The Clearance and Characterisation team at Sellafield are tasked with improving characterisation and categorisation of waste.

Opportunities identified in 2008 IWS	Progress made against opportunities
Potential avoidance of some additional stores through reducing the uncertainty around future waste volumes.	The Decommissioning Mandates produced over the last few years have applied more recent decommissioning experience to provide a summary of "how to decommission a specific building" for a number of key buildings on the Sellafield site. These have since been assessed collectively by the Decommissioning Strategy group and a number of long term challenges have been identified. They are now being further assessed and used to bound the range of uncertainty around future waste volumes and cost estimates.

2.0 Strategic Developments impacting on IWS

27. There have been several other developments at Sellafield since the 2008 IWS Report was issued in June 2008 which, together with some external influences, impact upon the overall site strategic development and the IWS. These are discussed in the sections below.

UK Discharge Strategy Review by DEFRA

28. The ongoing Department for Environment, Food and Rural Affairs (DEFRA) review of the UK Discharge Strategy may have an impact upon the Sellafield site and hence upon the Sellafield IWS. The review has just finished its consultation period and we are awaiting formal publication of the revised strategy. Sellafield Ltd made a significant contribution to this work. This is discussed further in section 4.2 (Aqueous Waste Strategy)

2010 LTP

29. The development of the 2010 LTP for Sellafield as an assured and robust plan for the lifetime of the Sellafield site is likely to influence the implementation of the IWS.

National LLW Strategy

30. The NDA has recently issued a national LLW strategy for consultation. Sellafield Ltd produced and issued the Sellafield LLW Strategy in January 2009, which has helped inform the developing national strategy. This is discussed in greater detail in a later section of this report (section 3.1.4 – LLW Strategy)

Creation of a Waste & Effluent Disposition Directorate

31. The new Sellafield executive has recognised that one of the key missions of the business is Waste Management and is therefore in the process of creating a new directorate within the business: "Waste & Effluent Disposition Directorate". Its remit is to integrate all waste and effluent programmes into a single Directorate. This will combine various OUs such as; High Level Waste Plants (HLWP), Effluent & Encapsulation Plants (E&EP) and Solid Waste that are currently within the Production Operations Directorate with other waste services and programmes to form a central function for all waste management programmes across the SLC. Integrating waste management programmes will allow for more focus on the challenges surrounding waste management, processing, disposal and storage.

Developing a Decontamination Strategy

32. Sellafield is currently developing a Decontamination Strategy. The purpose of this strategy is to understand the demand for decontamination during the decommissioning of the site and the facilities, techniques and skills base that would be required. This also requires an understanding of the consequences and benefits of decontamination and the practicability of its application in different situations. A paper is currently being written concerning the decontamination demand on the site i.e. where decontamination could be sensibly used to improve decommissioning and waste management. The decontamination strategy will be issued for internal comment by the end of this financial year.

2.1 Strategic Governance Arrangements

33. This section provides a summary of the current strategic governance arrangements for the Sellafield site.

34. The NDA have been reviewing their arrangements for acting as the strategic mind. This, together with the transition to a new PBO for Sellafield Ltd and the subsequent PAIS reviews that have been undertaken have required some changes to the business structure and hence the strategic governance arrangements. The previous strategic governance arrangements have been largely successful, and at present these changes are not finalised and therefore the current strategic governance arrangements summarised in this section should be considered as 'interim arrangements' whilst the NDA further develop their arrangements for the 'strategic mind' and as the PAIS review output is implemented.

35. Figure 6 provides a summary of the current strategic governance arrangements.

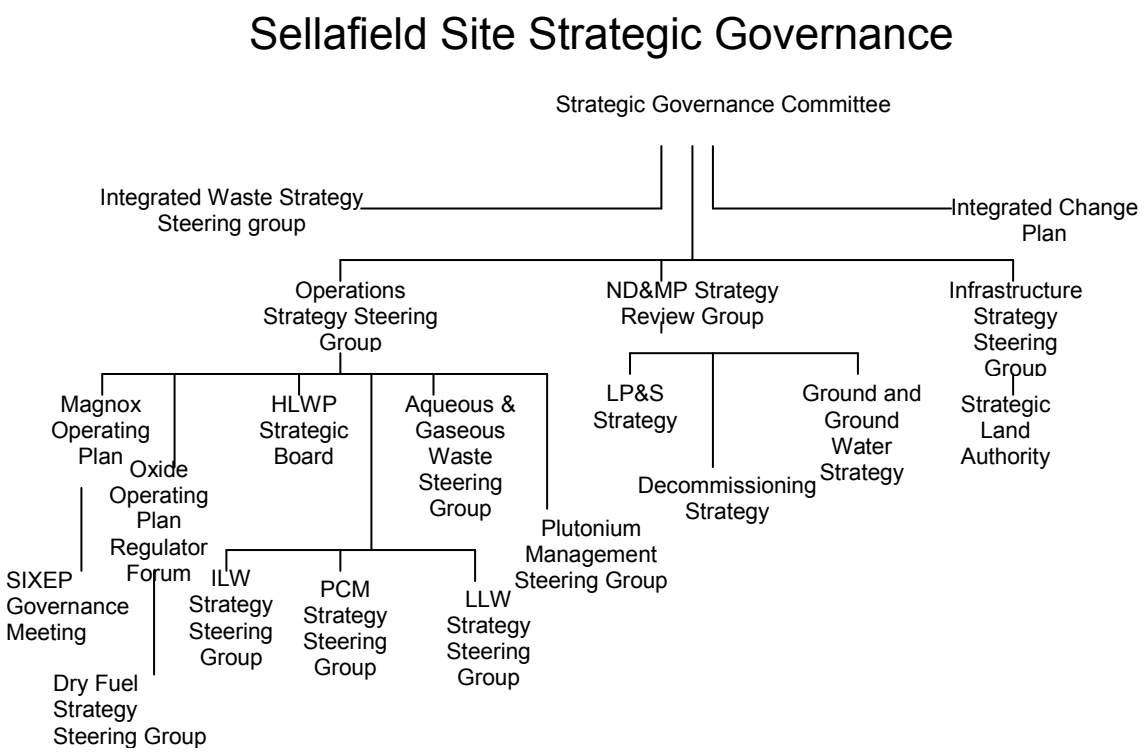


Figure 6: Current Strategic Governance Arrangements

36. The development of an Integrated Change Plan is the most significant change over the previous arrangements. The Integrated Change Plan brings the PAIS recommendations and actions together with other improvements identified. Combining all of the improvement activities in this way ensures that efforts aren't duplicated and that changes are implemented in a managed, planned way.

37. To ensure strategic governance is coherent across the site, members of the Strategy & Programme Group, of which the IWS team is a part, sit on or chair these various Strategy Steering Groups.

2.2 Integration with Windscale

38. The integration of the Windscale SLC within the Sellafield Ltd SLC took place on 1st April 2008 and the EA has included within the Compilation of Environment Agency Requirements (CEAR) a requirement for a IWS that considers the commonalities between the two sites IWSs; "Windscale is first to be included in the deliverable on 30 June 2009. In this instance, there will be two separate IWS with a review of their commonalities". By assessing the commonalities between the two Integrated Waste Strategies, it provided an ideal opportunity to:

- Identify opportunities for waste treatment routes within planned and existing facilities;
- Ensure best practice is shared between the two IWS teams to improve waste management;
- Identify and include data for the gaseous and aqueous effluents from the Windscale site into Sellafield's Overall Effluent Strategy Model (OESM).

Key Aims of combining the two Integrated Waste Strategies

- Identify the commonalities in all aspects of waste;
- Identify associated opportunities and risks;
- Deal with these opportunities and risks as early as possible.

39. The integrated waste strategies for Windscale and Sellafield have considerable differences in approach, size, and level of information contained within them.

40. The Sellafield IWS is a high-level strategy that emphasises the appropriate use of the WMH together with various ways to improve waste management. Wastes are grouped by common

characteristics and waste routes and bottlenecks identified, as well as risks, opportunities and uncertainties.

41. The Windscale IWS is a much more detailed strategy that describes each waste stream on the Windscale site and its proposed waste route and scheduling.

Identifying commonalities between the Windscale and Sellafield Wastes will lead to improvements in environmental safety and cost savings through improved waste management by seeking efficiencies through reducing the two separate plans into one.

2.3 Integration Process

42. A process was put in place to merge the two Integrated Waste Strategies following a series of workshops, outlined in Figure 7.

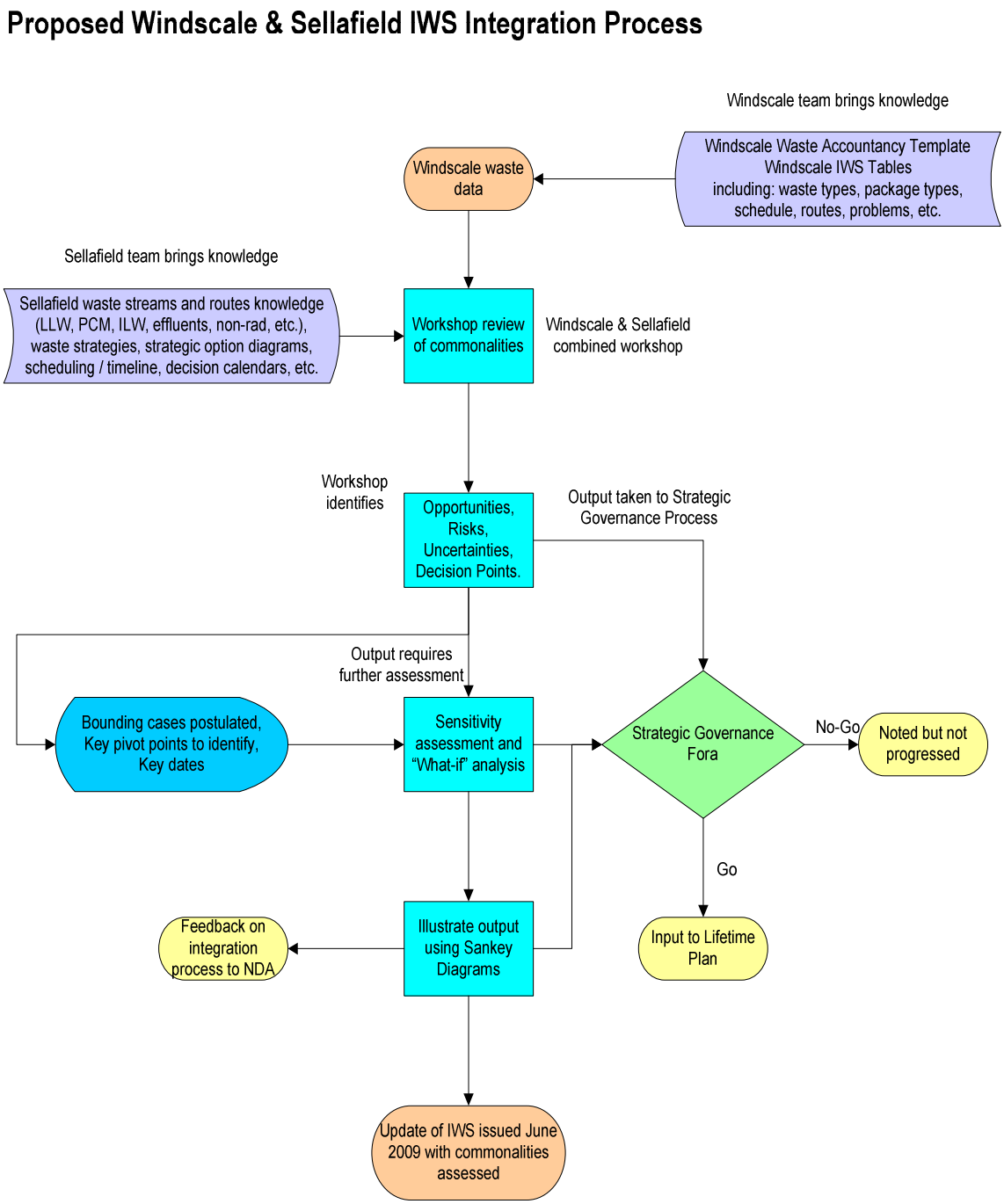


Figure 7: Proposed process for the integration of Windscale and Sellafield IWS

43. The main aim agreed between the two IWS teams was to identify the commonalities, cross-site opportunities and risks and ensure they are communicated and dealt with early. Some cross-site opportunities have already been identified and are being progressed via the inclusion of Windscale into the Intermediate Level Waste Strategy Steering Group (ILWSSG) and the Low Level Waste Strategy Group (LLWSG). It was proposed that these strategic governance groups will be the main forum to progress the output of this work.

44. A step-wise process was suggested to ensure all overlaps, risks, uncertainties and opportunities are identified, to note commonalities (including objectives) and assess why differences may exist.

45. The process for the Sellafield and Windscale integration has been agreed by both the Windscale and IWS teams and the majority of stages have been completed. There are a couple of outstanding stages still due for completion, mainly stages 4 and 5 (see Figures 11 & 12 below) due to a re-think of what is required as the commonalities assessment has progressed, together with prioritisation of resources.

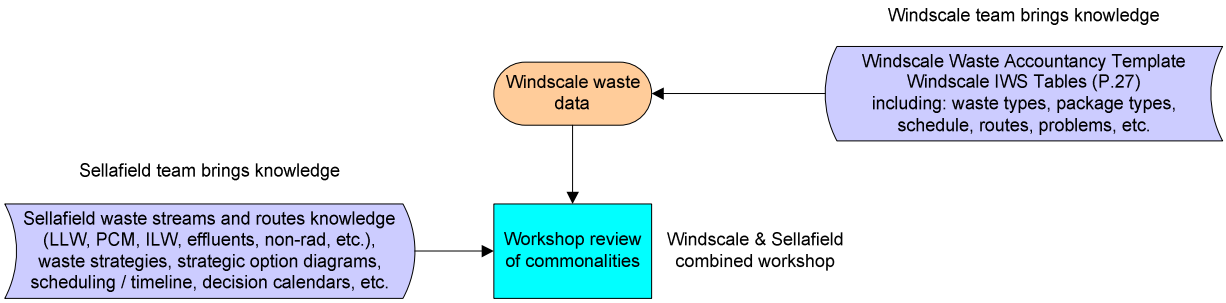


Figure 8: Stage 1 of the integration process

46. This section of the process has been completed, with workshops held between the Windscale and Sellafield IWS teams during the second half of 2008. The commonalities between the two sites with regard to waste were identified and are included in section 2.4.

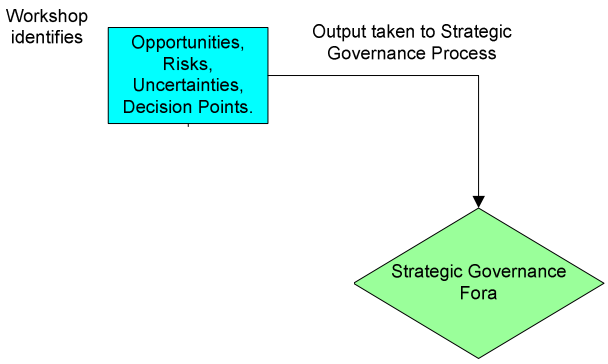


Figure 9: Stage 2 of the integration process

47. This section of the process of integration has also been completed with the various opportunities, risks, uncertainties and decision points being passed on to the relevant strategic governance fora. The opportunities etc that were identified as a result of the workshops are attached in section 2.4.

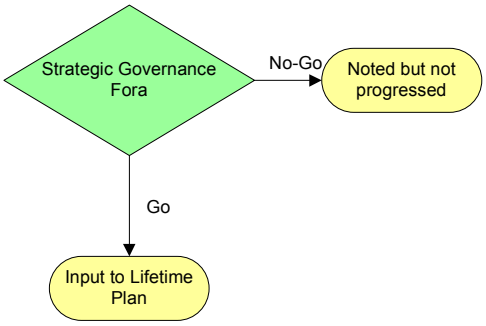


Figure 10: Stage 3 of the integration process

48. The third section of the process, which involves the relevant strategic for a considering the opportunities etc is currently being progressed.

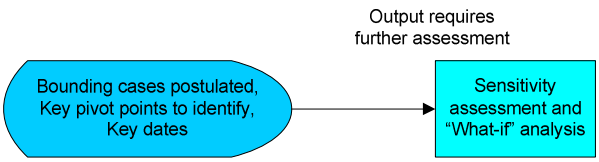


Figure 11: Stage 4 of the integration process

49. Detailed assessment in stage 4 has been deferred until more appropriate resources are available. It remains to be decided whether the IWS team or the attendees of the relevant strategic fora will deliver stage 4. Current thinking is that the latter will be likely to be responsible for the delivery.

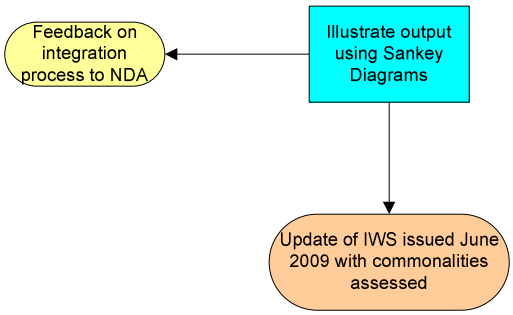


Figure 12: Stage 5 of the integration process

50. The final stage of the integration process will not be fully completed due to the fact that stage 4 is yet to be complete. Sankey diagrams have not been constructed as current thinking is that they will not add any benefit to the waste stream analysis graphs that have already been produced. These graphs help to indicate the opportunities, etc. that we presently believe to be available to the sites. The review of the integration that has taken place during 2008/09 will be fed-back to the NDA and this may have an influence on how the integration will progress further during the 2009/10 financial year.

The integration process has taken place, with minor changes to the proposed process, and achieved the aims of identifying commonalities, opportunities and risks.

2.4 Commonalities and associated opportunities

51. The process described above has identified the following opportunities:

Waste	Opportunity	Priority
LLW Oil	Windscale to consider routing its oil inventory to Sellafield. This would free up limited space at Windscale.	High
LLW Oil	R&D work between both sites should be aligned. Potential opportunities to use Windscale oils as the 'trial' media as part of the R&D work.	High
LLW Oil	Opportunities to use the Sellafield Nuclear Decommissioning & Major Projects (ND&MP) framework agreement which lets contracts out to preferred suppliers for overseas processing of certain wastes including oils.	High
LLW Lead	As above	High
LLW Lead	Opportunity for a common interim storage facility for lead in order to avoid disparate stores being set up.	Medium

Waste	Opportunity	Priority
LLW Asbestos	Opportunity to better characterise the expected quantity of contaminated asbestos in order to ascertain whether it is an issue.	Medium
LLW Bulk Metals	Opportunity to incorporate Windscale wastes into the trials in processing ferrous, stainless steel and lead.	Low
LLW Bulk Metals	There is the opportunity for the segregation of metals and processing at LLWR, which has started to be investigated by Windscale for Nationa Nuclear Laboratory (NNL) materials.	High
LLW Bulk Masonry & Rubble	LLW strategy to progress opportunities for decontamination and increasing packing efficiencies in order to minimise volumes for disposal.	Low
ILW Lead	Opportunity to re-categorise ILW lead to LLW levels will be explored (potential to use Computer Numerical Control (CNC) machines to remove outer surface contamination for lead non-smelted / recycled bricks).	Medium
ILW Stainless and Mild Steel	Opportunity to explore a common strategy for size reduction and encapsulation of ILW metals.	Medium
ILW Bulk Masonry and Rubble	Opportunity for Windscale to route ILW concrete to future Sellafield waste treatment facilities and to the Sellafield stores.	High
ILW Bulk Masonry and Rubble	Opportunity to explore decontamination and volume reduction in order to minimise overall volumes for disposal.	Low
ILW Graphite	Opportunity for Windscale to use the future Sellafield waste treatment facility for encapsulation of graphite prior to disposal, together with the suite of Sellafield ILW Stores for Graphite (e.g. CILWS and Encapsulated Product Store (EPS) etc). Opportunities for the treatment of graphite should be investigated at a national strategic level.	High
General Opportunities	➢ Opportunity for application of Windscale polymer encapsulation research and development trials to Sellafield wastes where encapsulation in cement is problematic due to the presence of reactive species. ➢ Consider using common waste package (3m^3 box) designs, reducing costs and complexity of shared systems. ➢ Central Facility / Capability for waste sorting, segregation and size reduction. ➢ Include Windscale waste when looking to maximise the utilisation of existing and planned Sellafield facilities as part of the overall Sellafield site strategy for ILW. ➢ Integrate the Sellafield & Windscale strategies for flask maintenance and disposal	High High Medium High Medium

52. These opportunities require further assessment prior to implementation, and this will be done via the appropriate strategic fora as noted in Stage 4 of the methodology above.

3.0 Progress Made on Waste Management Strategies

53. The purpose of this section is to report on how different component waste strategies have progressed since the publication of the June 2008 IWS update report. The various strategic advances are discussed in terms of the progress made. The aim is to provide the reader with an update of the different waste strategies on site, whilst also demonstrating how the principles behind the IWS, such as the WMH, are applied.

54. The format taken for this section is that the different strategies are discussed relevant to their waste form with sub-categories of Solid, Aqueous and Gaseous Wastes. Prior to this, the WMH is explained together with the Sellafield interpretation of the WMH. It should be noted that plants and systems where wastes are generated, processed or disposed of are managed, operated and maintained by suitably qualified and experienced persons in accordance with written processes and procedures. Sellafield Ltd operates under environmental and quality management systems which are externally validated to appropriate international standards (BS EN ISO 14001: 2004 and BS EN ISO 9001: 2000).

55. **Origin of the Sellafield version of the WMH:**

Figure 13: 'Conventional' waste management hierarchy

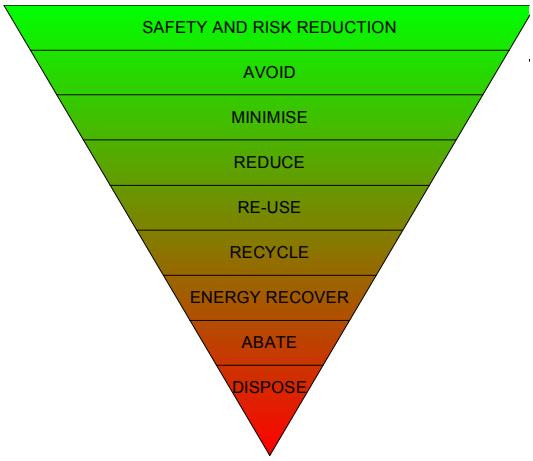


Figure 14: Sellafield Ltd adjusted version of the Waste Management

The WMH is a framework used to inform strategic thinking, highlighting the order in which options for dealing with waste should be considered. The WMH is applied throughout industry, and is not limited to the nuclear sector. The initial aim of the hierarchy was to provide a way of thinking that would extract the maximum possible benefits from products, whilst generating the minimum amount of wastes.

56. Figure 13 is an example of a WMH that would be applied to municipal, non-nuclear, waste management. Figure 14 shows how the WMH has been adjusted to better suit the needs and challenges faced at Sellafield site. As with the traditional model, those at the top of the triangle, shown in green are the factors of most importance, demanding greatest consideration and giving the greatest benefit, and as you progress further down the triangle the options for waste management become less favourable. The primary difference has been the inclusion of 'safety and risk reduction', at the very top of the triangle. This is considered the most important priority at Sellafield, such that if a strategic option is chosen which is not necessarily the best from a waste minimisation viewpoint but which provides essential safety & risk reduction, then that strategic option would be considered the right thing to do. The second difference is the segment that reads 'Abate'. Prior to waste being discharged into the environment, any opportunity for abatement should be explored. This is predominantly applicable for the treatment of gaseous and aqueous wastes, thus reducing the impact to the environment upon final discharge. Finally, the nature of the Sellafield site inevitably means that a lot of the waste already exists. In such instances the application of the WMH generally focuses on the lower levels of the triangle and on avoiding the unnecessary creation of secondary waste.

57. The key strategic priority of the site remains focussed on the reduction of the most significant hazards. The NDA requirement for Sellafield Site provides the following high-level objectives (Source: Sellafield 2008 LTP, Site Introduction 35.0.08 Site Strategy Overview):

- Spent fuel – all fuel either reprocessed or placed in long-term storage under safe and secure conditions.
- Reprocessing products – all products from reprocessing operations are either recycled and/or exported from Sellafield or stored on the site under safe and secure conditions, pending future decisions on recycle or immobilisation.
- Reprocessing wastes – all wastes generated through reprocessing operations are either exported to overseas customers or disposed of at the LLWR, or stored on the site under interim safe storage (ISS) conditions pending final disposal routes.
- Legacy wastes – all wastes are either retrieved and placed in long-term storage under ISS conditions or are left in situ in a condition that is acceptable for the longer term, pending a final end-state decision.
- Buildings – all buildings and associated structures are either demolished to their foundations and removed, or are left partially or fully standing in such a condition that any residual items or activity remaining in the building can be considered to be immobile and safe in the long term.
- Ground contamination – all activity in the ground and building foundations is either retrieved and placed in long term storage under ISS conditions or left in-situ in a condition that is acceptable for the longer term, pending a final end-state decision.
- Final Site End State - It is presently anticipated that the Sellafield Site will never be totally de-licensed, and that some form of ongoing institutional control will therefore be required

58. Factors that are considered in prioritisation and scheduling of the high-level objectives include the following:

- Hazard potential of legacy inventories (using the NDA Safety and Environmental Detriment (SED) score methodology)
- Fault mechanisms, release fractions and consequences
- Building condition, longevity and possible future deterioration
- Regulatory, stakeholder and contractual commitments and concerns
- Utility customer requirements/constraints
- Revenue
- Cost of delay – asset care etc.
- Supply chain and obsolescence
- Loss of key skills and resources
- Scheduling logic and plant capacity

59. Using the NDA prioritisation process informs the site priorities, which therefore leads to the following set of Strategic Priorities for Sellafield

Table 3: Strategic Priorities for Sellafield

HAZARD REDUCTION	OPERATIONAL
	1. Maintain safety & security of nuclear material
2. Highly Active Liquor (HAL) stocks hazard reduction	
3. Magnox Swarf Storage Silos waste retrieval and immobilisation	
4. First Generation Magnox Storage Pond waste retrieval and immobilisation	
5. Reprocess stocks of wetted Magnox fuel to ensure that fresh Magnox fuel is not allowed to degrade	5. Magnox Operating Plan (MOP) wetted stocks reduction

HAZARD REDUCTION	OPERATIONAL
6. Improve the containment and storage of plutonium and plutonium residues	
	7. Ensure ability for ongoing receipt of Advanced Gas-Cooled Reactor (AGR) fuel
8. Reduce the hazard potential of the Floc Storage tanks through retrievals and treatment	
	9. THORP reprocessing contracts (ref. revenue income)
10.Retrieve PCM to improved storage	
	11. Return overseas Plutonium (i.e. SMP)
12. Separation Area Head End Plant decommissioning	
13. Pile Fuel Cladding Silo waste retrievals	
14. Pile Fuel Storage Pond waste retrievals	

3.1 Solid Wastes

3.1.1 Update to the solid radioactive waste strategy

The strategy for radioactive solid wastes in this version of the IWS report is based on the 2009 Inherited Lifetime Plan (ILP) strategy for Sellafield. There are no major strategic changes since the previous Lifetime Plan (LTP) 2008 submission and the 2008 IWS report. Any changes are mainly around the re-scheduling of certain projects to meet the NDA funding requirements.

60. The total quantity of radioactive waste requiring processing and disposal at Sellafield is sourced from the Sellafield ILP09 Process wiring diagrams and the 2007 UK Radioactive Waste Inventory and is summarised in table 4 below:

Table 4: Total lifetime projection of packaged waste from Sellafield (excluding contaminated land LLW and VLLW)

Waste Category	High Level Waste (HLW)	ILW [including PCM]	LLW	HVVLLW
m^3 (packaged volume)	1,485 m^3	~ 276,000 m^3	~ 756,000 m^3	~ 1,400,000 m^3
Equivalent number of packages	7,654 vitrified containers *(excludes returns to overseas customers but includes* Post Operational Clean Out *(POCO))*	~ 81,000 x 3m^3 box equivalents	~ 38,700 x Half Height Isofreight (HHISOs)	Reported as raw waste

3.1.2 High Level Waste strategy

61. The overall strategy for HLW remains the same as described in last year's report i.e. minimising stocks and arisings of HAL through use of evaporation and vitrification. The total allowable stocks of HAL are to be progressively reduced until July 2015 when the stock of HAL is to be less than

200m3. The measure is being reviewed by the NII, it is considered likely that the measure will change from a volumetric basis (m3), to one of tonnes of uranium equivalent (teU) in the processed HAL, which will in turn change the end point target. Reductions are to be achieved through management of reprocessing and vitrification schedules.

62. HAL is a corrosive liquid and the operation of storage tanks and evaporators is subject to an operational lifetime restriction due to corrosion of key parts of the plant. Assessments of the remaining life of the existing High Active (HA) evaporators, together with the required operations and decommissioning activities for the plant have identified the need for replacement evaporative capacity as soon as practicable. Therefore a new HA evaporator (Evap D) is being constructed on the site with a programme delivery date of July 2014. The potential requirement for a further HA evaporator (Evap E) and additional HA storage tanks is being evaluated. The decision on whether or not these facilities will be needed will be taken in 2011.

3.1.3 Intermediate-Level Waste Strategy Update

3.1.3.1 Operational wastes

63. There is no major change to ILW operational waste strategy since the 2008 IWS report.

64. Magnox and Thorp reprocessing programmes as well as the operating schedules for associated ILW conditioning facilities, namely MEP, WEP and Waste Packaging and Encapsulation Plant (WPEP) remain unchanged from the 2008 IWS report.

65. MEP will continue to support Magnox decanning operations and POCO until 2019/20. Once Magnox reprocessing has been completed, there are potential opportunities for utilising MEP to condition other ILW such as Tokai Mura End Crops, Magnox Silo scrap and some Beta-Gamma contaminated ILW from decommissioning. These opportunities are to be reviewed through the ILW site governance processes.

66. WEP will continue to support Thorp reprocessing which is currently scheduled until 2014/15. It will also process some Magnox Ponds wet Bay Miscellaneous Solid Wastes from 2010 onwards until the BEP becomes available. It will also support Thorp POCO until 2018. There are opportunities to utilise WEP for other ILW waste and these will be reviewed through the site ILW governance processes.

67. WPEP will continue to support reprocessing of bulk feeds from Thorp and Magnox and condition active flocculates generated from the Enhance Actinide Removal Plant (EARP), including the feeds from the treatment of historic waste recovered by the Floc Retrieval Project. The baseline includes the diversion of the SETP feeds to EARP subject to continuing technical underpinning. Further opportunities for utilising WPEP will be reviewed through the site ILW governance processes.

68. Conditioned ILW waste will be interim stored at the Sellafield site pending transport to the future national GDF for disposal. The stores strategy for interim storage of operational ILW remains the same as the 2008 IWS, that is, to use existing and planned future stores to safely store the waste.

3.1.3.2 Legacy Ponds and Legacy Silo wastes

69. There are some changes to the LP&LS strategy since the 2008 IWS report. These are mainly due to rescheduling in line with the NDA's re-prioritisation constraints and removal of the Site Ion Exchange Plant Waste Processing Plant (SWP). It should be noted that there is significant review of LP&LS project schedules taking place for LTP 2010 and operational dates for the treatment facilities will be defined then.

70. The treatment facilities planned within the LP&LS strategy are as follows:

- Silos Direct Encapsulation Plant (SDP) - For the conditioning of ILW from Magnox Swarf Storage Silos and Site Ion Exchange Plant (SIXEP) Sludge and Sand and Clinoptilolite (an Ion Exchange material).
- Sludge Packaging Plant (SPP1) buffer, processing and exporting facility – ILW sludge from the First Generation Magnox Storage Pond is to be transferred to the SPP1 buffer tanks initially. The sludge will be processed via the SPP1 process facility.
- Local Sludge Treatment Plant (LSTP) buffer, processing and export facility. ILW sludge from the Pile Fuel Storage Pond is to be buffer stored in LSTP initially prior to processing.
- BEP - For the conditioning of ILW solids from the First Generation Magnox Storage Pond and the Pile Fuel Storage Pond.

- Pile Fuel Cladding Silo Treatment Plant (PFSTP) - For the conditioning of ILW from the Pile Fuel Cladding Silo.
- SWP – This is no longer required as SIXEP sludge and Sand / Clinoptilolite are to be processed through SDP.
- Conditioned LP&LS ILW packages are to be stored in the suite of new-build Box Encapsulation Plant Product Stores (BEPPS). Exports to the future GDF will be in line with the NDA's GDF export programme. Some LP&LS may be stored in the EPS3 prior to BEPPS being available

71. The potential re-work and export of ILW is included within the strategy for the Final Treatment and Disposal of ILW (OU 35240). This is discussed in Section 3.1.3.4 of this report.

3.1.3.3 Plutonium Contaminated Material wastes

72. There are no major changes to the Plutonium Contaminated Material (PCM) strategy since the 2008 IWS report.
73. Operation of the current PCM treatment facility (WTC1a) is scheduled to continue until 2023 with progressive enhancements in its capability to accept a greater range of wastes and increased throughputs. A new PCM treatment complex is programmed to become available in 2017 and will operate until 2059. The processing specification for this facility has not yet been finalised but is intended to include all wastes that cannot be processed through WTC1a. This complex will include a crate breakdown facility which will enable crates containing PCM to be broken down into a form that can be stored safely prior to treatment into a long term product.
74. Raw and conditioned PCM wastes are interim stored in the Engineered Drum Stores (EDS's). Work is ongoing to improve the storage regime in the existing ED stores so as to minimise the overall number of stores required.
75. The new build PCM treatment complex will include the capability to re-work any out of specification waste products to meet the Repository Waste Acceptance Criteria. The export of PCM product to the GDF is included in the Final Treatment and Disposal of ILW strategy.

3.1.3.4 Final Treatment and Disposal of ILW (OU 35240)

76. There are no major changes to the strategy for the Final Treatment and Disposal of ILW since the 2008 IWS report.
77. The scope is:
    - Treatment and conditioning of Beta-Gamma ILW from decommissioning, Miscellaneous Beta Gamma Waste Store (MBGWS) contents, AGR dismantler wastes and excavated contaminated land.
    - Potential rework of any Beta-Gamma ILW waste products as required in order to satisfy the Repository Waste Acceptance Criteria
    - Vouchsafing and exporting the lifetime yield of Beta Gamma ILW <u>and</u> PCM products to the repository
78. There is an opportunity to offset the additional liability of the new treatment facilities by utilising the remaining life of the existing and future committed ILW treatment facilities (e.g. WEP, BEP, SDP etc). This opportunity is being explored further and will be reviewed through the site ILW governance process.
79. The rate at which ILW is to be exported to the GDF is dictated by the NDA as part of their National GDF Export programme. This assumes that Sellafield will export around 1,200 ILW packages per annum from 2040 onwards. It should be noted that this constraint requires the site to export ILW over a lengthy period of 66 years and significantly challenges the design lives of the existing stores. Work is currently ongoing to optimise the store design lives as well as the export rate to the repository.
80. Figure 15 illustrates the total ILW Export profile from Sellafield to the GDF. Key assumptions have been made in deriving the profile, such as prioritising the export of ILW from older stores in order to minimise the impact on the store lifetimes.

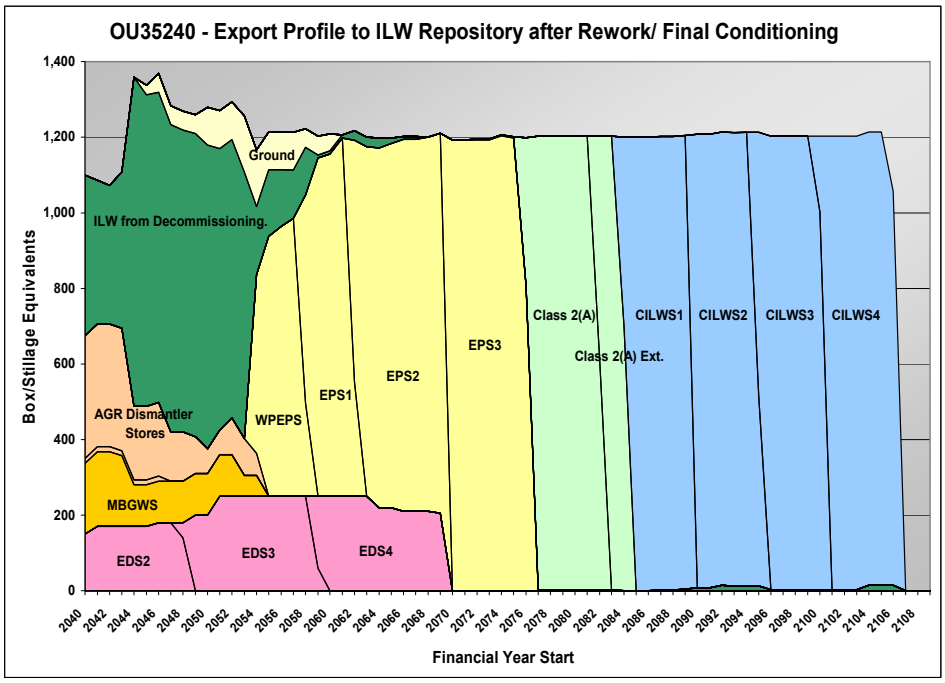


Figure 15: Export profile of all ILW (including PCM) from Sellafield stores to the Repository

81. The logistics of waste transport on the site (both raw and conditioned) are significant owing to the volumes, safety requirements and congested nature of the site. Site Infrastructure strategy is still developing and is taking into account future requirements for waste transport.

3.1.4 Low Level Waste strategy

82. Sellafield Ltd. published its LLW strategy on January 2009 (Ref: IWSSG(08)01) and outlines the forward strategy for managing current and future LLW arisings from the Sellafield site, including Windscale.

83. The aim of the Sellafield LLW strategy is encompassed in the following vision statement:

"Low Level Waste Management solutions implemented through practical, cost effective, application of the WMH to support current operations and the safe and timely decommissioning of the Sellafield site"

84. The strategy outlines a number of enabling strategic principles:

- Ensuring that the WMH is applied without compromising safe operations or hazard reduction principles
- Avoiding and minimising unnecessary generation of radioactive wastes
- Reducing the burden of waste routed to current disposal facilities
- Reducing the lifetime waste management cost to stakeholders
- Managing all wastes in a manner so as to minimise the impact on health, safety and the environment
- Standardising best practice in the management of LLW and embedding it across the Sellafield Site

85. The Implementation of the strategy will consist of a phased approach with short (0-3 years), medium (3-15 years) and long term (15+ years) goals whilst taking cognisance of the national LLW strategy being developed by the NDA.

86. Sellafield Ltd. have recognised the benefits for alternative LLW treatment and have done some high level analysis showing a saving of around 20,000 ISO Freight containers if the following processes could be developed:

- Waste sorting & segregation capability
- Thermal treatment capability
- Metal decontamination capability

- Specified landfill capability

87. Figure 16 illustrates the high level analysis that was done in LTP08 and the resultant volumes for disposal to the LLWR.

88. The benefits outlined in Figure 16 will be further underpinned during the strategy implementation work.

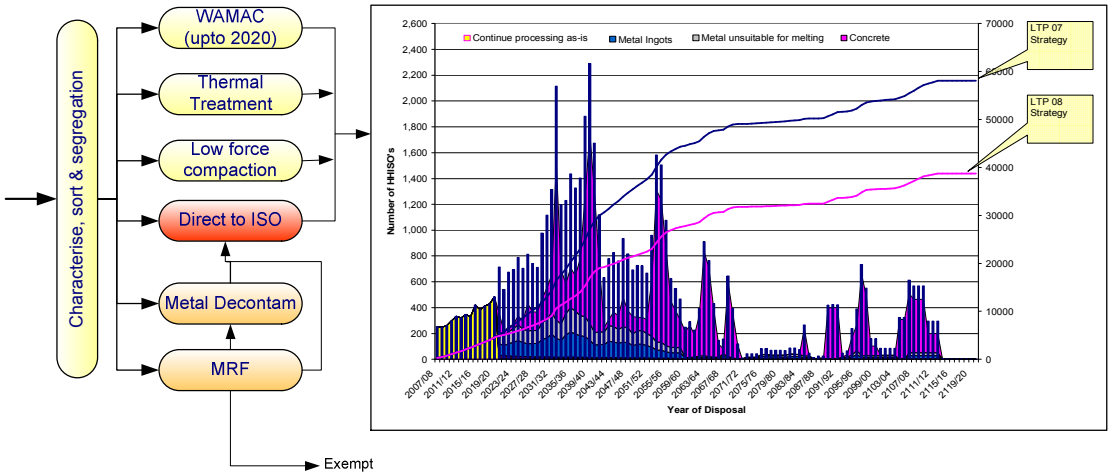


Figure 16: Potential impact of alternative LLW treatment

89. Whilst Sellafield Ltd. have recognised the importance of these alternative treatment capabilities, the location of any facilities is not yet decided and will be part of the NDA's national LLW strategy

90. In addition to LLW, there is a significant quantity (circa. 1.4 million m^3) of HVVLLW to be generated over the lifetime of the site. This excludes the large volumes of contaminated land and comprises of demolition material from future decommissioning activities. Work is ongoing within the decommissioning directorate to better characterise the wastes and identify techniques to allow for appropriate segregation of waste at the workface in order to reduce volumes for disposal.

91. The strategy for the disposal of HVVLLW is included within the overall Sellafield LLW strategy and its associated implementation plans. This includes work to review Calder Landfill Extension Segregated Area (CLESA).

3.2 Aqueous Waste Strategy (AWS)

92. This section represents the update to the AWS as required under Schedule 9 Requirement 1 of the RSA 93 Authorisation within the 'CEAR'.

93. The AWS can be summarised thus:

There has been no change to the Sellafield Aqueous Waste Strategy (AWS) since the 2008 IWS report, that is, the strategic objective for Effluent Management on the Sellafield site is still

- ⇨ to enable the site strategic imperatives to be delivered, safely, reliably and efficiently
- ⇨ in line with government policy and
- ⇨ by applying principles of best practice

- It has developed in line with knowledge, understanding and Site activity.
- Avoids arisings by design of plant & processes (e.g. high integrity containment) and by operating practice (e.g. delay storage of some wastes prior to processing).
- Minimises aerial and liquid discharges (e.g. the reprocessing of spent fuel is designed so that the first chemical separation of fission products from the recyclable plutonium and uranium is optimised to concentrate and contain as much of the activity as practicable into a single waste stream).
- Reduce (e.g. Medium Active (MA) stream activity is reduced by delay storage).

- Reuse & recycle within plants (e.g. solvent recovery, recovery of Nitric Acid, recirculation of pond water).
- Abate prior to discharge to the environment (e.g. use of floc precipitation and ultrafiltration process prior to sea discharge).

94. This strategy forms the basis by which the site currently manages its effluents and is manifested in the following tactics:

- Plants and processes will use BPM to minimise the quantity, activity and suspended solids content of liquid effluent arisings, and to segregate different categories of liquid effluent.
- Plants and processes will generally discharge their liquid effluents to centralised treatment facilities, complying with any receiving plant acceptance criteria.
- Centralised effluent treatment plants will continue to be operated as long as technically feasible and safe to do so. Technical feasibility takes account of economically viable asset care and changes to effluent feed quality and quantity.
- Magnox and AGR fuel pond and Magnox silo effluents are generally discharged to SIXEP for the removal of Magnox sludge, other suspended solids and soluble caesium and strontium, prior to sea discharge.
- HA effluents and low salt medium active effluents are evaporated to minimise volume and immobilised by vitrification.
- Medium active effluents with high salt content are evaporated to minimise volume and delay stored to reduce short lived beta emitters. They are then subjected to floc precipitation and ultrafiltration to reduce activity prior to sea discharge.
- High alpha, low active effluents are subjected to floc precipitation and ultrafiltration to reduce activity prior to sea discharge.
- Low active acidic effluents are neutralised and blended with low active caustic effluents prior to sea discharge.
- Thorp Dissolver Off-Gas scrubber effluent is treated locally by C-14 precipitation and decanting prior to sea discharge.
- Thorp pond purge is filtered locally to remove suspended solids prior to sea discharge.
- Long lived I-129 is driven to sea as this has been identified as Best Practicable Environmental Option (BPEO).

95. The OES work (which focuses on the medium to long term effluent strategy) is also relevant to the IWS. Decisions by the IWSSG are taken with due regard to the OES work. The AWS is focused upon optimising the use of existing facilities, supported by additional facilities only when required.

96. The UK Radioactive Discharge Strategy(UKDS) represents the UK's national plan for addressing certain requirements associated with the Oslo-Paris European Union Convention (OSPAR) Radioactive Substances Strategy. This strategy is in the process of being updated (UKDS 2006-2030), currently in its final drafting stage following an extensive consultation exercise, which includes revised discharge targets:

Table 5: Summary of 2002 UK Discharge Strategy Targets and Proposed UK Discharge Strategy 2006-2030 Targets

UK Discharge Strategy Targets (Liquid)		Dose* µSv	Beta** TBq	Alpha TBq	Tc-99 TBq	Tritium TBq
Current	by 2020	20	50	0.2	1	N/A
Proposed	by 2020		20	0.1	1	100
	by 2030		10	0.05	0.1	10

* Dose target from all liquid discharges
** Beta - Taken as Beta-5 excludes Tritium

97. To meet these aims, and deliver an optimised strategy regarding aqueous waste, the OES team has looked to incorporate national and international best practice for effluent management. Alignment of the OES to the 2002 UK Discharge Strategy was achieved in June 2007 and using current data (based on LTP2008) it is predicted that future discharges will meet the revised 2006 UK Discharge Strategy.

98. Further improvements and optimisation of the Sellafield AWR are being driven by a ‘bottom-up’ application of BPM via development of BPM / IEA (Integrated Environmental Assessment) cases

and their implementation. An effluents decision calendar is also being developed to aid strategic decision making. Following the completion of the BPM cases and the production of the effluents decision calendar, it is intended that a high-level review of aqueous effluent arrangements should take place. This would seek to rationalise the localised improvements arising from the 'bottom-up' BPM cases while meeting the requirements of the strategic effluent decisions to provide an appropriate improvement plan.

99. Discharges of liquid and aerial effluents from the Sellafield site are governed by an authorisation (RSA 93), which includes numerous limits for maximum discharges (in terms of Becquerels). There are both plant and site limits in place. Predicted discharges from the site based on the current LTP would be below the current RSA (93) Authorisation site discharge limits. The likely schedule changes for LTP10 are not expected to threaten the current site authorisation limits.

3.2.1 Discharge Trends

100. The graphs below demonstrate the current predicted discharge trends.

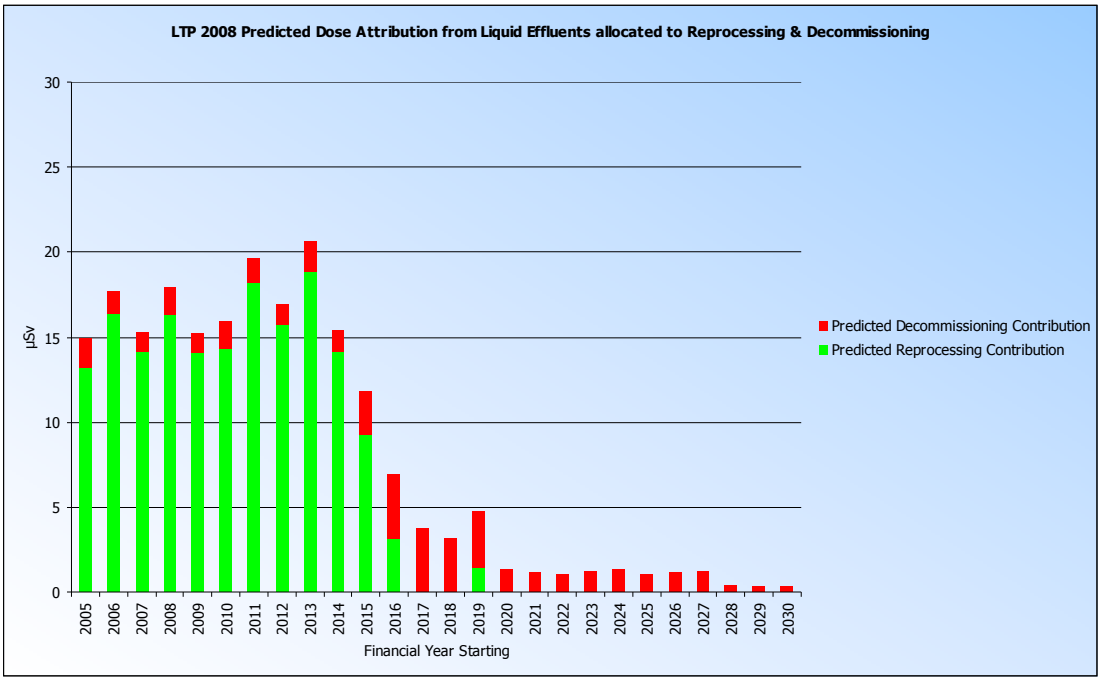


Figure 17: Predicted trend for dose attributed to liquid effluents, showing the discharge from reprocessing and decommissioning operations

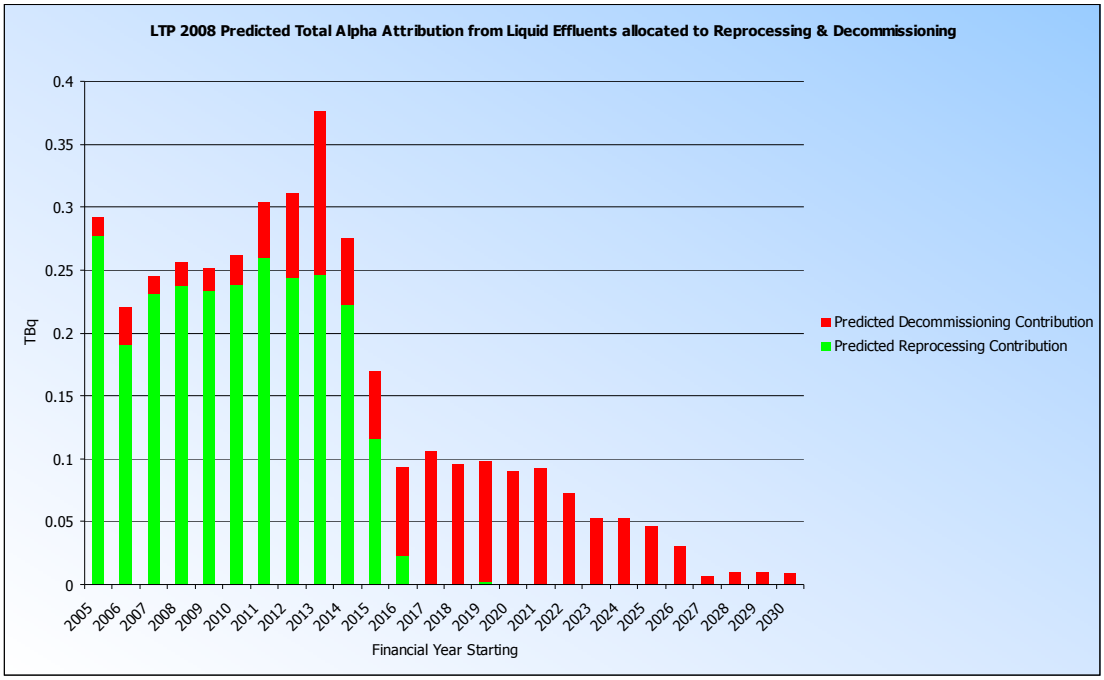


Figure 18: Predicted trend for total alpha aqueous discharges from reprocessing and decommissioning operations

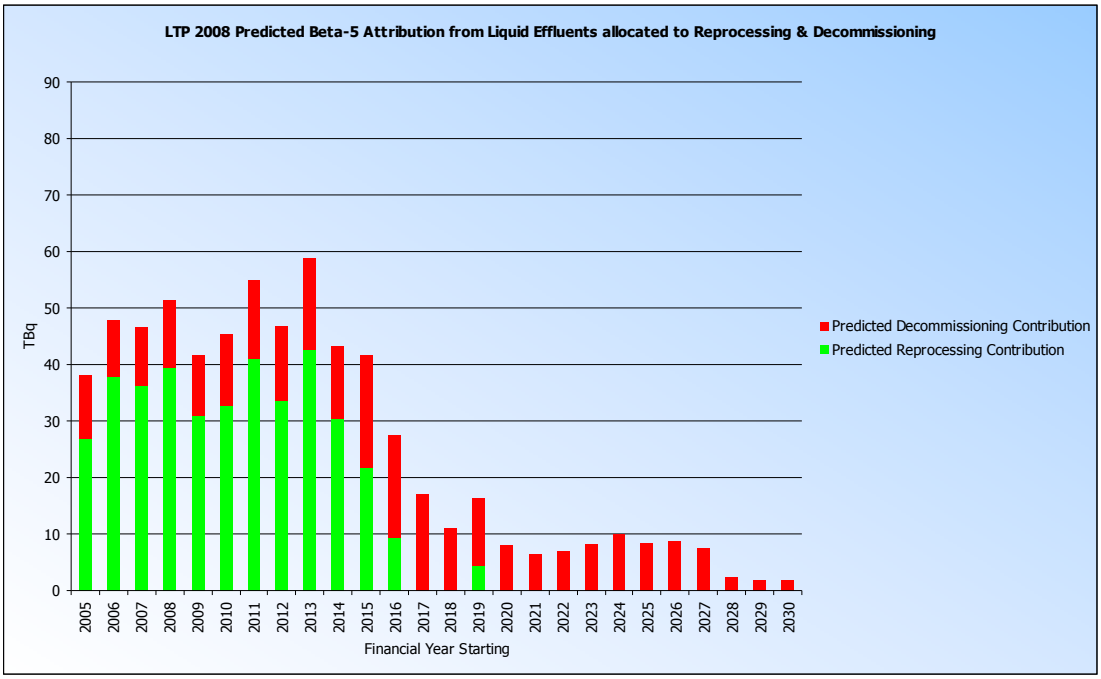


Figure 19: Predicted trend for beta-5 aqueous discharges from reprocessing and decommissioning operations

101. As can be seen from the graphs above, the discharges due to reprocessing are currently low owing to the low throughput of the reprocessing plants in recent years. The slight increase in discharges over the next few years will be due to the planned ramp-up of reprocessing operations to operate closer to previous rates. Once reprocessing operations cease, the associated discharges will reduce considerably and quickly, though discharges due to retrievals of legacy wastes and decommissioning operations become more significant. It can be seen that the projected discharges meet the UK Discharge Strategy target, though it should be understood that projected discharges due to decommissioning operations inherently carry a greater degree of uncertainty than those for reprocessing operations. It should also be noted that the UK Discharge Strategy target does not preclude additional reprocessing business, should the UK Government choose to progress that opportunity. As noted previously, the current development of the Sellafield LTP10 is likely to impact project schedules on the site, and subsequently on discharge profiles.

3.3 Gaseous Waste Strategy (GWS)

3.3.1 Update of the Gaseous Waste Strategy

There has been no change to the Sellafield Gaseous Waste Strategy (GWS) since the 2008 IWS report, that is, the strategic objective for Effluent Management on the Sellafield site is still

- ⇨ to enable the site strategic imperatives to be delivered, safely, reliably and efficiently
- ⇨ in line with government policy and
- ⇨ by applying principles of best practice

102. The strategy remains focused upon supporting and enabling commercial operations and remediation activities at Sellafield, whilst ensuring adequate protection of the environment.

103. The strategic governance of the Sellafield GWS is undertaken by the Aqueous and Gaseous Waste Strategy Steering Group which has a membership providing input from the Aerial Effluent Control Working Party, Ventilation Technical Support Group, OES, IWS, Environmental Health, Safety & Quality, and the Technical & Strategy Leads from the relevant OUs.

104. The current strategic approach to gaseous waste management at Sellafield can be summarised as:

- Application of the WMH (Avoid, Minimise, Recycle, Re-use, Abate)
- Concentrate and Contain radioactivity.
- Use of the company's Business Investment Delivery (BID) process to ensure that the selection and design of processes and plant avoids and /or minimises aerial arisings (both in terms of amount of contamination and volume), consistent with BPEO
- Control of subsequent unavoidable aerial contamination through containment using ventilation systems.
- Use of BPM for process and ventilation operation, monitoring and control to ensure optimised operation.
- Provision of effective abatement matched to the type and level of aerial contamination
- Provision of contingency & security through redundant and diverse systems
- Offsite monitoring and environmental assessments to confirm minimal discharges and impact.

105. Key sources and components of discharges from the site are identified. Comprehensive in-situ sampling and monitoring at source confirms that releases are small, and this is supported by extensive environmental and foodstuff analysis for reassurance.

106. The critical group (group most at risk) impact resulting from the annual gaseous discharge for 2008 was very low and is evaluated as ≈16 μSv, which is less than 1 % of the average radiation dose from natural background and other sources in the UK.

107. This indicates that the current strategy is effective with regards to managing radioactive arisings and that focus should be directed towards maintaining the reliability of processes which ensure the continued effective management of aerial effluents.

108. Detailed modelling, together with the results of environmental monitoring confirm that the impacts of non-radioactive discharges are well within national air quality objectives and relevant guidelines.

109. Current operations at Sellafield result in several main gaseous effluent streams that have the potential to contribute to radioactive discharges to the atmosphere. These include:

- Reprocessing Operations
- HLW Treatment
- Spent Solvent Treatment
- Legacy Waste Storage

110. Reprocessing operations contribute the most towards gaseous discharges. Therefore, once reprocessing finishes, a significant reduction in amount of gaseous activity released is expected to be seen. Since June 2007 however, the main contributor to gaseous discharges has been legacy

ponds as both HLW Treatment and Reprocessing Operations have been curtailed owing to a lack of Evaporative capacity for treating HA Liquid waste.

111. All significant gaseous waste streams are subject to treatment prior to discharge. The use of these facilities represents the BPM for minimising discharges, and the application of the WMH. When treating gaseous streams, emphasis is placed on abatement. The aim of which is to contain the radioactivity in solid or aqueous form, thus immobilising or mitigating the environmental impact of the activity.

112. There are some items that have affected how the strategy is tactically implemented and these are discussed below.

- Status update regarding the instrumentation and monitoring of the Alpha Plant Discharge Stack following subjective reports of larger than anticipated deflections of the during winter storms.
- Status update on the Separation Area Ventilation (SAV) project,

3.3.2 Status Update - Alpha Plant Discharge Stack

113. The previous IWS report (June 2008) noted that the alpha plant discharge stack that jointly serves the Analytical Services Facility and the Product Finishing & Storage Facility was to be instrumented to assess any movement of the stack over several months. This to provide assurance to allay concerns of prior subjective reports of larger than anticipated deflections during winter storms. The instrumentation has been purchased and is now on-site but remains to be installed on the stack. The delay of this work is due to the potential safety implications of installing the instrumentation on a tall civil structure in the centre of a nuclear site. The safety case for the work is currently undergoing peer review through the appropriate safety committees at Sellafield.

114. It is anticipated that the first phase of the installation of the instrumentation will take place in July 2009. In the meantime visual inspection of accessible parts of the stack has given confidence in the integrity of the structure. All indications to date confirm the stack to be adequate for the requirements upon it (i.e. at least 5 years). Therefore it is noted that there should be sufficient time to provide a solution should the monitoring instrumentation indicate any problems with the longer term use of the stack.

3.3.3 Status Update - Separation Area Ventilation (SAV) Project

115. Both the first generation reprocessing plant stack (that serves Magnox reprocessing plants, various legacy and storage plants, and some plants that are being decommissioned) and the Pile 1 stack are nearing the end of their effective operational lives and are scheduled for demolition in the near future. The objective of the SAV Project is to divert aerial effluents currently routed to these stacks to a new discharge facility that will provide a long-term discharge capability to meet current and future operational and decommissioning needs. This is an example of where early recognition of an issue has led to a decision to replace aging facilities to enable both ongoing operations to continue and also to minimise the future environmental impacts of the Post-Operational Clean Out and Decommissioning phases of the associated plants.

116. The SAV project is part of the current GWS. The project has been sanctioned by the NDA and a single Design & Build contract has been placed with Doosan Babcock. Construction will commence on site this financial year and the stack should be operational to enable the diversions of aerial effluents in 2013.

3.3.4 Discharge Trends

117. The graphs below were based on profiles produced by the OES Model and modified using best judgement for the DEFRA review of the UK Discharge Strategy, using the best available data at that time. The graphs refer to predicted aerial discharges from the Sellafield site. It should be noted that the OES model currently aims to predict broad trends in aerial discharges associated with remediation and future operations for strategic assessment. Further improvements to the aerial modelling capability to enable more detailed assessments of future discharges are planned within the OES work, and are now being undertaken, but it may be several years before modelled predictions become close to actual discharges.

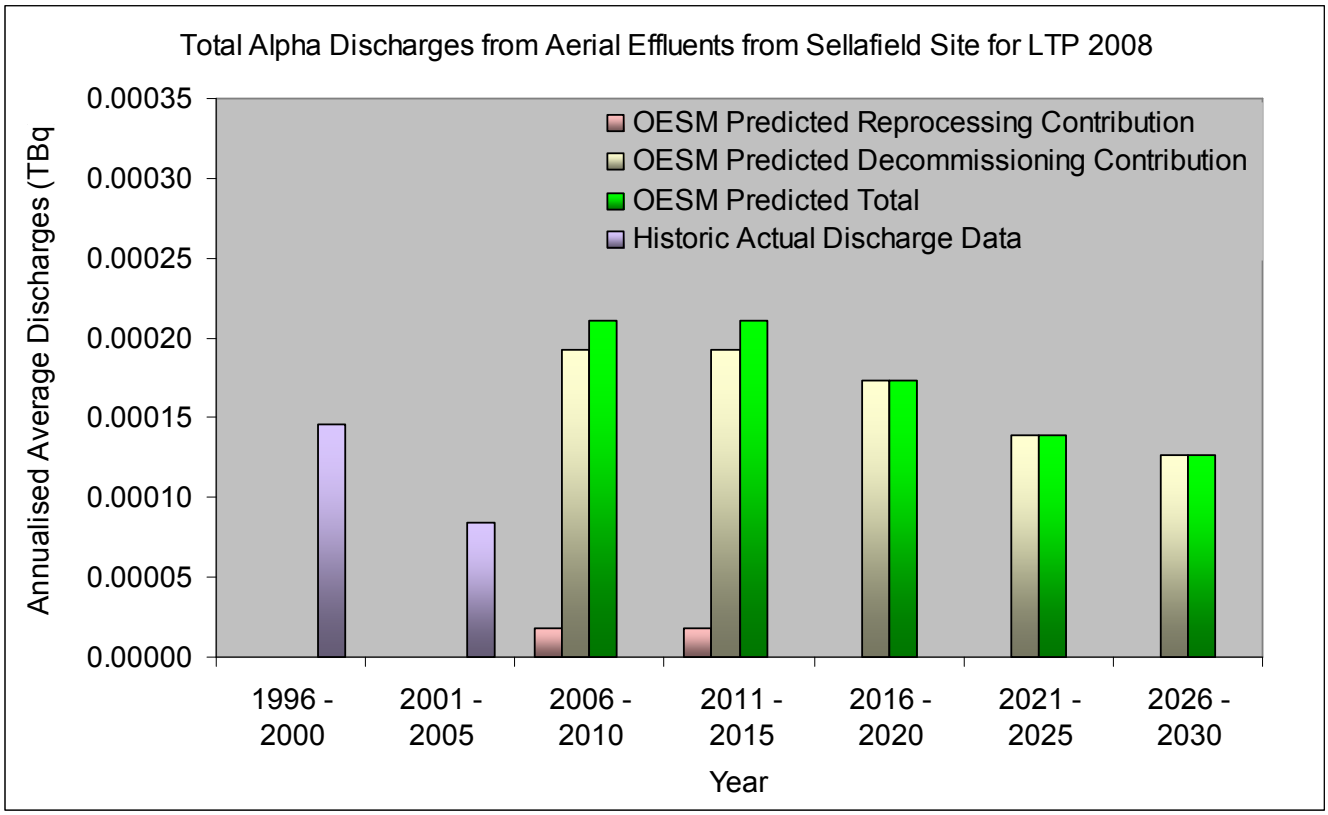


Figure 20: Predicted trend for total alpha aerial discharges from reprocessing and decommissioning operations

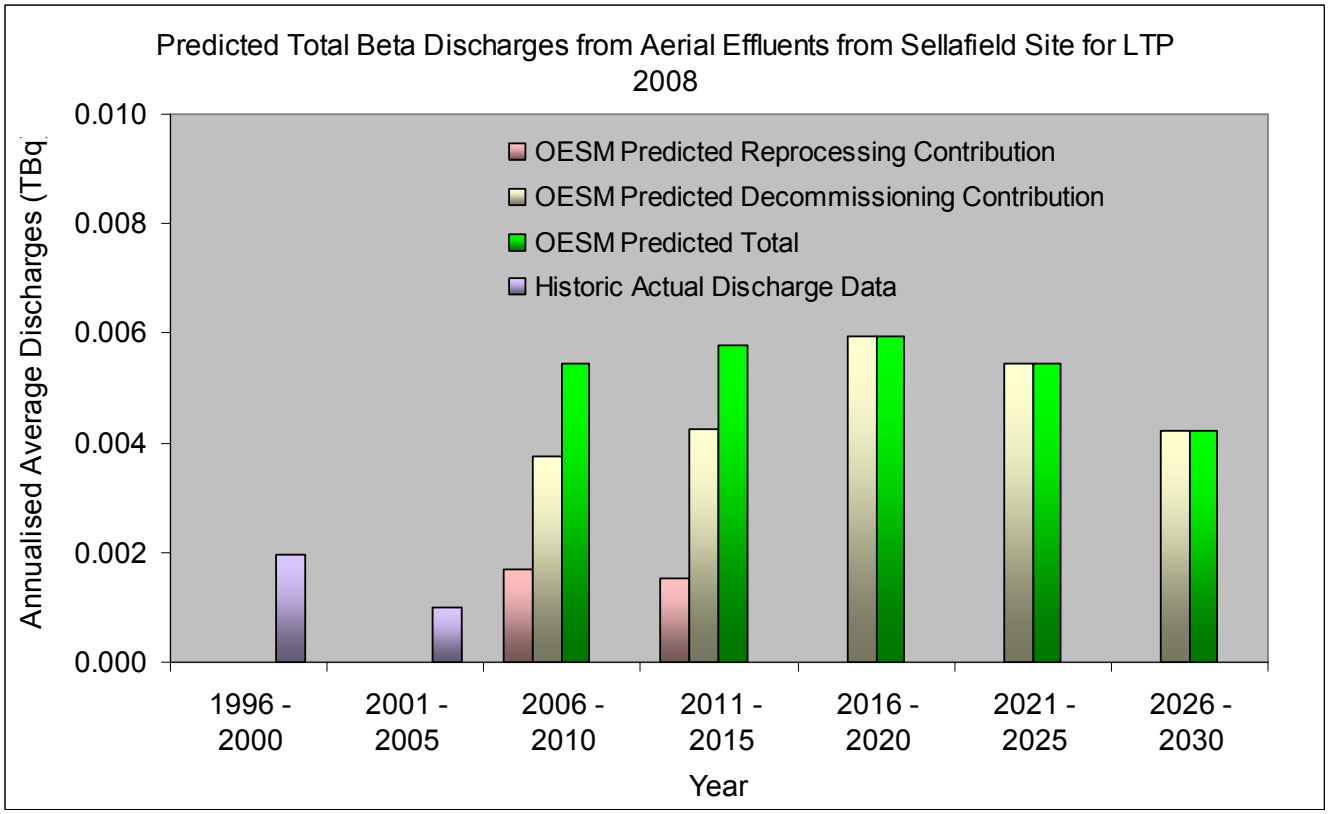


Figure 21: Predicted trend for total beta aerial discharges from reprocessing and decommissioning operations

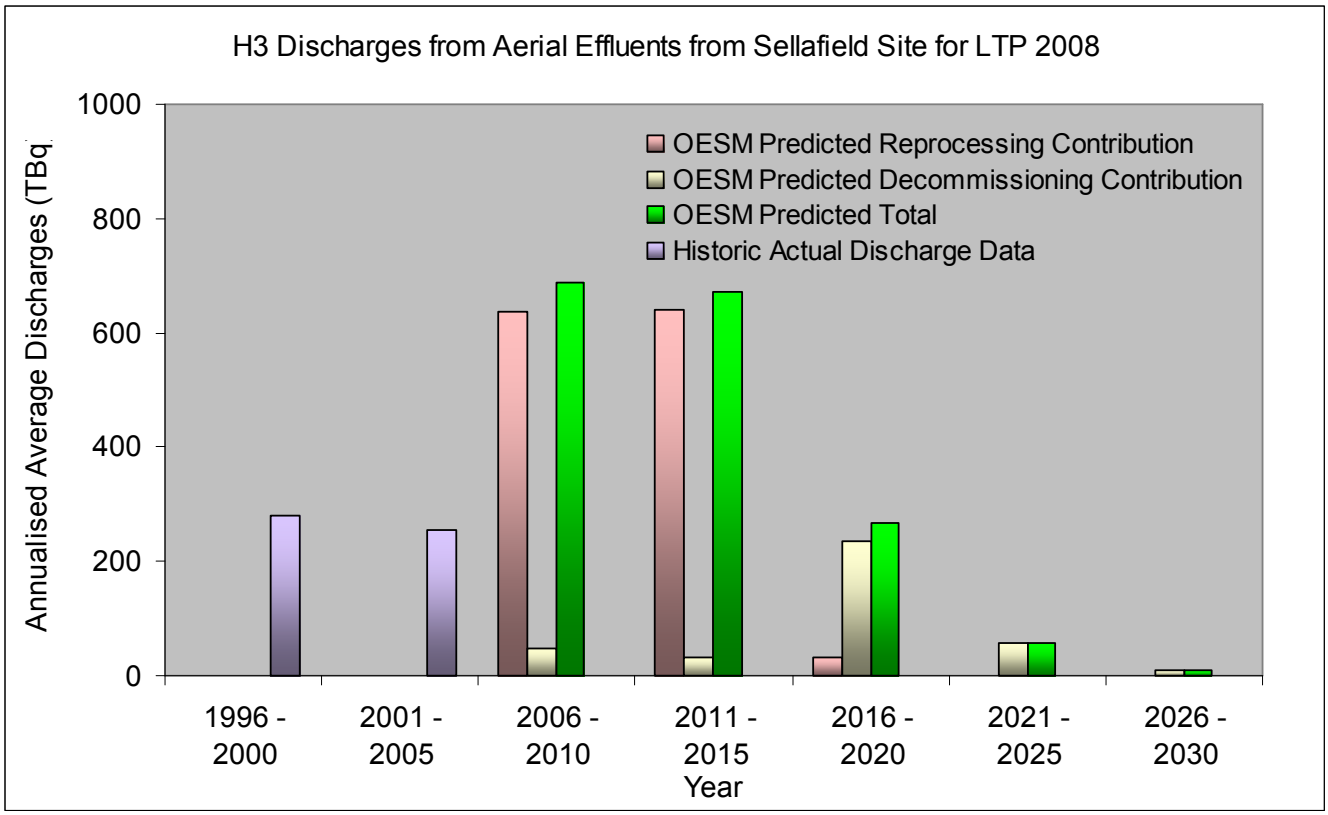


Figure 22: Predicted trend for Tritium (H-3) aerial discharges from reprocessing and decommissioning operations

3.4 Decommissioning Strategy

118. There has been no change in Decommissioning Strategy in the last year, that is, it remains as:

- The overarching objective of decommissioning is to deliver efficient and controlled hazard reduction while meeting regulatory and legislative requirements. The decommissioning phase follows on from the POCO phase of a facility's life, when much of the bulk radioactive inventory has been removed. Decommissioning is undertaken as soon as practicable and is prioritised and scheduled accordingly, taking due account of, among other things: residual hazard; application of the WMH; funding; plant availability; technical feasibility.
- The scope of decommissioning activities covers the removal or fixing of contamination within a facility, removal of plant and equipment, and culminates in facility demolition. In its broadest sense the approach to decommissioning can be categorised in two ways: manual ("hands on") or remote. The former dominates where radiological dose levels permit man access to radioactive areas, the latter dominates where meaningful man access is not achievable. The option to decontaminate a facility or part of one is in the toolkit available to enable a move from the remote to the manual approach, although in all cases adopting a manual approach has to be thoroughly justified.
- Wastes generated during decommissioning cover a wide range of radiological categories ranging from ILW down through LLW to exempt. It is sorted and segregated at the workface only where appropriate on safety grounds to do so, and is routed to the appropriate waste treatment facilities.

119. Work in this area in the last year has focussed on:

- Developing the understanding of uncertainty around future waste that will be generated from decommissioning (volumes anticipated, etc)
- Establishing & justifying the correct decommissioning workstreams to progress in the near-term to take decommissioning forward.
- The Decommissioning Mandates produced over the last few years have applied more recent decommissioning experience to provide a summary of "how to decommission a specific building" for a number of key buildings on the Sellafield site. These have since been assessed collectively by the Decommissioning Strategy group and a number of long term challenges have

been identified. They are now being further assessed and used to bound the range of uncertainty around future waste volumes and cost estimates.

120. Decommissioning strategy is likely to remain relatively unchanged for the near-term future, though it will be significantly influenced should decisions be made on site-end state, or national policy / decisions change (e.g. assumed date of national ILW repository, etc).

3.5 Contaminated Land & Site End States

121. The Sellafield contaminated land strategy remains unchanged from the high-level strategy stated in the 2008 IWS report.

122. Work that is currently underway as part of the Contaminated Land Strategy includes:

- Site Characterisation, 2007 -2010.
- Development and implementation of a strategy to manage historical waste burial trenches in the Separation Area, 2010 – 2018.

123. Key elements of the contaminated land strategy are to use the new characterisation data to develop risk based remedial approaches in conjunction with stakeholder and regulatory interaction and to optimise sustainability by effective sorting and segregation of contaminated soil and management of contaminated groundwater in order to maintain control and minimise waste.

124. The volumes of contaminated land (as currently assessed) remain the same as provided for the 2007 UK Radioactive Waste Inventory.

3.6 Non-Radioactive Discharges

125. An Environmental Permit for Pollution, Prevention and Control (PPC) was issued by the EA to Sellafield Ltd in October 2007. This permit replaced the existing regime of Integrated Pollution Control (IPC) under which the site's non-radiological discharges were previously authorised, but extends to cover other impacts such as energy, resource usage and noise.

126. The main requirements of the Environmental Permit are:

- Compliance with discharge limits as set in the Permit (many of which are the same as under IPC) and ensuring all monitoring and reporting of these discharges to the EA is undertaken
- Energy and Water efficiency, including regular reviews to determine if there are opportunities to make improvements
- Raw material efficiency, including regular reviews to look for suitable alternatives and opportunities to make improvements
- Avoidance, recovery and disposal of non-radiological wastes (i.e. the WMH)
- Use of appropriate pollution prevention measures to prevent (or minimise) spillages reaching the environment (including the ground)
- Application of Best Available Techniques (BAT) – similar to BPM for radioactive materials

127. In addition to and complimenting the above activities, Table S1.3 in Schedule 1 of the PPC permit specifies specific improvements required by the EA as part of the permit process which include the following:

- Improvement IP4 looked at energy metering across the site to understand site consumption and highlight improvement areas. Recommendations were made to address any shortfalls and are currently in the implementation stage.
- Improvements IP7 and IP11 focused on carrying out raw materials reviews to help identify areas where potential minimisation or substitutions could occur. A number of recommendations have come out of these reviews and are in the process of being implemented.
- Improvement IP 14 reviewed the discharges of steam condensate across the site and made proposals for how these could be regulated. The EA were content with these proposals and further work is underway to effect these changes.

128. Other variations to the Environmental Permit and/or improvements during the year have included:

Combined Heat & Power (CHP) Plant Turbines

129. In the last two years the 3 CHP plant gas turbines, suffered a common mode failure of corrosion of all 3 exhaust stacks. For safety reasons the heights of the stacks were reduced. As a result, a

review was needed to assess the impact of operating at a lower stack height, and whether the CHP plant could continue to operate in its modified state.

130. It was concluded that reduced stack heights did not result in a breach of the permitted emission limits, however it represented a change to the agreed operating technique and a variation was submitted to the EA who agreed in February 2008 that discharges from CHP would be acceptable and would not exceed the limits set on the site for Nitrogen Oxides (NOx). Therefore the CHP plant continued to operate, and hence maintained a reliable source of steam to the site when operating with the reduced stack heights

Use of the "Sonoxide" Water Treatment System in Magnox

131. Magnox successfully trialled and subsequently permanently installed an improved water treatment system to control Legionella in one of their cooling tower systems. Previously the cooling tower had been dosed with one of two biocides to control biological growth within the system.

132. The new system that was installed removed the requirement for using biocides in the system as it utilised Ultrasonic energy to control biological growth. The trial period demonstrated that bacterial growth was being successfully control using the "Sonoxide" system with results consistently below the required limits.

Light Water Reactor (LWR) Open Storage Pond: Anti-algae trials

133. Following a large number of experimental trials, the EA approved the trial of a Bacterial Enzyme Mixture (BEM) as a means of controlling algal growth in the LWR Open Storage Pond; if assessed to be successful this may become permanent.

134. Continuing to integrate and optimise the Sellafield IWS to fully include non-radioactive wastes is an ongoing development target for the site.

4.0 Uncertainties, Risks & Opportunities

135. At both site level and at the component strategy level there are uncertainties, risks, and opportunities that impact on, or are relevant to, the IWS.

Uncertainties

136. The following uncertainties are noted for which Sellafield is dependant upon national policy/decisions and their resolution:

- Waste Repository design, timing and location
- Decision on the future of LLWR
- UK Policy on plutonium and uranium
- The potential for future use of Sellafield as a national asset for waste management

Risks

137. In last year's IWS report it was noted that the risks to the Sellafield IWS arise from three areas:

- Component Waste Strategies at Sellafield (e.g. HLW, LLW, ILW, PCM, Effluents, etc.)
- Site Wide internal risks, for example, High activity evaporative capacity limits reprocessing throughput and consequently delays the start of clean-up of the HLW Plants.
- Uncertainties due to decisions that are external or outside the control of Sellafield Ltd. (e.g. government funding, national waste repository timing & acceptance criteria, national radioactive waste policy, CFA of the LLWR, etc.)

138. There remain lower-level risks that are specific to the component waste strategies, which if realised could affect the tactics of the component strategies. Under such circumstances the 'flankguard' role of the IWS is to ensure that a change in tactics does not affect the intended strategic direction.

139. The Component Strategies are also the key to mitigating the risks described above. However, several of the component waste strategies have yet to be taken through to full implementation and communication within the site's LTP, therefore specific & measurable actions to mitigate the IWS risks are not readily identifiable. Further work has since been done on identifying risks that are within the scope of the IWS together with the mitigating actions and planned delivery dates. These are summarised in the diagram below.

Risk	Actions	By When
Potential uncertainties over predicted waste volumes, categories, waste forms and schedules of waste arising.	Monitor implementation of site strategy and challenge assumption underpinning the strategy.	30th June 2010
Potential changes to funding or pricing structure for waste.	Engage with the NDA to discuss the issue and agree a way forward within the overarching national strategy.	31st March 2010
Regulatory audits may place a disproportional emphasis on elements of the IWS.	Centralise Sellafield Ltd response to regulatory audits.	30th January 2010
	Proactively engage with regulators on risk based approaches.	
There may not be sufficient resources to support the development and implementation of the IWS.	Clarify priority of IWS against other strategies.	30th September 2009
	Develop and implement a communications plan to all relevant stakeholders.	31st December 2009
Sellafield Ltd waste strategy may not be alligned to National Waste Strategy.	Develop communications plan.	31st December 2009
	Implement communications plan	30th June 2010
Potential changes in decommissioning strategy or end states that will significantly affect IWS.	Monitor risk	31st March 2010
Potential instability of supply chain.	Review long term strategy with commercial	30th September 2009
	Monitor risk	31st March 2010
Stakeholders may not support the IWS and its implementation	Identify key stakeholders	30th September 2009
	Develop communication plan	31st December 2009
	Implement communication plan	30th June 2010
Criteria for waste categories may be redefined.	Monitor current environment and proactively engage with the NDA for any developments that may lead to a change in the criteria for categorisation of waste.	30th June 2010
Potential failure to implement opportunities identified through Windscale integration.	Complete commonalities assessment through IWS.	30th June 2009
Opportunity - Potential cost saving through economies of scale and Learning From Experience from Windscale integration.	Complete commonalities assessment through IWS.	30th June 2009
Opportunity - Potential cost benefits through reclassifying the criteria for categorising waste.	Investigate if there is any benefit in conducting a high level review of the potential impacts any change in the waste categorisation criteria would have.	30th September 2009

Figure 23: Risks & Mitigating Actions for the Sellafield IWS

Opportunities

140. There are several opportunities identified in the assessment of Windscale & Sellafield Commonalities that if realised have the potential to further integrate and optimise the IWS (see section 2.4 for more details). These include:

- Windscale to route its oil inventory to Sellafield in order to free up limited space;
- Windscale oils could be used as the trial media as part of aligned R&D work, thus eliminating a waste stream;
- Opportunity for a combined interim storage facility for LLW lead in order to avoid separate stores being set up;
- Opportunity for Windscale bulk metal wastes to be incorporated into Sellafield trials for processing ferrous, stainless steel and lead;
- Opportunities for Windscale to route ILW concrete & graphite to future Sellafield waste treatment facilities and Sellafield stores;
- Centralised & common capability for waste sorting, segregation and size reduction;
- Opportunities to develop common strategies for flask maintenance and disposal, ILW waste package design, ILW Lead, Decontamination of metals & concrete;
- Opportunity to apply Windscale polymer encapsulation research and development trials to Sellafield wastes where encapsulation in cement is problematic due to the presence of reactive species.

141. All of these opportunities are subject to further assessment of technical underpinning and potential secondary consequences in order to determine whether it is appropriate to incorporate these changes into the strategic baseline. As appropriate, these opportunities will then be pursued by the relevant OUs and component strategies through the LTP process and implementation is being assured via the Strategic Governance arrangements in place on the site.

142. The creation of the new “Waste & Effluent Disposition Directorate” to form a central function for all waste management programmes across the company will focus on the challenges surrounding waste management, processing, disposal and storage and has the potential to create new opportunities in integrated waste management strategy.

143. As discussed earlier, NMP have been undertaking an evaluation of the status of Sellafield Ltd and identifying areas of best practice and areas for improvement, together with plans to make the required improvements. This is likely to lead to significant opportunities for improvements in waste management.

5.0 Conclusions & Way Forward

144. The NDA state that an IWS is a strategy which describes;
    - How a site optimises its approach to waste management in an integrated way.
    - The waste streams and discharges expected from current and future operations.
    - Actions that are required to improve the sites approach to waste management.

145. In its current form the IWS for Sellafield describes:

146. **How the site approached waste management in an integrated way –**

147. The integration with Windscale is a significant aspect of developing waste management as a number of opportunities the two sites have integrated and the respective waste management strategies will reflect this – Commonalities between the two sites have been identified and assessed for opportunities in waste management.

148. **The waste streams and discharges expected from current and future operations –** these predictions are covered in section 3.

149. **Actions required to improve the sites approach to waste management**

150. This report describes the proposed way forward for to improve the sites approach to waste management and notes those opportunities for further improvement which are still being pursued.

151. Over the past four years the Sellafield IWS has developed from being a statement of the baseline strategy (Version 1, June 2006) to a mature and live strategy process fully embedded in the site LTP. Since the 2007 IWS report considerable progress has been made in translating this strategy into the LTPs for the site. In particular:
    - all wastes and routes have been identified
    - estimates quantities of waste have been reassessed for both raw and conditioned volumes
    - Opportunities have been identified for waste minimisation and the use of existing facilities. These have either been incorporated into the lifetime or identified for further assessment.
    - Strategies for implementation are being developed for LLW, ILW and PCM
    - Tools and techniques to facilitate quantification and assessment and to enable the visible management of wastes information have been developed e.g. Sankey Diagrams in the 2007 IWS report and the OES model.
    - The analysis has contributed to the NDA led national strategies in particular ILW and LLW strategies.
    - The incorporation of the Windscale site with Sellafield has led to further opportunities to improve waste management being identified.

152. The IWS in its present form fulfils all of the above requirements with the exception of optimisation, which will be an ongoing goal.

153. It is difficult to fully optimise the IWS whilst high-level uncertainties remain around funding, waste volumes, scheduling and waste characterisation. The next 'step-change' in IWS development will be achievable once these uncertainties are sufficiently resolved and optimisation around a set of 'fixed' parameters can be undertaken. In the meantime the Sellafield IWS will continue to integrate and optimise the site's component waste strategies within these constraints and will inform and support the development of national strategies which will help resolve these uncertainties.

Way Forward

154. Recent changes to the company structure and the potential for Strategic realignment of the business and its governance are providing an opportunity to develop an IWS that meets the business requirements as well as Regulator and Customer needs.

155. It should be noted that the ownership of the IWS within Sellafield Ltd will move from the Strategy & Programmes Directorate to the new Waste & Effluent Disposition Directorate shortly after the publication of this annual update report and will therefore take the Director-level ownership of the IWS, though strategic direction and support will still be provided by the Strategy & Programmes Directorate.

156. The proposed process for the IWS to take forward is therefore that the following documents should be produced:

- A high-level document, endorsed by the Executive, that is stand-alone and does not require frequent updates containing:
  - How national, NDA & corporate policy are taken into account in the IWS
  - A set of Principles that provide robust waste management direction for waste producers and managers to use.
- A document that provides the Scope of the component waste strategies (to enable their appropriate development)
- A Review of the Component Strategies and their Integration (and optimisation) – it is proposed that this part could form the majority of future 'annual updates' of the IWS

157. This proposed forward process is a recent development and as such is all subject to consultation and agreement with the relevant stakeholders and customer

158. The strategic milestones for the delivery and implementation of the component waste strategies can be used to aid strategy visualisation & coordination, and to enable progress monitoring to take place. Strategic Milestone Diagrams have been therefore been constructed to illustrate the process for management control. At present these are unapproved draft diagrams and are based on the current site LTP: they will be revised for LTP10 as appropriate and used by the IWSSG to monitor progress.

159. In the immediate future (2009-10), the Sellafield and Windscale should produce a fully combined IWS by June 2010.

160. This annual update of the IWS report has described the key strategic changes that affect waste management on the site since the last report and the opportunities arising from the integration with Windscale. The component strategies will continue to implement the principles of the IWS and hence the future development of the IWS will be as a 'flankguard' role to:

- ensure the general strategic direction is maintained, regardless of changes to tactics that may be needed in the future
- undertake assessment of potential strategic changes initiated by resolution of uncertainties or changes in assumptions
- Assess the individual component waste strategies for cross-site impacts of strategic change & identify further opportunities for improvements in waste management.

161. It is recognised that there is still some implementation work to be done and some opportunities to be pursued within the LTP. This work will be undertaken by the relevant OUs with the IWS team (within Strategy and Programme group) providing a 'flankguard' role going forward and using appropriate Strategic Governance arrangements to ensure delivery.

6.0 Glossary

Abbreviations	Full Text
AGR	Advanced Gas-Cooled Reactor
AWS	Aqueous Waste Strategy
Becquerel (Bq)	The SI unit of radioactivity. A becquerel is the smallest unit of radiation – it corresponds to the activity of a quantity of radioactive material in which one nucleus decays per second
BEM	Bacterial Enzyme Mixture
BEP	Box Encapsulation Plant
BEPPS	Box Encapsulation Plant Product Stores
BNFL	British Nuclear Fuels Limited
BPEO	Best Practicable Environmental Option The BPEO 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 the mediums of 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 as well as in the short term.
BPM	Best Practicable Means BPM is a term used in authorisations issued under the Radioactive Substances Act that 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.
C-14	Carbon-14
CEAR	Compilation of Environment Agency Requirements
CFA	Conditions For Acceptance
Characterisation	Characterisation of radioactive materials involves analysing the materials in terms of their physical and chemical form, radioactive content, origin, current state and storage conditions and other relevant information and properties. Characterisation is an essential step at the beginning of the decommissioning process and may need to be repeated at different stages during the decommissioning programme. Waste should be characterised as far as possible at the point of its arising to ensure that the boundaries between waste categories (and therefore the feasibility of segregation) are known with a high degree of confidence and to minimise the risk of waste being accepted at unsuitable facilities.
CHP	Combined Heat & Power
CILWS	Containerised Intermediate Level Waste Store
CLESA	Calder Landfill Extension Segregated Area The Calder Landfill Extension Segregated Area, is authorised by the Environment Agency to accept HVLA or high volume VLLW up to a maximum activity limit of 37Bq/g along with non-hazardous waste which meets the criteria for authorised RSA disposal i.e. a maximum limit of 37 Bq/g with an alpha activity <50% of the total activity (disposal is assumed to be as VLLW).
CNC	Computer Numerical Control

Abbreviations	Full Text
Conditioning	Treatment of a radioactive waste material to create a wasteform that has passive safety. Radioactivity present in waste is generally immobilised by converting the waste to a solid form that confers passive safety. This reduces the potential for migration or dispersion of the radioactivity by natural processes during storage, transport, handling and potential disposal. A passively safe wasteform is one in which the waste is chemically and physically stable, and is stored in a manner that minimises the need for safety mechanisms, maintenance, monitoring and human intervention, and that facilitates retrieval for final disposal
Contaminated Land	Contaminated land is defined as ground, soil, water and, potentially, underground structural materials such as building foundations which have been impacted by radioactive and/or chemical substances from past or present operations (including authorised discharges and disposals), and for which the level of the radioactive or chemical contamination is above natural background
DEFRA	Department for Environment, Food and Rural Affairs
DILWEP	Decommissioning Intermediate Level Waste Encapsulation Plant
E&EP	Effluent & Encapsulation Plants
EA	Environment Agency
EARP	Enhanced Actinide Removal Plant
EDS	Engineered Drum Store
EN	Enforcement Notice
End State	The 'end state' of a site is its physical condition at the point when the NDA declares that all decommissioning activities are complete. The 'end point' of a site is the time at which this 'end state' is reached.
EPS	Encapsulated Product Store
Exempt	Exempt Radioactive Waste is waste that may contain small quantities of man-made radioactive contamination or specified radio-elements above the limits in Schedule 1 of RSA93, but at levels below the relevant limits in Exemption Orders which have been issued under the RSA93. These Orders specify classes and descriptions of radioactive material which do not need to be registered or authorised for disposal as waste. The Radioactive Substances of Low Activity (SoLA) Exemption Order 1986 allows disposal without authorisation under RSA93 of material with radiological levels up to 0.4Bq/g (allowing for subtraction of normal background levels for non-specified radio-elements). An (RSA) exempt article or substance may be subject to control as radioactive under other legislation e.g. for transport.
GDF	Geological Disposal Facility A long-term management option which consists of the emplacement of radioactive waste in an engineered repository at between 200 metres and one kilometre underground where the geology (rock structure) provides a barrier against the escape of radioactivity. Although the intention is to deposit the waste in a suitable facility with no plan for retrieval it is possible that this option may be exercised at a later date in which case it is more appropriate to call the facility a storage. In 2006 the Government decided to implement geological disposal and tasked the NDA with the role of implementation.
GWS	Gaseous Waste Strategy
HA	Highly Active
HAL	Highly Active Liquor
HHISO	Half-Height ISO-freight container
HLW	High Level Waste Defined as for ILW but self-heating must be taken into account.
HLWP	High Level Waste Plant

Abbreviations	Full Text
HVVLLW	High Volume Very Low Level Waste Waste which although within the category of Low level Waste, bulk VLLW contains less than 400 kBq of beta/gamma activity for each 0.1 m3 of material, or single items contain less than 40 kBq of beta/gamma activity. Alpha activity is normally excluded from disposal authorisations for VLLW. In the case of bulk disposals 'High Volume' VLLW is waste with a maximum concentration of 4 MBq/te of total activity which can be disposed of to a specified landfill. For waste containing hydrogen-3 (tritium, H-3), the concentration limit for tritium is 40MBq/te.
IAE	Integrated Environmental Assessment
ILW	Intermediate Level Waste ILW is defined as waste with a radioactivity level that exceeds the upper boundaries for Low level Waste (4,000 Bq/g alpha and 12,000 Bq/g beta-gamma) but which does not require self heating to be taken into account in the design of storage or disposal facilities.
ILWSSG	Intermediate Level Waste Strategy Steering Group
IPC	Integrated Pollution Control
ISO	International Standards Organisation
ISS	Interim Safe Storage
IWS	Integrated Waste Strategy
IWS V2	Integrated Waste Strategy Version 2
IWSSG	Integrated Waste Strategy Steering Group
LLW	Low Level Waste LLW is defined as waste containing radioactive materials other than those acceptable for disposal with ordinary refuse, but at levels not exceeding 4,000 Bq/g alpha or 12,000 Bq/g beta-gamma activity.
LLWR	Low Level Waste Repository This is the national LLW repository near Drigg, currently owned by the Low Level Waste Repository Site Licence Company Ltd SLC, or LLWR (SLC) Ltd. which has operated since 1959.
LLWSG	Low Level Waste Strategy Group
LP&LS	Legacy Ponds & Legacy Silos
LSTP	Local Sludge Treatment Plant
LTP	Lifetime Plan
LTP10	Lifetime Plan 2010
LWR	Light Water Reactor
M&O	Management and Operator
MBGWS	Miscellaneous Beta Gamma Waste Store A Sellafield facility which provides the safe packaging of larger items of ILW such as contaminated equipment imported in purpose built flasks to storage in vaults (3.5 m^3 unshielded steel boxes), until a national repository is available. It is expected that further treatment of the waste will be required prior to transfer to the repository.
MEB	Multi Element Bottle
MEP	Magnox Encapsulation Plant
MOP	Magnox Operating Plan
ND&MPG	Nuclear Decommissioning & Major Projects Group
NDA	Nuclear Decommissioning Authority A public body set up by the Government in April 2005 with responsibility for the UK's public sector civil nuclear liabilities, and their subsequent management. In October 2006, the Government also gave the NDA the responsibility for developing and ensuring delivery and implementation of the programmes for interim storage and geological disposal of the UK's higher activity wastes. From March 2007, the NDA was also given responsibility for developing a UK wide strategy for managing the UK nuclear industry's LLW and for securing disposal capacity for LLW generated by non-nuclear industry users.
NII	Nuclear Installations Inspectorate
NMP	Nuclear Management Partners

Abbreviations	Full Text
NNL	National Nuclear Laboratory (incorporates Nexia Solutions)
NOx	Nitrogen Oxides
OES	Overall Effluent Strategy
OSPAR	Oslo-Paris European Union Convention
OU	Operating Unit
PAIS	Partner, Assess, Innovate, Sustain
PBO	Parent Body Organisation
PCM	Plutonium Contaminated Material
PFI	Private Finance Initiative
PFSTP	Pile Fuel Cladding Silo Treatment Plant
POCO	Post Operational Clean Out
PPC	Pollution, Prevention & Control
R&D	Research & Development
Reprocessing	The chemical extraction of reusable uranium and plutonium from spent nuclear fuel.
RSA 93	Radioactive Substances Act 1993
RWMD	Radioactive Waste Management Directorate
SAV	Separation Area Ventilation
SDP	Silos Direct Encapsulation Plant
Secondary Waste	This is waste produced as a by-product of processing the primary waste stream.
SED	Safety and Environmental Detriment
Sellafield Ltd	The new name for British Nuclear Group, Sellafield Ltd operates the Sellafield site on behalf of the NDA
SETP	Segregated Effluent Treatment Plant
SFL	Site Funding Limit
SIXEP	Site Ion Exchange Plant
SLC	Site License Company
SMP	Sellafield Mox Plant
Spent Fuel	Fuel that has been used to power nuclear reactors that is no longer capable of efficient fission due to the loss of fissile material.
SPP	Sludge Packaging Plant
SWP	SIXEP Waste Processing Plant
THORP	Thermal Oxide Reprocessing Plant
UK	United Kingdom
UKDS	UK Radioactive Discharge Strategy
VLLW	Very Low Level Waste
WEP	Waste Encapsulation Plant
WMH	Waste Management Hierarchy
WPEP	Waste Packing and Encapsulation Plant
WTC	Waste Treatment Complex
α	Alpha, in reference to alpha radiation
β	Beta, in reference to beta radiation
γ	Gamma, in reference to gamma radiation