LLW Repository Ltd

Progress with LLWR Long-term Safety Analyses

Presentation to WCSSG

Andy Baker
Post-closure Safety Case Expert
April 2008

LLW Repository Ltd

Objectives

- Context
- Where are we now - and some of the problems;
- Future management of the site - output of the BPEO;
- Issues for the future.

Context I

- Safety Case in 2002 - submitted to the Environment Agency;
- Environment Agency review and new Authorisation - 2006;
- Requirement 2 - risk management and limits on inventory - submission on 1st May 2008;
- Full Safety Case due in 2011.

Context II

- Current work - not a full safety case;
- Some developments and new conclusions;
- Other positions are interim and will be updated when the 2011 Safety Case is submitted;
- Key technical and other issues - identified later;
- Best current view - calculations and conclusions still being checked and reviewed.

Overview

Scope:

- Demonstrate that we are using best national and international practice as the basis of our work;
- Interim update on long-term performance;
- Risk management study - demonstrate that we are doing the best that we reasonably can to manage the liabilities;
- New limits on the disposal of certain categories of waste.

Old and New Disposals

- Trenches are existing disposals - more appropriate to consider them in the context of intervention criteria (10 -100 mSv per year);
- Trenches designed and filled before advent of modern criteria;
- Consider trenches against intervention criteria and vaults against the risk target;
- Also need to look at overall impact of the facility;
- Approach discussed with the Environment Agency.

Changes since 2002

- Site will be eroded by the sea within some thousands of years unless coastal defences are put in place;
- Less cautious models for radon and thoron inhalation and exposures on the beach - interim view is that site performs well against relevant quantitative criteria;
- Improved and calibrated groundwater flow model;
- Less uranium in the trenches;
- Leaching model for uranium;
- Less pessimistic Potentially Exposed Groups;
- Changed view of engineering.

Impacts – what are we trying to manage?

- In 2002, we completed a systematic review of what impacts will arise in the future - interim update.
- Calculations using the computer program Gold*Sim* for key pathways.
- Scoping calculations only for gas pathway.
- Site is safe now.
- After the end of management control, radioactivity could be released to the environment.

Impacts I

Human intrusion:

- Hundreds of years in the future, the location of the facility may be forgotten and people might live on the current site – buried waste may be disturbed as a result of construction activities and people may eat crops that have been grown on contaminated soils or radon gas may collect in houses constructed over the facility.
- Large consequences are unlikely as there will be a thick cap;
- Doses up to a milliSievert or so will arise were intrusion to occur - comparable to background.

Impacts II

Coastal Erosion

- As a result of coastal erosion, linked to future sea-level rise, waste may be exposed on the beach. This may happen after some thousands of years. Users of the beach may then be exposed to contaminated material.
- Radiation doses would arise from the Trenches or Vaults of around 5 μSv per year - less than 1% of normal background.

Impacts III

Exposure to Radioactive Gases

- Radioactive gases will be generated from the waste. They may collect in any buildings that might be located on the site or contaminate the soil and enter the food chain. Future inhabitants or agricultural users of the site may receive radiation doses.
- C-14 - cautious scoping calculation suggests risks less than the regulatory target.

Impacts IV

Release of Radioactive Groundwater

- When the engineered barriers degrade, water may enter the vaults and trenches and leach radioactive contaminants, which will be transported in slowly flowing groundwater. Eventually contaminated groundwater may reach the surface environment.
- Good engineering limits impacts and model is cautious;
- Annual risks for discharge to the sea are very low - water abstraction wells - higher radiological consequences, but very low likelihood;
- Discharge to drains and stream - low quantities of contaminated water.

Where are we on performance?

- On the basis of an interim update to performance, risks and doses are less than the annual risk target and intervention levels;
- Radiation doses that might arise - generally less than the range of background radiation in the UK;
- Optimisation/risk management – still a key part of process.

Uncertainties

- Regulatory criteria;
- Near-surface groundwater pathways;
- Uncertainty in the inventory;
- Gas;
- More detailed review needed of certain models e.g. for radon.

Prioritisation and use of data sources

	Trenches 1 to 7	Vault 8	Future Vaults
Operational Data			
Historic Disposal Records			
LLWR Waste Tracking Database			
Public Records Office Data			
2004 UK National Inventory			
Historic UK National Inventories			

High

ORDER OF PRIORITY

Low

Key: Data used directly; Data used to backfit; Data used to predict; Data not used

Process: BPEO Methodology

- Assessed the options for management of the site using a BPEO methodology;
- Consider the impacts and which options might be used to address them;
- Preliminary screening;
- Assess each remaining option against a set of attributes;
- Consider the scale at which the option might be applied;;
- Combine options into a strategy – consider sequencing and timing;
- Two stakeholder meetings;
- Link with NDA End State work;
- Today's briefing.

Which options address which impacts?

	Human Intrusion	Sea Level Rise/Coastal erosion	Ground Water	Gas Generation
Repository cap ##	L, C		C	C
Institutional control ##	L	L,C	L	L,C
Bulk or local retrieval	L,C	L,C	L,C	L,C
In-situ remediation	C	C		C
Coastal defences		L		
Engineered barriers ##			C	
Vertical Drains ##			C	

Key
= already in baseline plan
L=reduces likelihood of potential hazard being realised
C=reduces consequences should potential hazard be realised

Attributes

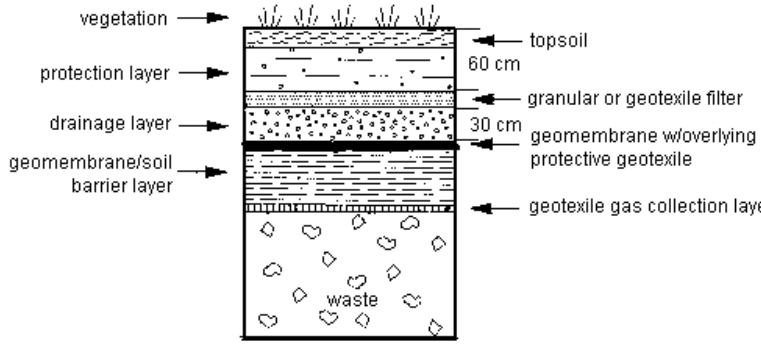
- Human Health and Safety;
- Environment;
- Technical;
- Socio-economic;
- Financial cost;
- Regulator/legal requirements.

Our Proposed Strategy I

- Plan to maintain *institutional control* over the site for a long time;
- Necessary to provide funding and organisational arrangements;
- Necessary to retain knowledge;

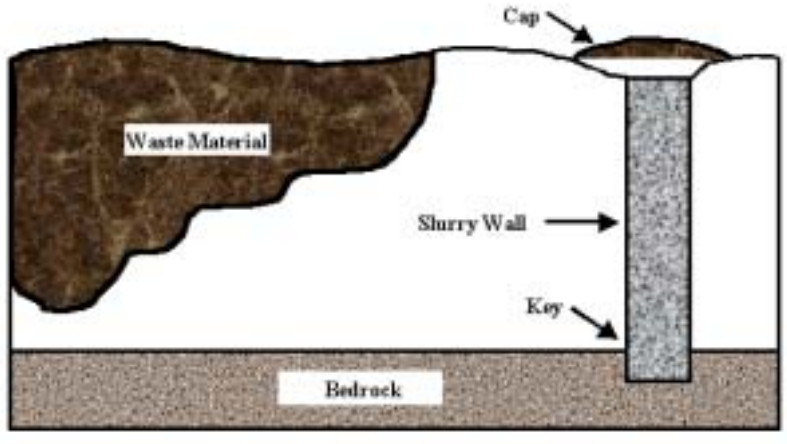
Our Proposed Strategy II

- Plan to build a final *repository cap* (an engineered cover for the waste vaults and trenches);
- Prevent human intrusion;
- Prevent water ingress;
- Prevent the release of some radioactive gases;
- But will degrade with time and won't be effective against coastal erosion;
- Temporary cap – also a part of strategy.



Our Proposed Strategy III

- Build *engineered barriers* - vertical cut off walls around the site;
- Hinder the flow of groundwater from the facility to the local environment.
- Repository cap and cut off walls – minimise releases in groundwater during the lifetime of the engineered measures.
- Not effective against coastal erosion.



Our Proposed Strategy IV

- Installation of *'Vertical Drains'* (engineered pathways along which groundwater would flow to depth);
- Designed to ensure that contaminated water is only released to the environment after delay and dilution;
- Ensure contaminated water is discharged to depth;
- Strength in depth.

Rejected Options

- Retrieve the waste;
- Coastal defences;
- Vitrification;
- Compaction;
- Grouting;
- Base Liner or Linear Jet Grouting

Bulk or Local Retrieval

- Retrieve some or all of the waste;
- sort and characterise;
- treat and store;
- dispose the waste to a repository somewhere.

Bulk or Local Retrieval: Characteristics

- Total retrieval would remove any long-term impact from the LLWR;

- Substantive plant required so lots of traffic and very high cost;
- Plant will have to be designed to mitigate worker radiological exposures;
- If partial retrieval – may be difficult to find hotspots;
- Very large quantities of waste will have to be retrieved to make a difference;
- Regulatory approvals required;
- Secondary wastes;
- If wastes are redisposed to the LLWR - little benefit in long term performance (quantity of radionuclides is the same).

- Local retrievals?

Coastal Defences

- If defences could be built and maintained, coastal erosion would be prevented;

- Needs big engineering with a large cost;
- Defences are needed hundreds of years in the future - current organisations unlikely still to be around - can't rely on future generations to take action.
- Large construction project - large sea-level rise over period of interest;
- Question of overall strategy for coastal management - what is wanted in a wider sense ;
- Bottom line - not sure that the strategy is desirable, no guarantee can be given that it could be delivered, unacceptable to the regulators.

Summary of Options Study

- Retrieval of all the wastes would be grossly disproportionate;
- Cannot claim that sea defences will solve the problem;
- On the basis of calculated radiation doses - intervention not normally justifiable;
- Possibility of localised interventions;
- Current Base-line plan looks good:
  - Institutional control;
  - Repository cap;
  - Hydrological barriers - cut-off walls etc.

Strategic Issues

- Future use of the facility not just a matter of calculating radiological capacity;
- Need to consider what sort of wastes are appropriate for near-surface disposal facilities e.g. long-lived LLW;
- Range of options for use of remaining of disposal capacity need consideration in the context of national LLW strategy.

Overall Summary

- Current update suggests that doses and risks are below the applicable quantitative limits.
- Separate consideration of the Trenches and the Vaults on the grounds that the Trenches were designed and approved not against current standards.
- Conclude that the engineering in the base line plan is the optimum forward strategy for the site as things stand now.
- Proposed interim modification to the Conditions for Acceptance to better manage future disposals.
- Broad questions remain and await a national LLW strategy.

LLW Repository Ltd