Developments in Disposal at the LLWR


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Presentation

- Background
- Upgrades to LLWR in 1980s/90s
- Development of regulation
- Improvements to the environmental safety case
- Design optimisation
Background
Low Level Waste Repository
Disposal of Low Level Waste

• LLW
  – < 4 GBq/t alpha and 12 GBq/t beta/gamma (110/320 nCi/g)

• VLLW
  – < 4 MBq/t total activity (H3 < 40 MBq/t)

• Contains long-lived radionuclides at disposal
Intermediate Level Waste

• Current plan is to dispose of ILW in a deep geological repository

• Latest Government white paper published in July 2014
Developments in 1980s/90s
Start of Disposals

• Disposal started in 1959 – waste tumble-tipped into trenches constructed in clay
Need for Facility Upgrade

• By the 1980s need for upgrade recognised
• But not designs based on a safety case
Upgrades

- Cut-off wall built round trenches
- Interim cap put on trenches
- Concrete vault (Vault 8) constructed
Upgrades

- Steel waste containers introduced
- Container grouting facility built
Tritium Levels in the Railway Drain

- Installation of Cut-off Wall around Trenches 1-6
- Extension of Cut-off Wall along Trench 7

Graph showing Tritium Levels (Bq/l) over time from 01/01/1985 to 01/01/2010.
Regulation
Regulation of LLW Management

• Office for Nuclear Regulation:
  – Licenses nuclear sites
  – Requires ‘nuclear safety cases’ address:
    • Worker safety
    • Off-site consequences of accidents
  – Transport
  – Security

• Environment agencies:
  – Permits radioactive waste disposal
  – Requires ‘environmental safety cases (ESCs)’
    • Off-site impacts assessed during disposal, continuing active institutional control and after in the long term
Guidance on Solid LLW Disposal

- Environment agencies provide guidance on requirements for demonstrating safe disposal: ‘GRA’
- First issued in mid-1990s
- Sets out how an ESC should be developed and what it should address
- Requires a ‘modern’ safety case – not just a radiological impact assessment
- High-level and non-prescriptive – allowing a flexible approach to demonstrating and regulating disposal depending on level of hazard, site etc.
GRA Principles

1. Level of protection against radiological hazards at the time of disposal and in the future
2. Radiological optimisation (ALARA)
3. Level of protection against non-radiological hazards at the time of disposal and in the future
4. Reliance on future human action
5. Openness and inclusivity
GRA Requirements

1. Process by agreement
2. Dialogue with local communities and others
3. Environmental safety case
4. Environmental safety culture and management system
5. Dose constraints during the period of authorisation
6. Risk guidance level after period of authorisation
7. Human intrusion after period of authorisation
8. Optimisation
9. Environmental radioactivity
10. Protection against non-radiological hazards
11. Site investigation
12. Use of site and facility design, construction, operation and closure
13. Waste acceptance criteria
14. Monitoring
Improvements to the Environmental Safety Case
Safety Case History

- Radiological impact assessment in 1988
- An environmental safety case submitted in 2002 but not accepted by the Environment Agency:
  - Calculated doses and risks exceeded regulatory criteria
  - Failed to address coastal erosion
  - Radiological optimisation of facility not addressed
- LLWR’s current permit only allows temporary storage of new waste (not disposal)
New Environmental Safety Case

- Delivered to Environment Agency on the 1st May 2011
- Addresses problems with 2002 environmental safety case
Coastal Erosion

- Example of how ESC has been improved
- And regulatory guidance has been revised
Research Programme

• Extensive research programme:
  – geological evidence
  – historical evidence
  – studies of current coastal behaviour
  – evidence of past sea levels and predictions of future sea-level rise
  – mathematical modelling

• Concluded disposal site would start to be eroded on a timescale of 100s to 1000s of years
New Coastal Erosion Assessment
Results

- Risks shown to be consistent with the regulatory requirement: $10^{-6}$ risk guidance level
- Revision of regulatory guidance relating to acceptable levels of heterogeneity in wastes
- New Waste Acceptance Criteria on ‘Active Particles’ and ‘Discrete Items’
Design Optimisation
Previous Design
Optimised Design

Diagram showing a cross-section of a site with labels for various structural elements such as cut-off walls, partition walls, and ISO containers.
Optimised Design

Site boundary

Realigned Drigg Stream

Proposed cut-off wall
(to 2m below base/BES)

1. Surface soil
2. Moisture retention
3. Filter layer
4. Bioinvasion barrier
5. Drainage layer
6. Geomembrane
7. BES
8. Geotextile
9. Gas collector
10. Geotextile
11. Profiling fill
12. ISO containers
13. Concrete
14. Shear separator
15. Geoprotector
16. Geomembrane
17. BES
18. Geotextile
19. Granular material
20. Geotextile
New Design

- Underpinned – results from improved hydrogeological models a key input into selection and justification of new design
- Better performance
- Cheaper
Current Situation
Current Situation

• Environment Agency ‘minded to accept’ 2011 ESC (subject to public consultation)
• Revised permit allowing resumption of disposal (rather than just storage) expected Autumn 2015
• Also awaiting permission to construct from local government
• Construction of final cap over Vault 8 and adjacent area of trenches will then begin