



Review of LLW Repository Ltd's 2011 environmental safety case: Forward issues

Issue 1, 15 May 2015

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Environment Agency
Horizon house, Deanery Road,
Bristol BS1 5AH
Email: enquiries@environment-agency.gov.uk
www.gov.uk/environment-agency

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1. Introduction

This report collates all of the Forward Issues (FI) we raised during our review of the 2011 Environmental Safety Case (ESC) submitted to us by LLW Repository Ltd as required by their Environmental Permit (LLW Repository Ltd 2011a to LLW Repository Ltd 2011p).

Our review of the 2011 ESC is documented in a series of technical review reports of which this is one (Environment Agency 2015a to Environment Agency 2015i). Each of our technical review reports provides further information on our approach to the review and our assessment of the adequacy of the 2011 ESC against our requirements which are detailed in our Guidance on Requirements for Authorisation: Near-Surface Disposal Facilities on Land for Solid Radioactive Wastes (the GRA) (Environment Agencies 2009). A high level summary of our review can be found in our Non-technical Summary report (Environment Agency 2015a) and a fuller overview in our Overview report (Environment Agency 2015b). Environment Agency (2015b) provides a fuller explanation of our review process. This report should be read in conjunction with the originating technical review reports (Environment Agency 2015c to 2015g) and the Overview report (Environment Agency 2015b).

We recognise that the 2011 ESC is a complex submission involving a wide range of technical assessments that will evolve and improve in the future as technology and understanding advances. Certain details will also be developed further as the site advances, for example towards construction of the final engineered cap over the waste. Within our review we therefore identify important areas which we believe will benefit from further work, development or clarification in the future. These areas are identified as FIs. These represent areas of work that we believe it is important for LLW Repository Ltd to progress as part of its forward improvement plan. FIs address areas where we expect continued improvement in the ESC and its implementation. We will require LLW Repository Ltd to engage with us on these FIs, to put in place formal mechanisms to track and address them and, as necessary, incorporate work to address them in its forward programmes of work and report to us on progress and when it believes the FIs have been fully addressed. We will expect the outcome of FIs to be considered within any subsequent updates to the ESC.

Although most of the FIs do not have timescales specified for their completion, some are linked to specific activities, such as construction of the final engineered cap and therefore must be addressed before that activity takes place.

We have categorised the FIs according to our view on their importance to the continued development of the ESC, the likely level of effort required to address the issue and also whether the issue should be addressed well in advance of any future ESC update, or can be addressed to longer timescales. The categories used (A1, A2, B1, B2 and C) are explained further in Table 1. A summary of each FI is presented in Appendix 1 with the full FIs presented in Appendix 2.

The FIs presented in Appendix 2 represent the status of the FI at the end of our review of the 2011 ESC. They include blank sections towards the end of the form for LLW Repository Ltd's future response to the FI (or summary of it) and our comments on the response following our review of it.

Table 1: Forward Issues categories

Category	Summary	Explanation
A1	More important, shorter term	<p>An issue that is expected to be important in supporting the provision of an acceptable update of the ESC in the future and where we consider there is a need to address the issue well in advance of the next major ESC update.</p> <p>LLW Repository Ltd is likely to need to provide substantial further information, or to significantly change approach. We expect plans to be put in place to address these issues and ongoing reports on progress. This reporting might, for example, include detailed plans of action, descriptions of proposed approaches, models or data, or results from interim or provisional analyses.</p>
A2	More important, long-term	<p>An issue that is expected to be important in supporting the provision of an acceptable update of the ESC in the future, but where this improvement can be provided over relatively long timescales.</p> <p>LLW Repository Ltd is likely to need to provide substantial further information, or to significantly change approach. We expect ongoing but infrequent reports on progress with these issues. This reporting might, for example, include detailed plans of action, descriptions of proposed approaches, models or data, or results from interim or provisional analyses.</p>
B1	Important, shorter term	<p>Issues of less importance than category A. LLW Repository Ltd will need to provide some further information, evidence or analysis well in advance of the next major ESC update. Plans should be put in place to provide this information. Generally we estimate the level of effort needed to address this category of issue will be substantially less than for category A. We expect reports on progress with these issues, but with less emphasis than for Category A.</p>
B2	Important, long-term	<p>Issues of less importance than category A. LLW Repository Ltd will need to provide some further information, evidence or analysis, but over relatively long timescales or as part of the next ESC update. Generally we estimate the level of effort needed to address this category of issue will be substantially less than for category A. We expect only infrequent reports on progress with these issues and with less emphasis than for Category A.</p>
C	Additional evidence / improvements in approach	<p>Of lesser importance but of value in improving the ESC. Issues where we require limited reporting or information in advance of any updated ESC.</p>

2. References

Environment Agency, Northern Ireland Environment Agency and Scottish Environment Protection Agency, 2009. Near-Surface Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation, February 2009.

Environment Agency, 2015a. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Non-technical Summary. Issue 1.

Environment Agency, 2015b. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Overview. Issue 1.

Environment Agency, 2015c. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Safety Case Management. Issue 1.

Environment Agency, 2015d. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Inventory and Near Field. Issue 1.

Environment Agency, 2015e. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Site Understanding and Evolution. Issue 1.

Environment Agency, 2015f. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Optimisation and Engineering. Issue 1.

Environment Agency, 2015g. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Assessments. Issue 1.

Environment Agency, 2015h. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Issue Resolution Forms. Issue 1.

Environment Agency, 2015i. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Issue Assessment Forms. Issue 1.

LLW Repository Ltd, 2011a. The 2011 Environmental Safety Case. Addressing the GRA. Repository Ltd Report LLWR/ESC/R(11)10031.

LLW Repository Ltd, 2011b. The 2011 Environmental Safety Case. Main Report. LLW Repository Ltd Report LLWR/ESC/R(11)10016.

LLW Repository Ltd, 2011c. The 2011 Environmental Safety Case. Management and Dialogue. LLW Repository Ltd Report LLWR/ESC/R(11)10017.

LLW Repository Ltd, 2011d. The 2011 Environmental Safety Case. Inventory. LLW Repository Ltd Report LLWR/ESC/R(11)10019.

LLW Repository Ltd, 2011e. The 2011 Environmental Safety Case. Near Field. LLW Repository Ltd Report LLWR/ESC/R(11)10021.

LLW Repository Ltd, 2011f. The 2011 Environmental Safety Case. Optimisation and Development Plan. LLW Repository Ltd Report LLWR/ESC/R(11)10025.

LLW Repository Ltd, 2011g. The 2011 Environmental Safety Case. Engineering Design. LLW Repository Ltd Report LLWR/ESC/R(11)10020.

LLW Repository Ltd, 2011h. The 2011 Environmental Safety Case. Hydrogeology. LLW Repository Ltd Report LLWR/ESC/R(11)10022.

LLW Repository Ltd, 2011i. The 2011 Environmental Safety Case. Site Evolution. LLW Repository Ltd Report LLWR/ESC/R(11)10023.

LLW Repository Ltd, 2011j. The 2011 Environmental Safety Case. Monitoring. LLW Repository Ltd Report LLWR/ESC/R(11)10024.

LLW Repository Ltd, 2011k. The 2011 Environmental Safety Case. Environmental Safety during the Period of Authorisation. LLW Repository Ltd Report LLWR/ESC/R(11)10027.

LLW Repository Ltd, 2011l. The 2011 Environmental Safety Case. Assessment of Long-term Radiological Impacts. LLW Repository Ltd Report LLWR/ESC/R(11)10028.

LLW Repository Ltd, 2011m. The 2011 Environmental Safety Case. Assessment of Non-radiological Impacts. LLW Repository Ltd Report LLWR/ESC/R(11)10029.

LLW Repository Ltd, 2011n. The 2011 Environmental Safety Case. Assessment of Impacts on Non-human Biota. LLW Repository Ltd Report LLWR/ESC/R(11)10030.

LLW Repository Ltd, 2011o. ESC Forward Programme. LLW Repository Ltd Report LLWR/ESC/R(11)10040.

LLW Repository Ltd, 2011p. The 2011 Environmental Safety Case. Waste Acceptance Criteria. LLW Repository Ltd Report LLWR/ESC/R(11)10026.

Appendix 1: Forward Issues summaries

Forward Issue number	Title	Category	Summary of issue	Source report
ESC-FI-001	Cap settlement issues	A1	LLW Repository Ltd should develop and implement a work programme to identify an optimised cap design and container stack heights.	Optimisation and Engineering
ESC-FI-002	Tritium monitoring and establishment of trigger and action levels	B2	LLW Repository Ltd should continue to monitor tritium throughout the period of authorisation in line with our requirements outlined in this FI.	Site Understanding and Evolution
ESC-FI-003	Revised borehole fire assessment	C	LLW Repository Ltd should present a 'what if' type assessment of a deep seated fire occurring during the construction or operation of a borehole drilled into trench waste.	Assessments
ESC-FI-004	Forward programme	A1	LLW Repository Ltd should further develop and update its forward programme of work to make sure there is continued improvement of the ESC.	Safety Case Management
ESC-FI-005	Use of monitoring to reduce uncertainties in the ESC	B1	LLW Repository Ltd to collate and integrate monitoring objectives, strategies and procedures in a single document, so as to provide evidence of how the forward monitoring programme will be implemented and developed throughout the period of authorisation and linked to the ESC to reduce uncertainties.	Site Understanding and Evolution
ESC-FI-006	Non radioactive groundwater assessment reporting	A1	LLW Repository Ltd should update the hydrogeological risk assessment for the LLWR for issue by December 2017.	Assessments

Forward Issue number	Title	Category	Summary of issue	Source report
ESC-FI-007	Inaccessible voidage minimisation procedures and emplacement strategies	B1	LLW Repository Ltd should have appropriate procedures in place to make sure that potential container settlement remains within acceptable limits and that placement is optimised.	Inventory and Near Field
ESC-FI-008	Management of uncertainty	A2	LLW Repository Ltd should further develop the FEPs and uncertainty tracking system (or alternate tools) as a tool to manage uncertainty in the ESC and feed into the forward programme.	Safety Case Management
ESC-FI-009	EDTA analysis to support the complexant assessment	B1	LLW Repository Ltd should undertake further work to underpin the conclusions of their assessment of complexants such as EDTA. Further work is required to continue to improve LLW Repository Ltd's knowledge of complexants leaching from the trenches and the vaults and the risk this may have via the groundwater pathway.	Inventory and Near Field
ESC-FI-010	Waste heterogeneity in Vault 8 and future vaults	B2	LLW Repository Ltd should undertake further work to understand the distribution of key radionuclides and key materials in Vault 8 and future vaults. This work will allow LLW Repository Ltd to demonstrate via the ESC their understanding of the distribution of these species and materials in the vaults.	Inventory and Near Field
ESC-FI-011	Forward review of the extended disposal area	A2	LLW Repository Ltd should fully integrate the EDA assessment into the ESC at the next periodic review of the ESC.	Assessments
ESC-FI-012	Use of probabilistic calculations in derivation of	A2	LLW Repository Ltd should consider update of the probabilistic groundwater pathway	Assessments

Forward Issue number	Title	Category	Summary of issue	Source report
	radiological capacity		assessment model and as appropriate recalculate radiological capacity calculations based on the expectation value of the model output.	
ESC-FI-013	Assessment of discrete items in stored and disposed waste	A1	LLW Repository Ltd should review the disposed records for stored waste located in Vault 8. LLW Repository should provide a BAT case for disposal of these items within Vault 8.	Assessments
ESC-FI-014	Impact of changing waste composition	B2	LLW Repository Ltd should assess the implication of future waste treatment processes on the settlement of the engineered cap and on the performance of the near field.	Inventory and Near Field
ESC-FI-015	Monitoring of colloids	B2	LLW Repository Ltd should implement a proportionate colloidal material monitoring programme, to ensure that the conclusions reached in the 2011 ESC will remain valid.	Inventory and Near Field
ESC-FI-016	Discretisation of the GRM model	B2	LLW Repository Ltd should assess the sensitivity of the outputs from the GRM to the discretisation of the model grid.	Inventory and Near Field
ESC-FI-017	Radiological capacity calculations	B1	LLW Repository Ltd should explore the relationship between disposed inventory and dose or risk to determine the suitability of the linear relationship assumption. Particular emphasis should be placed on C-14. If required, outputs should be fed into the WAC.	Assessments
ESC-FI-018	Near field vault and trench experimental programme	B1	LLW Repository Ltd should propose and implement a near field experimental and monitoring programme	Inventory and Near Field

Forward Issue number	Title	Category	Summary of issue	Source report
			capable of providing sufficient understanding of the vault and trench near field environments to support the ESC throughout the period of authorisation.	
ESC-FI-019	Monitoring of coastal erosion	B2	LLWR Repository Ltd should develop and implement a coastal evolution monitoring programme. The company should use the output to check assumptions made within the 2011 ESC and to inform continued development of the ESC.	Site Understanding and Evolution
ESC-FI-020	Development of a new Low Level Waste Tracking System (LLWTS)	A1	LLW Repository Ltd should develop a new waste tracking system that is fit for purpose for future waste tracking.	Inventory and Near Field
ESC-FI-021	Learning from development of the ESC	B1	LLW Repository Ltd should undertake a review of learning from the development of the 2002 and 2011 ESCs, so as to inform future major reviews of the ESC.	Safety Case Management
ESC-FI-022	Active management of ESC records	C	LLW Repository Ltd should make sure all ESC related records are actively managed.	Safety Case Management
ESC-FI-023	Leachate management strategy	A1	LLW Repository Ltd should produce a leachate management strategy that demonstrates the application of BAT to the management of leachate during the period of authorisation. The company should also investigate long-term leachate drainage performance, degradation and failure mechanisms.	Optimisation and Engineering
ESC-FI-024	Gas management strategy	A2	LLW Repository Ltd should establish and implement a programme of work to develop a gas	Optimisation and Engineering

Forward Issue number	Title	Category	Summary of issue	Source report
			management strategy and infrastructure, including collection of necessary monitoring data, for the period of authorisation.	
ESC-FI-025	Protection of waste prior to final capping	A1	LLW Repository Ltd should develop and implement a programme of work to develop an optimised container design and restoration sequence that provides adequate protection to waste containers and minimises discharges to the environment.	Optimisation and Engineering
ESC-FI-026	Engineering delivery	A1	LLW Repository Ltd should develop and implement the engineering forward programme to finalise the as-built design so as to allow further construction to begin. This programme should include: <ul style="list-style-type: none"> • an engineering R&D programme • an engineering performance monitoring programme • the scoping of a proportional Engineering Performance Assessment framework for use in future updates to the ESC. 	Optimisation and Engineering
ESC-FI-027	Cap performance assessment	A1	LLW Repository Ltd should undertake further assessment of the performance of the capping system, including consideration of potential failure scenarios. Where appropriate, the company should incorporate the outcome of the investigations into the repository engineering design and updates to the ESC.	Optimisation and Engineering
ESC-FI-028	Improved understanding	A2	LLW Repository Ltd should seek to improve its	Site Understanding

Forward Issue number	Title	Category	Summary of issue	Source report
	of the repository erosion process		conceptualisation and understanding of the repository erosion sequence.	and Evolution
ESC-FI-029	Management of elicited data	C	LLW Repository Ltd should develop documented procedures for the future management of elicited data.	Safety Case Management

Appendix 2: Forward Issue forms

Forward Issue Form
ESC-FI-001

FORWARD ISSUE

ESC-FI-001: Cap settlement issues

Title	Cap settlement issues
Date raised	02/12/2014
Review group / area	Optimisation and engineering
Related FIs	ESC-FI-025, ESC-FI-026 and ESC-FI-027
Related or source IRFs	ESC-RO-SUE-009
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Our review of the 2011 ESC (Environment Agency 2014, 2015), together with subsequent container condition investigations by LLW Repository Ltd (Jefferies 2013) identified the need for a comprehensive work programme to develop and implement an optimised cap design, taking full account of all available information on the potential for cap settlement and optimisation of waste stack height. Any resulting cap design or performance changes must be taken account of within the ESC. The work programme should develop and justify detailed capping proposals.

We note that considerable work has already been undertaken in this area and LLW Repository Ltd has already put in place planned programmes of further work. This FI therefore outlines our expectations, which we anticipate will overlap with work already ongoing or planned to a large extent.

The outcome of this work programme needs to be in place prior to the commencement of restoration and capping works. The programme should include, but need not be limited to the following areas:

- Collection of information to demonstrate the performance of the repository capping system, taking full account of potential for waste settlement, voidage and degradation (container and waste).
- Assessment of acceptable waste stacking heights within each vault (with a primary focus on Vault 8).
- Further development of strategies to manage voidage within both individual ISO freight containers and in waste stacks.
- Production of an updated and refined cap settlement assessment taking account of the outcome of container condition investigations and engineering performance assessment. This

Forward Issue Form
ESC-FI-001

FORWARD ISSUE

should include all container and vault waste types and all appropriate settlement, voidage and degradation scenarios.

- Confirmation of the final proposed detailed cap design and placement (for Vault 8 and, in lesser detail, for subsequent vaults).
- Identification of optimisation measures, taking account of the revised settlement assessment and final detailed cap design.
- Proposals for and production of material-specific performance investigations.
- Identification and assessment of the full range of possible cap performances, taking into account the range of possible settlement and the full range of wastes present in the repository.
- Update and review of relevant elicited values used in the ESC performance assessment, or development of new methodologies as appropriate.
- Identification of cap performance assessment and monitoring proposals associated with cap settlement.

Any work programme identified to address cap settlement issues is likely to have links to other areas of work (for example, container optimisation work). Any such links should be recognised and addressed.

We expect the outputs from the cap settlement investigations to be used to inform an engineering performance assessment and relevant performance and elicited values used in future ESCs.

References

Environment Agency, 2015. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Optimisation and Engineering.

Environment Agency, 2014. Vault 8 ISO container inspection report.

Jefferies, N., 2013. LLWR Vault 8 Containers Issues Project: Action Plan. LLW Repository Ltd Report RP/LLWRGR/PROJ/00141 ISSUE A.

Forward Issue Summary

ESC-FI-001.a	LLW Repository Ltd should provide a work programme to develop and implement an optimised cap design and waste stack heights, which takes full account of all available information on the potential for cap settlement. This programme should take account of the points raised within this FI and further discussion provided within our review of the 2011 ESC. The programme should identify stages for regulatory review and interactions with other work streams. The programme should be supported by indicative timescales.
ESC-FI-001.b	LLW Repository Ltd should implement the agreed work programme to address potential cap settlement issues.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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Forward Issue Form
ESC-FI-001

FORWARD ISSUE

<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-002

FORWARD ISSUE

ESC-FI-002: Tritium monitoring and establishment of trigger and action levels

Title	Tritium monitoring and establishment of trigger and action levels
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	ESC-RO-SUE-007
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	X
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

As a result of past authorised disposals to the trenches, a plume of tritium has developed which is currently migrating in groundwater in a broadly westerly direction. Significant work has been carried out by LLW Repository Ltd to understand the tritium source term and the nature and extent of the groundwater contamination.

The 2011 ESC incorporated an assessment of the nature and extent of the current and predicted tritium groundwater plume. LLW Repository Ltd used groundwater monitoring information from the site monitoring programme to support an assessment of the expected off site migration of tritium contaminated groundwater. Projected discharges of tritium peaked in the past and are shown to decrease with time. This is consistent with monitoring data. Current discharges of tritium do not represent an unacceptable groundwater discharge because of the observed low concentrations at compliance points and the lack of a current viable receptor, the observed declining source term and the impact of radioactive decay.

Because of the historical extent of tritium concentration and remaining uncertainty in the nature and extent of the trench inventory, we consider it important that LLW Repository Ltd continues to undertake a focused groundwater monitoring programme for tritium. In addition, the existing tritium groundwater plume provides a good indication of the location and extent of groundwater flow pathways, along which other radionuclides may subsequently migrate. This provides important underpinning information for the groundwater flow and contaminant transport model and the radiological safety assessment.

Forward Issue Form
ESC-FI-002

FORWARD ISSUE

As part of the development of the tritium monitoring strategy and forward programme, LLW Repository Ltd should consider how tritium data will be used to:

- build confidence in understanding the remaining trench tritium inventory, as far as reasonably practicable
- review the spatial extent and trends in the current tritium groundwater plumes
- help understand the impact of the placement of surcharging material and the final trench cap on tritium remaining within the trenches
- indicate the performance of the eastern and northern cut-off wall
- review and improve understanding of repository groundwater flow and contaminant transport models
- demonstrate tritium monitoring data are not inconsistent with repository groundwater flow and contaminant transport models
- support assumptions made in the 2011 ESC and in particular the associated habitats assessments relating to potential groundwater receptors within the protected habitats on the western edge of the site and within the Drigg dune system

Forward Issue Summary

ESC-FI-002.a	As part of the development of a forward plan and monitoring strategy, LLW Repository Ltd should outline how future tritium monitoring will meet the objectives outlined above.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-003

FORWARD ISSUE

ESC-FI-003: Revised borehole fire assessment

Title	Revised borehole fire assessment
Date raised	02/12/2014
Review group / area	Site understanding and evolution and Assessments
Related FIs	
Related or source IRFs	ESC-TQ-SUE-030
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	
C	X

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

As requested within its response to TQ ESC-TQ-SUE-030, LLW Repository Ltd assessed a scenario for a waste fire resulting from the construction of a borehole after the period of authorisation. The assessment assumed that a fire occurs in one of the boreholes. The fire is assumed to be short lived, not continuing beyond the two days over which the drilling occurs. It is assumed the receptors would be the borehole drillers and geologist who were responsible for the construction of the borehole. It is assumed that the fire can be extinguished without disturbance of the waste.

The original TQ was intended to ensure that the ESC was comprehensive in its considerations. We accept that the likelihood of a waste fire in the trenches is very low and would be even lower within the vaults. However, we are not fully convinced of the assumption that a borehole fire will always be short lived and extinguished after 1-2 days, with a dose only being received by the drillers and associated geologists. Experience of deep seated waste fires at landfills indicates that they can be difficult to extinguish and can burn for extended periods (Environment Agency 2007). Assuming the fire is significant then there would likely be a need for fire service involvement in order to extinguish the fire. We therefore request that either further justification be provided for the limited duration of the assumed fire, or the assessment of this 'what if' scenario be modified to take account of an extended duration, potential for a fire during borehole operation and the involvement of fire service personnel.

We are satisfied that an adequate ESC has been made regarding a trench fire, largely on the grounds of the very low probability of such fires occurring within the disposal system at the LLWR. However, we consider it valid to request a fuller assessment addressing these broader scenarios.

**Forward Issue Form
ESC-FI-003**

FORWARD ISSUE

Reference

Environment Agency, 2007. Science Report - Review and Investigation of Deep-Seated Landfill Fires.

Forward Issue Summary

ESC-FI-003.a	LLW Repository Ltd should further justify the limited duration and scope of the currently assessed 'what if' fire scenario, or present a modified assessment taking account of a longer duration fire, the risk of fire during operation of the borehole and the involvement of further at risk groups, such as the fire service.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-004

FORWARD ISSUE

ESC-FI-004: Forward programme

Title	Forward programme
Date raised	02/12/2014
Review group / area	Safety case management
Related FIs	
Related or source IRFs	ESC-RO-SCM-005
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Our GRA states: *'The environmental safety case should be used to help specify a forward programme of improvement work, both to the environmental safety case itself and more broadly'* (GRA paragraph 7.2.17).

LLW Repository Ltd presents an overview of a proposed future work programme in support of the 2011 ESC in the ESC Main Report (LLW Repository Ltd 2011). During our review of the 2011 ESC we requested a more detailed forward programme (ESC-RO-SCM-005). The company supplied this information in October 2011 (Cummings 2011). We concluded that this forward programme was adequate and contained an appropriate level of detail at that point in time.

However, we also concluded that the forward programme was still at a relatively high level and would benefit from further development in a number of areas, including consideration of our review of the 2011 ESC.

For each subject area of the ESC, we would expect LLW Repository Ltd to prepare a forward programme that identifies work areas corresponding to reduction of key uncertainties and safety requirements.

We therefore require LLW Repository Ltd to develop and update its forward programme further. Specifically the forward programme should systematically take account of:

- our completed review of the 2011 ESC, along with any associated FIs and recommendations made
- alignment of the forward plan with the engineering forward plan

**Forward Issue Form
ESC-FI-004**

FORWARD ISSUE

- any specific requirements stipulated in any varied environmental permit for the site and any development work required to support compliance with that permit
- any further input from LLW Repository Ltd’s ESC Peer Review Group
- any required development work that may have resulted from ‘new issues’ that arose during our review of the ESC following submission, such as issues associated with container voidage and particles / discrete items
- commitments made within the ESC¹
- any necessary research and development, which may include development and testing of novel techniques and technologies
- work undertaken on the long-term monitoring strategy and monitoring data
- necessary activities to inform and improve site understanding
- key uncertainties (for example, as tabulated in the FEP and uncertainty tracking system)
- further developments in understanding resulting from operations at the LLWR against the 2011 ESC
- outputs from annual or periodic reviews of the ESC

The forward plan should be presented in sufficient detail to allow an understanding of why work is being undertaken (for example, links to 2011 ESC), what work is being undertaken and over what timescales. Where possible, reporting timescales for each element of the programme should be presented.

We recognise that LLW Repository Ltd has already committed to update the forward programme further following completion of our technical review of the ESC and when any varied environmental permit is issued. We expect the forward programme to be updated at that point, but also to be updated and reviewed on an ongoing basis, to take account of new information and opportunities as they become available.

References

Cummings, R., 2011. ESC Forward Programme. LLW Repository Ltd Report LLWR/ESC/R(11)10040.

LLW Repository Ltd, 2011. Environmental Safety Case – Main Report. LLW Repository Ltd Report LLWR/ESC/R(11)10016.

Forward Issue Summary

ESC-FI-004.a	LLW Repository Ltd should update the forward programme of work, presenting it in sufficient detail to allow an understanding of why work is being undertaken (for example, links to 2011 ESC), what work is being undertaken and over what timescales. Where possible, reporting timescales for each element of the programme should be presented.
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¹ These include a commitment to review the implications of non-independent elicited parameters, for example where poor performance of one property leads to lower performance of another, and work on gaining improved understanding of the uncertainties associated with water flow and radionuclide release under partially-saturated conditions. Similarly, the FEP and uncertainty tracking system contains a number of entries detailing areas for further work under ‘uncertainty management’ but with no specific link to the forward programme.

Forward Issue Form
ESC-FI-004

FORWARD ISSUE

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-005

FORWARD ISSUE

ESC-FI-005: Use of monitoring to reduce uncertainties in the ESC

Title	Use of monitoring to reduce uncertainties in the ESC
Date raised	02/12/2014
Review group / area	Site understanding and evolution
Related FIs	ESC-FI-008
Related or source IRFs	ESC-RO-SUE-007 and ESC-RO-SUE-008
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	x
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Implementation of the monitoring strategy

Since the submission of the 2011 ESC, LLW Repository Ltd has undertaken further development of its long-term monitoring strategy. However, LLW Repository Ltd has not provided evidence of how the proposed monitoring programme and strategies will be linked to the ongoing management and development of the ESC.

In order to gain confidence in the scope and capability of the monitoring strategy, we expect LLW Repository Ltd to collate monitoring objectives, strategies and procedures in a single document. This document should provide evidence of how the forward monitoring programme will be implemented and developed throughout the period of authorisation and how it will be linked to the ESC in order to reduce uncertainties.

A more comprehensive update of the repository monitoring strategy should also take account of the strategy development carried out since the submission and our review of the 2011 ESC, as well as ensuring the continued alignment of the monitoring strategy with the needs of the ESC.

The use of monitoring to reduce uncertainty

A robust and comprehensive environmental sampling and monitoring programme will be required to support both the forward development of the ESC and to address the inherent uncertainties associated with a model-based ESC.

Under RO ESC-RO-SUE-007, we noted that the presented forward monitoring programme appeared focussed on environmental reassurance rather than the systematic reduction of the inherent environmental uncertainties. In particular, it did not specifically address how the key uncertainties identified in the 2011 ESC can be reduced in order to produce a more realistic

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ESC-FI-005

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assessment. We asked LLW Repository Ltd to provide evidence of how the forward monitoring programme will be developed throughout the period of authorisation and linked to the ESC in order to reduce key uncertainties within it. We wished to gain an improved understanding of how the ESC will be used to help drive the scope and content of the forward monitoring programme.

To maintain the audit trail LLW Repository Ltd should clearly map key uncertainties, which we define as an uncertainty that has, or could have, a significant effect on the ESC, to entries in the register of significant uncertainties (for example, as documented in the FEP and uncertainty tracking system or suitable alternative system) (also see ESC-FI-008). Mechanisms for the reduction of key uncertainties by monitoring should be identified and presented.

However, we acknowledge that assessment models are simplified and often cautious representations of real systems. As such, we accept that there may be limited opportunities to reduce uncertainties in assessment model parameters through monitoring, as opposed to conceptual model uncertainties or for general confidence building.

Forward Issue Summary

ESC-FI-005.a	LLW Repository Ltd should collate and integrate monitoring objectives, strategies and procedures in a single document so as to provide evidence of how the forward monitoring programme will be implemented and developed throughout the period of authorisation and linked to the ESC in order to reduce uncertainties.
ESC-FI-005.b	LLW Repository Ltd should identify mechanisms for determining how key uncertainties, as identified in the register of significant uncertainties, could be reduced by monitoring, where possible.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner’s assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Forward Issue Form
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FORWARD ISSUE

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-006

FORWARD ISSUE

ESC-FI-006: Non-radioactive groundwater assessment reporting

Title	Non-radioactive groundwater assessment reporting
Date raised	02/12/2014
Review group / area	Assessments
Related FIs	
Related or source IRFs	ESC-TQ-ASO-021
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The 2011 ESC contains a non-radiological groundwater impact assessment, which aims to demonstrate compliance with the GRA (Environment Agency et al. 2009) and associated supplementary guidance (Environment Agency 2013). Through our review of the 2011 ESC we have concluded that, whilst it demonstrates compliance with the relevant guidance, further work is necessary in some key areas to improve clarity and maintain consistency with relevant guidance in the future. This Forward Issue sets out the steps LLW Repository Ltd should take in order to do this.

It is important to note that the LLWR permit does not allow the disposal of Directive Wastes and therefore is not legally bound by requirements imposed upon landfills. Instead, the LLWR is bound by requirements laid out in the GRA and associated supplementary guidance, which, if met, will demonstrate compliance with the groundwater activity provisions of EPR 10. However, LLWR must also have regard to the specific requirement laid out in the supplementary guidance, which states that 'In applying for a permit, the applicant should have regard to the Environment Agency's guidance relating to hydrogeological risk assessments for landfills and the derivation of groundwater control levels and compliance limits'. We believe the operators could present an assessment that has fuller regard to this guidance.

The 2011 ESC non-radiological groundwater assessment has included the information we expect from a Hydrogeological Risk Assessment (HRA). We have made a number of recommendations for improvements to the assessment and its presentation, in our review of the 2011 ESC (Environment Agency 2015). However, we consider that further work is necessary to demonstrate that there has been sufficient regard to the Environment Agency's guidance on HRA for landfills (Environment Agency 2012). We therefore require LLWR Repository Ltd to update the LLWR HRA to demonstrate continued protection of groundwater. We wish to see this improved HRA in

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advance of expected timescales for the next major review of the ESC (in 2021) by the end of 2017. The development of an agreed format and approach will help the review process run smoothly and be as transparent as possible.

For the updated HRA, we require further development of the current HRA as laid out in the 2011 ESC and supplementary documents (for example, Champion and Shevelan 2012) towards an improved non-radioactive groundwater assessment, having a fuller regard to the guidance discussed in this FI. This will rely on site-specific data that will need to be gathered and assessed over the period leading up to submission of the next HRA.

In many instances, we consider the information required to report compliance with our guidance already exists in the 2011 ESC, along with information reported against Schedule 9, Requirement 8 of the current permit and the output of site environmental monitoring programmes. Existing information should be used where available and clearly signposted, or presented in such a way as to clearly demonstrate compliance with the GRA and associated supplementary guidance. We recognise that certain aspects of the assessment cannot achieve direct equivalence with the HRA guidance for landfills. It is recognised that there will be differences between the LLWR concept and a landfill disposal. Such differences should be identified and where possible justification should be provided. Additional conservatisms used in the repository assessment and the nature and significance of uncertainties should be explained. Towards submission of the updated HRA in December 2017, a staged development of conceptual understanding and relevant considerations is required that will ensure clear compliance with the GRA and associated supplementary guidance.

The final report should seek to:

- outline and describe the approach taken to the assessment of non-radiological groundwater assessment
- identify and demonstrate that necessary and reasonable measures to avoid the entry of hazardous substances into groundwater have been taken
- demonstrate the current compliance status of historical disposals
- assess the whole life impacts of the authorised activity on the groundwater directive compliance points
- provide a reporting format which can easily be updated

During the development of the reporting format and the subsequent reporting, we would encourage and expect the submission of draft reports, against which we will provide timely comment.

We set out our expectations for the development work that is needed to support the future reporting and assessment framework in the actions below. We expect the assessment and reporting process to be proportionate to the nature of the non-radiological hazards and broadly comparable to an equivalent non-radioactive hazardous waste landfill as far as is practicable.

References

Champion, J. and Shevelan, J., 2012. ESC Technical Memo: Non-radiological Monitoring - Response to the Environment Agency. LLW Repository Ltd Technical memo LLWR/ESC/MeM(12)182.

DEFRA, 2010. Environmental Permitting Guidance Groundwater Activities for the Environmental Permitting (England and Wales) Regulations 2010 (December 2010 Version 1.0).

Environment Agency, Northern Ireland Environment Agency and Scottish Environment Protection Agency, 2009. Near-surface Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation. Environment Agency, Bristol.

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Environment Agency, 2012. Horizontal Guidance Note H1 – Annex J3. Additional Guidance for Hydrogeological Risk Assessments for Landfills and the Derivation of Groundwater Control Levels and Compliance Limits.

Environment Agency, 2013. Near-surface Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation: Supplementary Guidance Related to the Implementation of the Groundwater Directive.

Environment Agency, 2015. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Assessments.

Forward Issue Summary

ESC-FI-006.a	LLW Repository Ltd should identify and justify potential compliance points for discharges of hazardous substances and non-hazardous pollutants to groundwater for use in the HRA described above. The locations should be justified using the non-radiological conceptual model. Appropriate compliance points for vaults or trenches or both should be identified. Compliance points for future vault disposals should only be used for modelling purposes.
ESC-FI-006.b	<p>LLW Repository Ltd should develop proposals for updating the HRA to effectively demonstrate continued groundwater protection. The proposals should have regard to the Environment Agency guidance on Hydrogeological Risk Assessment for Landfills. The written report shall include but not be limited to:</p> <ul style="list-style-type: none"> a) Objectives for the HRA review, including objectives for compliance with the Water Framework Directive and Groundwater Daughter Directive. b) Confirm the hydrogeological conceptual model, identifying where aspects of the model presented within the 2011 ESC remain appropriate. The conceptual model should take into account historical and future disposals. The conceptual model should seek to visualise the source, pathway and groundwater receptor (and other receptors of relevance to the Water Framework Directive), as well as the location of compliance points. c) Identification and presentation of applicable existing data (in tabulated format) in terms of location specific groundwater quality and levels. If existing boreholes are adopted as compliance points, then historical information from these points can be used for either baselines or reporting. d) Identification of applicable elements of the existing LLWR groundwater monitoring plan and any additional measures needed to deliver a groundwater monitoring plan and suitable baseline to support the HRA reporting process. The plan should identify applicable non-radiological sampling techniques, location of compliance boreholes, borehole constructions, baseline monitoring locations (in addition to compliance boreholes), non-radiological monitoring suites, monitoring frequencies, trigger levels, data reporting format and frequency and compliance reporting. e) Leachate monitoring plan for the trenches including: sampling

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	<p>techniques, sampling locations, construction details of sampling points, catchment area of sampling point (where possible individual trench leachate should be collected), non-radiological analysis suites, analysis frequencies, data reporting format and reporting frequency. For the vaults appropriate work should be undertaken to derive an appropriate source term and predicted composition of any future leachate. This work may include assessment, development work and/or monitoring.</p> <p>f) Leachate source term review for the trenches. This should seek to ensure the existing leachate characterisation is aligned with the reporting and assessment requirements. For the vaults, long-term investigations should continue to be based upon best available disposal and inventory data.</p> <p>g) A description of the modelling approach including scenarios for the current site status, development of the site and the period post-authorisation. Reference may be made to the non-radiological and radiological groundwater modelling within the 2011 ESC where relevant. Each scenario should be modelled (if possible) to assess: a) impact of trenches, b) impact of vaults, c) combined impacts.</p> <p>h) Approach for assessing repository performance and its impact on groundwater and surface water receptors.</p> <p>i) Appropriate failure scenarios corresponding with those typically used in landfill HRAs should be identified and assessed.</p> <p>j) Timeline for HRA review and reporting including proposed hold points for Environment Agency review of draft material.</p> <p>The Environment Agency will provide written feedback on the scope and appropriateness of the report at the identified hold points.</p>
ESC-FI-006.c	<p>Submission of a draft final HRA update report. The report should, where applicable, provide monitoring and assessment information for the whole reporting period. This should include details demonstrating that all necessary and reasonable measures have been taken to ensure compliance criteria are likely to be met, or if compliance criteria are not likely to be met, the report shall detail how compliance shall be achieved in accordance with the third bullet point in Para 4.18 of DEFRA (2010):</p> <p>‘There are (or are predicted to be) discernible concentrations of hazardous substances in the groundwater down gradient of the discharge zone attributable to the discharge but all of the following conditions apply:</p> <p>a) Concentrations will not result in any actual pollution or significant risk of pollution in the future; and</p> <p>b) There is no progressive increase in the concentration of hazardous substances outside the immediate discharge zone, i.e. there will be no statistically and environmentally significant and sustained upward trend of significant increasing frequency in pollutant “spikes”; and</p> <p>c) All necessary and reasonable measures to avoid the entry of</p>

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	hazardous substances into groundwater have been taken'. The Environment Agency will provide written feedback on the scope and appropriateness of the report.
ESC-FI-006.d	Submission of the final HRA update report prior to December 2017. The final report should include (but not be limited to) up-to-date monitoring data and detailed justification of necessary and reasonable measures.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-007

FORWARD ISSUE

ESC-FI-007: Inaccessible voidage minimisation procedures and emplacement strategy

Title	Inaccessible voidage minimisation procedures and emplacement strategy
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	ESC-RI-INF-005
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	X
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd defines Total Potential Voidage (TPV)² as part of its process for limiting cap settlement. Our review of the outputs of the container condition survey (Environment Agency 2015a, b) concluded that the assessment of TPV could reasonably be used to identify cap settlement potential and to inform implementation of appropriate control mechanisms for this potential settlement. Because of the importance of understanding TPV so as to minimise cap settlement potential we would like to review the relevant procedures and emplacement strategies LLW Repository Ltd puts in place for this purpose.

LLW Repository Ltd has proposed a maximum TPV per container and per stack to prevent unacceptable cap settlement in the future. This information will need to be used during routine operations involving waste emplacement in vaults and during the movement of Vault 8 and Vault 9 containers prior to capping. Procedures will need to be in place to implement emplacement strategies and to ensure potential container settlement remains within acceptable limits and that placement is optimised. Such procedures will need to be in place prior to final container movements in advance of commencement of final capping. The procedures will need to take

² TPV is that voidage that remains after grouting of waste consignments, or that is subsequently formed by waste degradation and settlement which in total might be expected to have a significant effect on the performance of the cap above the wastes. It is the sum of inaccessible voidage, compression voidage and biodegradation voidage.

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ESC-FI-007

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account of waste packaging and consignment information, the grouting of the waste and the placement of the container in the vaults.

References

Environment Agency, 2015a. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Inventory and Near Field.

Environment Agency, 2015b. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Optimisation and Engineering.

Forward Issue Summary

ESC-FI-007.a	Prior to final container movements in advance of final vault capping, LLW Repository Ltd should present waste emplacement strategies and procedures relevant to the assessment of TPV and cap settlement potential.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-008

FORWARD ISSUE

ESC-FI-008: Management of uncertainty

Title	Management of uncertainty
Date raised	02/12/2014
Review group / area	Safety case management
Related FIs	ESC-FI-005
Related or source IRFs	ESC-RO-ASO-004
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	X
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

GRA paragraph 7.3.10 states: 'The developer/operator will need to demonstrate that the environmental safety case, for both the period of authorisation and afterwards, takes adequate account of all uncertainties that have a significant effect on the environmental safety case. This will mean establishing and maintaining:

- a register of significant uncertainties
- a clear forward strategy for managing each significant uncertainty, based on considering, for example, whether the uncertainty can be avoided, mitigated or reduced and how reliably it can be quantified.'

LLW Repository Ltd issued a features, events and processes (FEPs) and uncertainty tracking system to us in January 2013, which represented the position as of May 2011 (LLW Repository Ltd 2013). Following our review, we concluded that this tracking system provides a good starting point for documentation of uncertainties and proposals for addressing them.

Proper management of significant uncertainties is integral to maintaining confidence in the ESC. If LLW Repository Ltd plans to continue the use of the FEP and the uncertainty tracking tool for the management of uncertainties, we require the company to explain the future use of it to provide us with assurance that the tool will continue to be used to manage uncertainty in the ESC and inform the forward programme. Alternatively, we acknowledge that LLW Repository Ltd may choose to develop an alternate approach to the current database. If this is the case, we will expect LLW Repository Ltd to discuss its proposals with us and to take account of the points we have raised in our review of the FEP and uncertainty tracking system.

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ESC-FI-008

FORWARD ISSUE

Outlined below are areas of work that LLW Repository Ltd should consider to make improvements to the FEP and uncertainty tracking system (or in relation to any alternate system developed), noting that this list is not exclusive:

- Clarify how the company defines a 'significant uncertainty' as defined in the GRA and how it intends to use the system in the future to maintain the register of significant uncertainties.
- Present proposals for the reduction of significant uncertainties. Where appropriate, linkages between uncertainty reduction and the forward programme should be made. Where uncertainties cannot be further reduced, this should be clearly stated.
- Improve the consistency in classification of FEPs and uncertainty across all subject areas.
- Review the FEP and uncertainty tracking system to take account of learning since the submission of the 2011 ESC. This should include addition of new FEPs on, for example, engineering performance, container condition, discrete items and the non-radioactive inventory.
- Provide a mechanism to improve the linkage between identified FEPs and the assessment of uncertainty associated with key ESC assumptions. For example, those relating to engineering performance, conceptual uncertainty in assessments, model uncertainty (inherent in the choice of one particular model over alternatives) and uncertainty relating to alternative lines of reasoning, which are not captured in the tracking system in its current form.

Reference

LLW Repository Ltd, 2013. 2011 Low Level Waste Repository Environmental Safety Case: Features, Events and Processes and Uncertainty Tracking System. Excel spreadsheet reference MASTER 2011 FEP. List_LLWR04127061103_0_2 - ajb7 macro Jan 2013.

Forward Issue Summary

ESC-FI-008.a	Taking into account the comments presented above and within our review of the 2011 ESC, LLW Repository Ltd should provide a forward work programme which identifies areas of further work needed to improve the FEP and uncertainty tracking system, or provide an alternative system as appropriate.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Forward Issue Form
ESC-FI-008

FORWARD ISSUE

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-009

FORWARD ISSUE

ESC-FI-009: EDTA analysis to support the complexant assessment

Title	EDTA analysis to support the complexant assessment
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	X
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The current permit and Waste Acceptance Criteria (WAC) for the LLWR do not allow for the disposal of complexing and chelating agents (referred to here as complexants). However, LLW Repository Ltd has submitted an application to the Environment Agency to amend its permit so that complexants can be disposed to the LLWR, although in limited quantities in some cases and never in bulk quantities. If permitted, LLW Repository Ltd would subsequently amend its WAC to allow complexants to be disposed of at the LLWR.

Amino polycarboxylic acids are a class of complexants that present a specific challenge to the LLWR. These materials are known to enhance the solubility and reduce the extent of adsorption for a number of key radionuclides and other non-radioactive species. The presence of such complexants could therefore increase risks via the groundwater pathway and this is discussed within the ESC.

In supporting this proposed change to the permit, LLW Repository Ltd has assessed the impacts of Ethylenediaminetetraacetic acid (EDTA), a typical amino polycarboxylic acid, on the risk associated with the groundwater/surface water pathways. The presence of EDTA has a direct effect on the quantities of certain radioactive and non-radioactive species that can be accepted at the LLWR. LLW Repository Ltd has established that the risk guidance level will not be exceeded for EDTA reference concentrations of 10^{-7} M in the trenches and 6×10^{-6} mol dm⁻³ in the vaults. The assessment also established that the radiological and non-radiological capacities for Reference Case A in the ESC could be accepted.

We note the input reference concentration for EDTA in the assessment model is based on information presently available. We consider that this information is limited, for example the reference EDTA concentration for the trenches has been based on only 5 leachate samples from

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ESC-FI-009

FORWARD ISSUE

the trenches. It is also not apparent from the presented case what time periods these samples cover. Thus we recommend that further samples of the trench leachate are analysed to verify the EDTA reference concentration.

For the vaults, the EDTA reference concentration has been derived through engagement with Sellafield’s technical experts. We recommend that LLW Repository Ltd should engage further with Sellafield Ltd to ensure that this reference value is robust. We also recommend that LLW Repository Ltd should engage with other consigners, in addition to Sellafield Ltd, to establish that the reference input concentration for the vaults will bound its consignments as predicted.

We note that, should the permit (and therefore WAC) allow the disposal of further complexants to the LLWR, this has a potential to encourage greater use of these materials at the consigning sites. This could subsequently lead to increased disposals to the LLWR. It is therefore important that LLW Repository Ltd maintains awareness in the longer term of complexant disposals to the LLWR. We expect LLW Repository Ltd to monitor any changes in complexant disposal rates and trends and as necessary re-assess any impacts on the ESC.

LLW Repository Ltd has focussed on amino polycarboxylic acids in its assessment of complexants, focussing on EDTA within this class of compounds based upon evidence of concentrations, compound use, degradation rates and strength as a complexant. LLW Repository Ltd should periodically review the full range of complexants disposed of to the LLWR and present in leachate to confirm these assumptions remain valid. For example, LLW Repository Ltd should periodically confirm that other strong complexing agents have not started to be disposed of or are found within leachate.

Forward Issue Summary

ESC-FI-009.a	LLW Repository Ltd should undertake further sampling of the trench leachate to increase confidence in the reference concentration chosen for the trenches. Further periodic sampling should be undertaken in the future to ensure the reference case remains valid over time.
ESC-FI-009.b	LLW Repository Ltd should engage with other consigners to confirm whether the reference concentrations used for the vault bound all likely disposals.
ESC-FI-009.c	LLW Repository Ltd should continue to monitor quantities of complexants disposed of to ensure they remain consistent with assumptions made within the ESC. Any changes observed should be assessed as part of the ESC.
ESC-FI-009.d	LLW Repository Ltd should periodically review the full range of complexants disposed of to the LLWR and present in leachate, to confirm current assumptions remain valid.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

Forward Issue Form
ESC-FI-009

FORWARD ISSUE

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-010

FORWARD ISSUE

ESC-FI-010: Waste heterogeneity in Vault 8 and future vaults

Title	Waste heterogeneity in Vault 8 and future vaults
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	x
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd needs to demonstrate understanding of the distribution and position of waste within the trenches and vaults. The distribution of waste can have a direct affect on the performance of certain safety functions of the facility design. For example, the distribution of cellulose may influence the settlement of the engineered cap and hence its function of protecting the waste. The distribution of waste can also directly affect the risk/dose linked with specific exposure pathways. For example, the distribution of Radium-226 will affect the dose/risk associated with the human intrusion pathway.

When producing the 2011 ESC, LLW Repository Ltd established a work programme to gain a better understanding of the trench inventory and its distribution within the trenches. Lennon et al (2008) present distribution maps of key radionuclides and materials across the trenches. We also note that the trench data sheets, submitted as part of the inventory section of the 2011 ESC, highlights the activity distribution across the trenches. For Vault 8, the ESC does not present the same degree of information for the location and distribution of wastes. The 2011 ESC does not present any distribution maps of the key radionuclides or materials in Vault 8. We also note that the Vault 8 data sheet supplied as part of the inventory section contains very limited information when compared with the equivalent trench data sheet. We consider that this is an area that can be improved in the future, where there are identified benefits in terms of performance assessment and understanding.

We note that LLW Repository Ltd possesses knowledge of where key radionuclides and material are located in Vault 8 through the LLW Tracking System and therefore has the capability to present better information.

Forward Issue Form
ESC-FI-010

FORWARD ISSUE

Improvement in this area may allow for a fuller assessment of the effects of emplacement strategies and increase confidence in the ESC. We recommend that information presented on waste location is also used to describe the use of emplacement strategies, such as how total potential voidage within stacks has been addressed.

Reference

Lennon, C.P., Jones, A., Eden, L. and Ball, M., 2008. LLWR Lifetime Project: Heterogeneity of the Inventory of Past and Potential Future Disposals at the LLWR. Nexia Solutions Report (07) 9126 Issue 03.

Forward Issue Summary

ESC-FI-010.a	In future versions of the ESC and where benefits of doing this are identified, LLW Repository Ltd should present information on the distribution of key radionuclides and key materials for past disposals. This information may be beneficial in showing how emplacement strategies have been employed.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-011

FORWARD ISSUE

ESC-FI-011: Forward review of the extended disposal area

Title	Forward review of the extended disposal area
Date raised	02/12/2014
Review group / area	All
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	X
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The 2011 ESC includes a separate assessment of the extended disposal area (EDA), which mirrored the subject areas and approaches used for the reference disposal area (RDA). The EPR10 permit variation application (LLW Repository Ltd 2013) requests a radiological capacity based on the full disposal area assessed (that is, the EDA).

Because of the use of the EDA to generate the LLWR radiological capacity, we consider it important that future updates of the ESC include complete integration of the full disposal area into the main LLWR ESC. Within any future updates, all relevant assessment scenarios should be assessed for all the future vaults (noting that physical differences should be taken account of, for example changing groundwater level or expected inventory composition). In other words, we would expect to see future updates to the ESC being fully integrated across the whole disposal area proposed, taking account of all existing and future disposals in a consistent manner.

Within our review of the 2011 ESC, we identified a number of areas of uncertainty relating to the future engineering design and layout of EDA Vaults 15 to 20. Although we note that construction of such facilities is proposed to start many decades from now, we would expect to see the gradual development of the Vault 15 to 20 design to a similar level of maturity to that provided for the RDA vaults.

Where information and models used in the EDA assessment have been directly extrapolated from the RDA information, LLW Repository Ltd should work towards using EDA specific information where possible.

LLW Repository Ltd should continue to reduce uncertainties associated with the inventory of Vaults 15 to 20 and the characterisation of the footprint of Vaults 15 to 20. These activities should be included in the forward work plan.

Forward Issue Form
ESC-FI-011

FORWARD ISSUE

Reference

LLW Repository Ltd, 2013. Application to Vary LLWR's Permit. LLW Repository Ltd Report LLWR/ESC/R(13) 10057 Issue 1.

Forward Issue Summary

ESC-FI-011.a	At the next update of the ESC, LLW Repository Ltd should ensure that there is complete integration of the entire disposal area into the main LLWR ESC.
ESC-FI-011.b	LLW Repository Ltd should identify in future work plans any work necessary to reduce current uncertainties present in the EDA assessment.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-012

FORWARD ISSUE

ESC-FI-012: Use of probabilistic calculation in derivation of radiological capacity

Title	Use of probabilistic calculations in derivation of radiological capacity
Date raised	02/12/2014
Review group / area	Assessments
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	X
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

In the Developments Report (LLW Repository Ltd 2013), LLW Repository Ltd defines radiological capacities for the main exposure pathways (groundwater, gas, coastal erosion and human intrusion) that will be used to set radiological limits and manage the future capacity of the site.

We have queried the use of deterministic reference case calculation results for the groundwater pathway well scenario, as opposed to probabilistic calculation results which appear likely to be more limiting. Specifically, we asked LLW Repository Ltd to provide us with a comprehensive analysis of the conservatism and optimism associated with the proposed methodology for assessing radiological capacities for the well scenario in order to substantiate the current use of deterministic assessment results for defining radiological capacity (Environment Agency 2013). We also requested an initial scope statement of the work that would be required to assess radiological capacities for the well pathway, using a probabilistic approach and encompassing the extended disposal area (EDA) as well as the reference disposal area (RDA).

We have assessed the response to this request (Baker 2014) and have concluded that, whilst the deterministic approach applied by LLW Repository Ltd provides for a robust mechanism for radiological capacity control in the short to medium term, we remain unconvinced that the results of the deterministic calculations provide the most appropriate basis for radiological capacity determination in the longer term. This is because the probabilistic calculations include an allowance for low probability / high dose parameter combinations that we consider should be included and that are lacking in the deterministic reference case.

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ESC-FI-012

FORWARD ISSUE

We are satisfied that the deterministic approach applied to setting radiological capacity for the groundwater pathway is robust for the short to medium term because:

- We accept LLW Repository Ltd has demonstrated there is unlikely to be a significant difference between the outcome of the deterministic and probabilistic assessments.
- The majority of disposals of those radionuclides that dominate groundwater pathway impacts (C-14 and Cl-36) are not forecast to arise for several decades. Therefore, we do not consider the possibility of a future small reduction in the capacity relating to these radionuclides, following any re-assessment of capacity based upon probabilistic calculations to be an issue for the continued safe operation of the LLWR over the coming decades. Certainly, not before we expect the ESC to undergo further major reviews and updates.

However, we require LLW Repository Ltd to undertake the necessary further work (for example, as detailed in Baker 2014) to investigate and further consider update of the probabilistic groundwater pathway assessment model and, if appropriate, to recalculate radiological capacity calculations based on the expectation value of the model output. Or, if after further consideration LLW Repository Ltd believes that use of a probabilistic groundwater pathway assessment model remains inappropriate, further justify this.

The calculations should:

- be based on the latest groundwater pathway assessment model, including consideration of the effects of complexants such as EDTA
- be based on a suitable, and substantiated, reference PEG for the most limiting exposure pathways
- include the EDA vaults
- take account of the most recent data on inventory

This work should be undertaken in three stages. Firstly, LLW Repository Ltd should prepare a detailed work specification, which is to be agreed with the Environment Agency as being an appropriate way forward. Once we have agreed that the specification will meet our expectations, secondly, technical work should commence to consider the recalculation of radiological capacity using a probabilistic groundwater pathway assessment model and to undertake these calculations if viable. Justification should be provided if LLW Repository Ltd believes such an approach is not viable. Thirdly, the ESC should be updated in line with the most appropriate approach to the definition of radiological capacity for this pathway. WAC should be updated as necessary.

References

Baker, A., 2014. Response to Environment Agency Further Information Notice: Well Pathway Calculations and Other Issues. LLWR Memo LLWR/ESC/Mem(13)240.

Environment Agency, 2013. Further Information Notice to Support Variation Application EPR/YP3293SA/V002.

LLW Repository Ltd, 2013. Developments since the 2011 ESC. LLW Repository Ltd Report LLWR/ESC/R(13)10058 Issue 1.

Forward Issue Summary

ESC-FI-012.a	LLW Repository Ltd should prepare a detailed work specification stating how it will consider the update of radiological capacity determinations for the groundwater pathway using the probabilistic assessment model and complete these updates if appropriate. Justification should be
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**Forward Issue Form
ESC-FI-012**

FORWARD ISSUE

	provided if LLW Repository Ltd believes such an approach is not appropriate. The scope of the future use of probabilistic assessments should be in line with Baker (2014).
ESC-FI-012.b	Following agreement on the work specification in ESC-FI-012.a with us, LLW Repository Ltd should complete the necessary work.
ESC-FI-012.c	The ESC should be updated in line with the most appropriate approach to the definition of radiological capacity for this pathway. Radiological capacity limits should be updated as necessary. At the latest, this should be completed by the next major review update of the ESC.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form

ESC-FI-013

FORWARD ISSUE

ESC-FI-013: Assessment of discrete items in stored and disposed waste

Title	Assessment of discrete items in stored and disposed waste
Date raised	02/12/2014
Review group / area	Inventory and near field and Assessments
Related FIs	
Related or source IRFs	ESC-RO-ASO-006
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd has assessed the risks presented by the future disposal of discrete items that may carry a significant radioactive burden (Sumerling 2013) in response to a Regulatory Observation (ESC-RO-ASO-006). On the basis of this assessment, the company has proposed further Waste Acceptance Criteria (WAC) to control such discrete items.

As part of our review of the ESC we issued further guidance to our assessors and made this available to LLW Repository Ltd (Smith 2013). This stated that:

‘For past disposals at the LLWR it may as a general statement not be regarded as an optimised approach to attempt to retrieve discrete items carrying a significant burden of radioactivity. This is because any or all of the following may not be adequately known: (a) the nature of the items; (b) the burden of radioactivity the items carry; and (c) the location of the items within the LLWR. If LLWR Ltd considers that this general statement is true, it should submit an environmental safety case (ESC) that makes this argument to the Environment Agency. Such an ESC should identify all items that it covers to the extent that the available records make this possible [we indicated that such an assessment should be provided well in advance of any capping of the waste. We note that the ESC need not be fully revised and only relevant parts of the ESC need be presented].

If there are any items in past disposals at the LLWR for which LLWR Ltd considers that the above general statement is not true, it should submit proposals to the Environment Agency for retrieval of such items. Any such proposals should include the appropriate operational and environmental safety cases for retrieval of the items.’

**Forward Issue Form
ESC-FI-013**

FORWARD ISSUE

Additionally, one action within ESC-RO-ASO-006 asked LLW Repository Ltd to consider historical disposals of discrete items, assess the possible implications and identify any resulting action required. To date LLW Repository Ltd has not completed this assessment of historical disposals. This Forward Issue requires completion of such an assessment in advance of any capping of the wastes and in accordance with our further guidance to assessors.

If LLW Repository Ltd believes it can make the case that it is not an optimised approach to retrieve any historically disposed discrete items containing a significant burden of activity, or to remove any such items from stored waste before disposal, then it should do so. This case should make clear the extent to which records are available to identify or predict types and numbers of discrete items containing a significant burden of activity. In the first instance we would expect LLW Repository Ltd to focus on records related to stored waste, for which it hopes to make a BAT case for disposal. This evidence, other available records relating to discrete items disposed and evidence provided by the RECALL exercises should be considered, taking into account uncertainty within the disposal records.

References

- Smith, R.E., 2013. Advice to Environment Agency Assessors – Issue 1: Advice to Environment Agency Assessors on the Disposal of Discrete Items, Specific to the Low Level Waste Repository, Near Drigg, Cumbria.
- Sumerling, T.J., 2013. Assessment of Discrete Items and Basis for WAC. LLW Repository Ltd Report LLWR/ESC/R(13)10055.

Forward Issue Summary

ESC-FI-013.a	In accordance with the requirements outlined in this FI, LLW Repository Ltd should consider historical disposals of discrete items, assess the possible implications and identify any resulting action required in advance of emplacement of the final cap.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-013

FORWARD ISSUE

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-014

FORWARD ISSUE

ESC-FI-014: Impacts of changing waste composition

Title	Impacts of changing waste composition
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	X
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd has made a number of assumptions about future waste disposals and has modelled a range of scenarios to establish how near-field chemistry or other properties such as stability may change. For example, LLW Repository Ltd has modelled a number of variant cases to establish whether the hyperalkalinity in the vaults will be maintained over the lifetime of the facility (Small et al. 2011).

We note that, in accordance with the National LLW Strategy for the Nuclear Industry, LLW Repository Ltd is working to try and achieve certain changes in what wastes are disposed of to the LLWR. For example, efforts are ongoing to try and divert metals to recycling (disposing only of the residues), to incinerate certain soft materials and to divert lower activity LLW to other disposal sites. LLW Repository Ltd has taken account of this within the 2011 ESC. Due to changes in materials being disposed of and packing practices it is also possible that the amounts of grout added to waste containers will change. Other unforeseen changes to waste composition could also occur.

Each of the above changes could influence near field properties, such as pH. For example, the hyperalkaline conditions within the vaults are expected to be maintained by grout and ferric hydroxides derived from the corrosion of metal wastes. Any changes to the amounts of metal disposed, or grout utilised, could influence these predicted conditions.

LLW Repository Ltd should demonstrate that it understands any possible changes to waste compositions that could influence waste or system behaviour in the future, particularly changes that are outside of currently assessed variant cases. It should ensure that processes are developed that can collect and trend relevant information on waste composition and quantities.

**Forward Issue Form
ESC-FI-014**

FORWARD ISSUE

This information should be used to confirm current near field assumptions remain valid and therefore the overall ESC remains valid as waste composition changes.

Reference

Small J., Lennon, C. and Abrahamsen, L., 2011. LLWR Environmental Safety Case: GRM Near Field Modelling for the LLWR 2011 ESC. NNL Report (10)11233 Issue 2.

Forward Issue Summary

ESC-FI-014.a	LLW Repository Ltd should identify any possible changes to waste compositions that could influence waste or system behaviour in the future, particularly those that are outside of currently assessed variant cases. It should develop mechanisms to collect and trend relevant information on waste composition and quantities. This information should be used to confirm that current near field assumptions remain valid and that the overall ESC remains valid as waste composition changes.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-015

FORWARD ISSUE

ESC-FI-015: Monitoring of colloids

Title	Monitoring of colloids
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	X
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Colloids exist as two main classes: true colloids, where the colloids are generated from the waste themselves such as graphitic colloids; and pseudo colloids, where the colloidal material acts as a carrier for the transport of radioactive and non-radioactive components (both hazardous and non-hazardous species). The presence of colloids has the potential to increase the release of radioactive and non-radioactive substances from a disposal facility such as the LLWR. This can present an enhanced risk to Potential Exposed Groups (PEGs) from the groundwater pathway.

In the 2011 ESC, LLW Repository Ltd has stated that the risk associated with the presence of colloids in the near field and geosphere is unlikely to be significantly higher than that for the reference case in which no colloidal transport occurs. We note that BNFL Ltd in the 1990's and early 2000's undertook a number of studies to gain a better understanding of the types and quantities of colloids present in the near field and geosphere at the LLWR. BNFL Ltd assessed whether radionuclides were associated with colloidal material, both in the near field and the geosphere and whether colloids traversing from the near field to the geosphere might be expected to remain stable. These studies concluded that colloids were present both in the near field and the geosphere; however, radioactivity was only found to be associated with those colloids present in the near field. The work also demonstrated that colloids were unlikely to be stable when traversing across the near field/geosphere boundary. However, we note that the oxidation conditions employed during the experiments undertaken were relatively extreme and that less extreme changes in conditions across the boundary could exist.

LLW Repository Ltd based its position on colloids within the 2011 ESC partly on this earlier BNFL Ltd work. This demonstrates to us that LLW Repository Ltd has an awareness of the colloids present in the near field of the trenches and their possible behaviour. However, we note that sampling and analysis work undertaken only represents a 'snap shot' in time. LLWR Repository

Forward Issue Form
ESC-FI-015

FORWARD ISSUE

Ltd states that grout-derived colloids generated in the vaults are unlikely to be stable. However, at present no analysis of the vault leachate for colloids has been undertaken, nor would this be reasonable at this point in time as representative vault leachate has not yet been generated.

We support the work that has been undertaken to date and believe it shows a reasonable understanding of the current and likely impact of colloidal materials. However, the current conclusions are based upon relatively limited data over one relatively short period of time. Over time, biogeochemical conditions within the near field could change and have an influence on the geosphere.

We therefore expect LLW Repository Ltd to review its understanding of colloidal materials and their possible impacts at the LLWR. We expect LLW Repository Ltd to develop a proportionate programme of further sampling, monitoring and analysis for colloidal material and radionuclides associated with colloidal material. Where appropriate, this programme should be supplemented by experiments (for example, where representative leachate is not available). The programme should address the near field and geosphere and also the potential for colloidal materials to be generated within vault leachate. The programme should be refined as further data become available. It should be aimed at increasing and maintaining confidence in the validity of any conclusions with regards to the impact of colloidal material in enhancing contaminant transport.

Forward Issue Summary

ESC-FI-015.a	LLW Repository Ltd should make proposals for a proportionate monitoring and/or experimental program for colloids and implement this to validate its assumptions in the 2011 ESC.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-016

FORWARD ISSUE

ESC-FI-016: Discretisation of the GRM model

Title	Discretisation of the GRM model
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	X
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The Generalised Repository Model (GRM) is the principal model used by LLW Repository Ltd within the 2011 ESC to gain an understanding of the evolution of the near field at the LLWR facility. In our review of the Post Closure Safety Case (PCSC) in 2002, we raised an issue (IAF NRF_006.1) questioning whether the outputs from the GRM (then referred to as DRINK) were sensitive to the scale of the spatial discretisation of the waste.

In our review of the 2011 ESC we considered that LLW Repository Ltd had improved the discretisation within the GRM for both the trenches and the vaults. However, it is not clear how the company has demonstrated the sensitivity of GRM to changes in discretisation. This is particularly important for C-14 as GRM output is used as direct input to the assessment calculations. We would expect to see a direct comparison between grid sizes for a specific variable to demonstrate that the grid size effects are within acceptable limits.

We note that LLW Repository Ltd has begun to assess the effect of heterogeneity of the waste on the results generated from the GRM. This is still ongoing for the vaults, as Vault 8 is only partly filled and the effect of higher stacking should be assessed. In addition, the effect of heterogeneity between vaults has not been fully assessed as there are currently no disposals to Vault 9.

We therefore believe that IAF NRF_006.1 has not been fully addressed by LLW Repository Ltd and we will expect this issue to be fully addressed in future iterations of the ESC. We will expect LLW Repository Ltd to quantitatively demonstrate how sensitive, if at all, the model outputs are to the scale of the spatial discretisation of the model. Understanding the sensitivity of the model is important in establishing to what extent further discretisation of the model is required and also in assessing the uncertainty associated with the outputs from the GRM.

**Forward Issue Form
ESC-FI-016**

FORWARD ISSUE

We note that this Forward Issue (FI) specifically refers to work undertaken within the GRM. However, the same considerations should be made for any other model or future models replacing the GRM for near field modelling, where spatial discretisation of the waste is a factor.

Forward Issue Summary

ESC-FI-016.a	LLW Repository Ltd should undertake a quantitative assessment of the sensitivity of the outputs from near field models used to support the ESC (for example, GRM) to discretisation of the model grid. We will expect LLW Repository Ltd to demonstrate at what level further discretisation of such models will lead to little change in the outputs and therefore warrant no further discretisation.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-017

FORWARD ISSUE

ESC-FI-017: Radiological capacity calculations

Title	Radiological capacity calculations
Date raised	02/12/2014
Review group / area	Assessment and safety case management
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	X
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd’s approach to setting radiological limits is based on derivation of values of radiological capacity for each reference assessment case and for each radionuclide. The LLWR’s radiological capacity for a radionuclide is the most restrictive inventory that the facility is capable of accepting based on the environmental safety case such that the peak dose or risk from that radionuclide alone would be equal to the appropriate regulatory dose constraint or guidance level.

The basis of LLW Repository Ltd’s radiological capacity calculations is that there is a linear relationship between disposed inventory and resultant dose / risk. Thus, an increase in the disposed inventory of a particular radionuclide will lead to a corresponding increase in dose / risk by the same factor. However, this may not hold true in, for example, the situation where release of radionuclides is solubility limited. Similarly, given that the release mechanisms of C-14 to the gas and groundwater pathways are highly dependent on the waste form, it is not obvious that a linear relationship between radionuclide inventory and risk can be assumed for all waste types.

LLW Repository Ltd should explore further the relationship between disposed inventory and dose / risk, in particular with respect to the inventory management of C-14.

Forward Issue Summary

ESC-FI-017.a	LLW Repository Ltd should develop and implement a work programme designed to explore the relationship between disposed inventory and dose or risk, to determine the suitability of the linear relationship assumption. Particular emphasis should be placed on C-14.
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Forward Issue Form
ESC-FI-017

FORWARD ISSUE

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-018

FORWARD ISSUE

ESC-FI-018: Provision of near field experiments and monitoring capability

Title	Provision of near field experiments and monitoring capability
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	ESC-FI-023 and ESC-FI-024
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	X
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Following our review of the 2011 ESC we believe it is important that LLW Repository Ltd develops a programme of work to understand conditions within the vaults and trenches after placement of the final cap. This information is important to enhance understanding of vault and trench conditions, along with the evolution of the waste mass and surrounding near field, so as to inform the ESC. We expect this information to be gained through either in-situ monitoring infrastructure (existing or new) or via experimentation (field or laboratory based).

This programme of work should be able to:

- clearly define monitoring or experimental objectives
- help confirm assumptions within the ESC
- support future development of the ESC

We expect the programme to address the whole period of operations, considering how and when monitoring or experimentation is best undertaken.

We advise that the programme should take into consideration the original objectives of the long-term trench and vault experiments.

This programme complements recommendations made within ESC-FI-023 (Leachate management strategy) and ESC-FI-024 (Gas management strategy).

**Forward Issue Form
ESC-FI-018**

FORWARD ISSUE

Forward Issue Summary

ESC-FI-018.a	LLW Repository Ltd should propose and implement a near field experimental and monitoring programme capable of providing sufficient understanding of the vault and trench near field environments to support the ESC. This programme should consider needs over the whole operational period. It should be updated at each stage of development throughout the lifetime of the facility, taking account of results from previous monitoring and experiments and the requirements of the developing ESC.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-019

FORWARD ISSUE

ESC-FI-019: Monitoring of coastal erosion

Title	Monitoring of coastal erosion
Date raised	02/12/2014
Review group / area	Site understanding and evolution
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	X
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd has identified that, in the longer term (hundreds to thousands of years), coastal erosion presents a risk to the integrity of the LLWR. In the 2011 ESC the company sought to characterise and model the erosion sequence prior to the disruption of the LLWR. This assessment used the best available climate change predictions, local geomorphological information and coastal recession models to project the likely sequence of evolution of the coastline and the erosion of the LLWR. Uncertainty in this projection could potentially be reduced with the use of site-derived survey information.

The 2011 ESC also identified the need for ongoing monitoring and information gathering in relation to coastal erosion and flooding trends over the period of authorisation (LLW Repository Ltd 2011). The purpose of this monitoring is to improve understanding of coastal erosion and flooding events that may occur and to compare data with modelling results, with a view to validating or further enhancing models of coastal evolution at the LLWR. LLW Repository Ltd has already put in place a comprehensive annual monitoring plan that is designed to provide ongoing coastal erosion monitoring.

The objective of this Forward Issue (FI) is to set out our expectations for a coastal evolution monitoring plan and the use of the outputs. We would expect the coastal evolution monitoring programme to achieve the following objectives:

- Align with and make use of externally available coastal information already available or continuing to be collected, so as to avoid duplication of effort.
- Be carried out at a sufficient frequency to allow the identification of coastal erosion trends.
- Be carried out in such a way to provide a consistent long-term data set, where possible aligning with existing coastal characterisation data presented in the 2011 ESC.

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ESC-FI-019**

FORWARD ISSUE

- Provide appropriate information on the behaviour and response of key aspects of the coastal system (for example the beach, dunes and scars). This might, for example, include changes in vegetation colonisation and beach morphology.
- Take account of available good practice in coastal evolution monitoring.
- Ensure new information that becomes available is fully utilised.
- Ensure new technologies that may enhance the monitoring programme are identified, considered and employed where appropriate.
- Be capable of identifying and monitoring (if required) larger scale changes and developments on the West Cumbrian coastline, which could result in changes to the sediment supply and erosion rates adjacent to the LLWR. These might include flood defence schemes or changes to the current coastal management strategy at locations to the north and south of the LLWR.
- Over extended periods, allow comparison of the monitoring results with the predictions of the ESC models.

The outputs of the coastal evolution monitoring programme should inform the developing ESC. We would expect development of the ESC to include, but not necessarily be limited to:

- consideration of all monitoring information available to LLW Repository Ltd
- review of models and continuing data collection against the available information
- review of models and continuing data collection against changes in climate change and sea-level predictions available nationally or internationally
- consideration of the impacts of measured sea level change and wave size on coastal erosion
- comparison of modelled coastal evolution with actual measured data

Reference

LLW Repository Ltd, 2011. The 2011 Environmental Safety Case. Monitoring. LLW Repository Ltd Report LLWR/ESC/R(11)10024.

Forward Issue Summary

ESC-FI-019.a	LLW Repository Ltd should develop and implement a coastal evolution monitoring programme taking into account the issues raised in this FI and comments made within our review of the 2011 ESC.
ESC-FI-019.b	LLW Repository Ltd should use monitoring data on coastal evolution to check assumptions made within the 2011 ESC and to inform the continued development of the ESC.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Forward Issue Form
ESC-FI-019

FORWARD ISSUE

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-020

FORWARD ISSUE

ESC-FI-020: Development of a new Low Level Waste Tracking System

Title	Development of a new Low Level Waste Tracking System
Date raised	02/12/2014
Review group / area	Safety case management and inventory and near field
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

To support implementation of the ESC, LLW Repository Ltd has identified the need to develop a new, more flexible, fit-for-purpose Low Level Waste Tracking System (LLWTS). This will support management of waste acceptance and the tracking of waste disposals (LLW Repository Ltd 2012, 2013). However, LLW Repository Ltd has also indicated that a new system cannot be developed until around August 2016 and therefore, in the interim, temporary revisions will be made to current systems.

We accept that it takes time to properly develop such complex software systems and welcome LLW Repository Ltd's commitment to their development. However, we also note that temporary systems will be used in the interim which will be more vulnerable to error and less efficient to apply. We therefore expect development to be progressed as soon as possible, with plans and scope being presented to us as soon as possible and no later than the end of 2015, unless otherwise agreed in writing.

We therefore require LLW Repository Ltd to put in place robust plans to develop and then implement a new LLWTS, meeting the needs of the latest ESC and any varied permit that may be in force. We recommend that LLW Repository Ltd seek to gain maximum benefit from the LLWTS, incorporating flexibility and adequate functionality to support effective implementation of the ESC and waste acceptance criteria and enabling effective tracking and management of waste.

The plans and scope for the development of a new LLWTS should include the continued effective management of past disposal data, including how this past data will be effectively and transparently integrated within it. This could, for example, include the transfer of past disposal data into the new LLWTS or the development of further systems or procedures to ensure clarity and

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ESC-FI-020**

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effective management of the entire LLWR radioactive waste inventory. These plans should be implemented alongside, or as part of the new LLWTS.

References

LLW Repository Ltd, 2012. The LLWR Environmental Safety Case, 2011 ESC Implementation Plan. LLW Repository Ltd Report LLWR/ESC/R(12)10049.

LLW Repository Ltd, 2013. Developments since the 2011 ESC. LLW Repository Ltd Report LLWR/ESC/R(13)10058, Issue 1.

Forward Issue Summary

ESC-FI-020.a	LLW Repository Ltd should present robust plans to develop and implement a new fit-for-purpose and flexible LLWTS, meeting the needs of the current ESC, waste acceptance criteria and permit. These plans should consider and include how past disposal data will be managed.
ESC-FI-020.b	LLW Repository Ltd should prepare a clear scope for the new LLWTS, including the management of past disposal data.
ESC-FI-020.c	LLW Repository Ltd should develop and implement the new LLWTS, ensuring the effective and transparent management of the entire LLWR inventory of radioactive waste.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-021

FORWARD ISSUE

ESC-FI-021: Learning from development of the ESC

Title	Learning from development of the ESC
Date raised	02/12/2014
Review group / area	Safety case management
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	X
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Our GRA states: '*Lessons should be learned from internal and external sources to assure continuous improvement in all aspects that affect environmental safety*' (GRA paragraph 6.2.17).

The 2011 ESC was developed over a number of years, following on from the submission of earlier environmental safety cases in 2002. Due to the scale, complexity and timescales required to produce an ESC for a radioactive waste repository, quality will inevitably be very dependent upon the development process adopted. The processes and approach used for the development of the 2002 and 2011 environmental safety cases presents an important opportunity for learning in this respect.

We therefore require LLW Repository Ltd to undertake a review of learning from the development of the 2002 and 2011 environmental safety cases to inform future major reviews of the ESC. We would expect such a review to include, but not be limited to:

- feedback on the environmental safety cases from the Environment Agency, Peer Review Group and others
- approach to documentation and presentation of the ESC
- development approaches, what went well and what did not
- interactions within the wider LLWR during development
- identification of priority areas for further development
- questioning and challenging of assumptions and approaches used within the ESC
- communication and engagement during and following ESC development and production
- interactions with contractors

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ESC-FI-021

FORWARD ISSUE

- document production and review processes

We expect that LLW Repository Ltd’s management arrangements will drive such a review and learning to be undertaken. However, we have indicated here our expectations, due to the importance of learning from such a large, long timescale and complex project. We will expect to engage with LLW Repository Ltd on its approach to development of the next ESC in due course.

Forward Issue Summary

ESC-FI-021.a	LLW Repository Ltd should undertake a review of learning from the development of the 2002 and 2011 environmental safety cases to inform future major reviews of the ESC, taking into account the issues outlined in this FI.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner’s assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-022

FORWARD ISSUE

ESC-FI-022: Active management of ESC records

Title	Active management of ESC records
Date raised	02/12/2014
Review group / area	Safety case management
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	
C	X

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Our GRA states: ‘The developer / operator will need to set up and maintain a comprehensive system for recording information on all aspects of the project affecting the environmental safety case.’ (paragraph 6.2.37).

This includes all information generated ‘in-house’ by LLW Repository Ltd, information generated by contractors, underpinning evidence and references and information that may have been generated by previous operators of the site, for instance the 2002 environmental safety cases. All of these records need to be effectively and actively managed to ensure they remain accessible.

We are aware that LLW Repository Ltd is making efforts to bring, in particular, contractor data and records ‘in-house’. We believe these efforts should cover all records that may be held by other organisations where they support the ESC.

We require that LLW Repository Ltd, following completion of the 2011 ESC and on an ongoing basis, ensures that all records supporting the ESC are captured within a comprehensive records management system and that, wherever practicable, records are brought ‘in-house’ such that they can be actively managed in support of the site during operations and post-closure. Where records cannot practically be brought ‘in-house’, robust mechanisms should be put in place to ensure continued access to those records and to ensure they are maintained in an equivalent manner to other records retained under the sites environmental permit.

Forward Issue Summary

ESC-FI-022.a	LLW Repository Ltd should ensure that all records supporting the ESC are captured within a comprehensive records
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Forward Issue Form
ESC-FI-022

FORWARD ISSUE

	<p>management system and that, wherever practicable, records are brought 'in-house' such that they can be actively managed in support of the site during operations and post-closure. Where records cannot practically be brought 'in-house', robust mechanisms should be put in place to ensure continued access to those records and to ensure they are maintained in an equivalent manner to other records retained under the sites environmental permit.</p>
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-023

FORWARD ISSUE

ESC-FI-023: Leachate management strategy

Title	Leachate management strategy
Date raised	02/12/2014
Review group / area	Optimisation and engineering
Related FIs	ESC-FI-024, ESC-FI-025 and ESC-FI-026
Related or source IRFs	ESC-RO-SUE-009
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The following Forward Issue (FI) relates to all repository leachate management systems in the vaults and trenches as well as the basal drainage system.

The 2011 ESC did not include an holistic leachate management strategy. As a result, we do not consider that LLW Repository Ltd has fully demonstrated in detail that Best Available Techniques (BAT) are being applied to some aspects of the management of leachate generated in the vaults and trenches (Environment Agency 2015a & b). This demonstration is required prior to further construction. In addition, we have identified the need for additional investigation of long-term leachate drainage performance to validate the assumptions used in the 2011 ESC.

Demonstration of BAT during the period of authorisation for the trenches and vaults

To demonstrate that the LLWR leachate management system represents BAT, we expect:

- Demonstration of the ability to monitor and control leachate during routine operations (pre- and post-capping), including the capability to measure leachate height in the trenches and vaults away from the leachate collection sumps or discharge points, taking due cognisance of the objective to avoid penetration of the final cap as much as practicable.
- Within the vaults, the ability to maintain leachate heights below the 1 m side liner containment system, at all locations where the 1 m side liner container is present (incorporating an appropriate factor of safety).
- The ability to control and ensure containment of leachate during reasonable high rainfall events.
- Within the vaults, demonstration that inter-container spaces will not block leachate flow paths to the extent that the leachate system ceases to function as designed. This demonstration should

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take account of container and grout degradation and deformation which may contribute to inter-container space blockages.

- Within the vaults, demonstration that leachate will not become perched and ‘short-circuit’ the vault base, potentially exiting the vaults above the 1 m side-liner.
- Demonstration of the ability to identify failures in the capping system during the period of authorisation, measure infiltration and, where necessary, remediate failures.

Account should be taken of the design and functional differences between Vault 8, Vault 9 and any future vault leachate collection and management systems. Where appropriate, LLW Repository Ltd should substantiate the long-term predicted flow of leachate from Vault 8 and 9 into future vaults.

Leachate management strategy

Building on the information used to demonstrate BAT for leachate management, LLW Repository Ltd should develop a leachate management strategy which should include, but not be limited to the following:

- proposals for leachate monitoring and sampling
- outlines of proposed leachate management strategies for the whole repository throughout the period of authorisation
- number, location and design of remote monitoring points for the trenches, current and future vaults
- consideration of defence-in-depth measures for the maintenance of vault leachate levels below 1 m during the period of authorisation
- mechanisms to prevent perched leachate and ‘short-circuiting’ of leachate flows through the waste above the vault side-liner
- proposed arrangement of containers and placement of infill in Vault 8 and future vaults, including demonstration of drainage efficiency
- proposals for ongoing maintenance of the leachate management infrastructure throughout the period of authorisation
- mechanisms to prevent unacceptable levels of fines ingress into the inter-container spaces prior to capping
- methods to detect and identify cap and basal liner failures during the period of authorisation
- detailed design drawings of Vault 8 leachate management infrastructure, as well as generic designs for future leachate management infrastructures

Investigation into long-term leachate system performance

In our review of the 2011 ESC we have identified a number of issues relating to the leachate management system that would benefit from further R&D or investigation and improvements to the long-term assessment. LLW Repository Ltd should consider work in the following areas:

- identification of realistic long-term leachate management system failure and degradation mechanisms, including consideration of the scale and location of the failure mechanisms
- improved characterisation of long-term leachate collection infrastructure degradation and possible impacts
- the capability of the design to prevent overtopping for a wider range of cap failure scenarios
- reduction of uncertainties in the FEP and uncertainty tracking system (or equivalent future system) related to leachate management
- increased design and functional certainty for the drainage function of profiling materials

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ESC-FI-023

FORWARD ISSUE

- confirmation of the required functional requirements for the basal drainage layer and the inter container leachate drainage media covering the period of authorisation and the predicted cap degradation sequence
- improved understanding of cap and basal lining degradation to inform the assessment of potential overtopping
- identification of potential improvements to the near-field functionality of vault, trench and repository scale models to better reflect long-term leachate drainage behaviour

The outcome of these investigations should inform the engineering performance assessment and ongoing optimisation processes.

References

Environment Agency, 2015a. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Optimisation and Engineering.

Environment Agency, 2015b. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Inventory and Near Field.

LLW Repository Ltd, 2011a. The 2011 Environmental Safety Case. Engineering Design. LLW Repository Ltd Report LLWR/ESC/R(11)10020, May 2011.

LLW Repository Ltd, 2011c. The 2011 Environmental Safety Case. Near Field. LLWR/ESC/R(11)10021, May 2011.

Forward Issue Summary

ESC-FI-023.a	LLW Repository Ltd should demonstrate use of BAT for leachate management during the period of authorisation and produce a leachate management strategy. Account should be taken of the points raised within this FI and further discussion provided within our review of the 2011 ESC.
ESC-FI-023.b	LLW Repository Ltd should undertake investigations into the long-term performance of the leachate management system, taking account of the points raised within this FI and further discussion provided within our review of the 2011 ESC.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Forward Issue Form
ESC-FI-023

FORWARD ISSUE

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-024

FORWARD ISSUE

ESC-FI-024: Gas management strategy

Title	Gas management strategy
Date raised	02/12/2014
Review group / area	Optimisation and engineering
Related FIs	ESC-FI-023
Related or source IRFs	ESC-RO-SUE-009
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	X
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

Due to the composition of waste disposed of to the LLWR we accept that gas volumes and rates of production will be far lower than typical landfills receiving industrial and municipal wastes (Environment Agency 2010, 2015a, b). For this reason we consider that LLW Repository Ltd's current engineering design intent for no active gas management to be adequate and appropriate. However, this position is based on a limited data set from the trenches and predicted information for the vault disposals.

We therefore consider it important that further data is collected and assessed to confirm the adequacy of the gas management infrastructure. For the trenches, these data should be collected before and after for the placement of the final cap. For the vaults, these data should be collected over an extended period after the placement of a final cap.

Further gas discharge data and assessment should inform the development of a gas management strategy and the detailed design of the gas management infrastructure. We expect to see confirmation that the engineering design is fully optimised with regards to gas management. Future consideration of the gas management strategy and infrastructure should consider, but not necessarily be limited to:

- determination and implementation of gas monitoring requirements to inform and confirm assessments
- performance of the gas management infrastructure, including degradation of performance over time
- a performance based decision on the need for closure or sealing of any elements of the gas management infrastructure at the end of the period of authorisation

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ESC-FI-024

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References

Environment Agency, 2010. Guidance on monitoring landfill gas surface emissions, LFTGN07 v2 2010.

Environment Agency, 2015a. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Optimisation and Engineering.

Environment Agency, 2015b. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Inventory and Near Field.

Forward Issue Summary

ESC-FI-024.a	LLW Repository Ltd should establish and implement a programme of work to further develop its gas management strategy and infrastructure, including collection of necessary monitoring data. This work programme should take account of the points raised within this FI and in our review of the 2011 ESC.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-025

FORWARD ISSUE

ESC-FI-025: Protection of waste prior to final capping

Title	Protection of waste prior to final capping
Date raised	02/12/2014
Review group / area	Optimisation and engineering
Related FIs	ESC-FI-001, ESC-FI-026 and ESC-FI-027
Related or source IRFs	ESC-RI-INF-005
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd's investigations into the condition of waste containers and the resulting assessments of cap settlement (Jefferies 2012, 2013) have shown that the currently proposed restoration sequence (timescales and the plans for placement of the final cap over disposed vault waste and the trenches) and container design may no longer be fully optimised. This is due to a number of issues, primarily container degradation, voidage within some containers due to grout and waste settlement and evidence of water contact with waste. Within Vault 8 and Vault 9 wastes this has led to evidence that:

- Small radiological discharges are occurring as a result of rainwater contact with waste within the containers. This is unlikely to represent application of BAT for prevention of discharges to the environment.
- Container degradation and voidage within some waste containers puts into question the integrity of containers in the short-term and may influence cap settlement and long-term container performance assumptions used in the 2011 ESC.
- Wastes, prior to final capping, have not been adequately managed, for example sufficiency of container inspections.

We therefore expect to see further work in the short-term, based upon improved understanding gained through the waste container investigations and assessments of cap settlement (Environment Agency 2014, 2015). This work should further optimise the repository design with regards to waste container exposure, minimisation of waste container degradation and discharges from the vaults prior to final capping.

This optimisation could include, but need not be limited to, one or a combination of:

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1. Container design optimisation.
2. Changes to the sequencing, timing and scale of final capping, including vault size and construction.
3. The provision of other interim means of protecting disposed waste (for example, partial caps or covers).
4. Other means of protecting wastes (for example, vault covers / roofing).

The scope and need to address points 2 to 4 above are likely to be at least partly dependent upon waste container optimisation and the period over which it can be demonstrated that waste containers can safely be held unprotected within the vaults without degradation or risk of water ingress.

Container optimisation should consider, but not be limited to:

- adjusting container engineering to prevent water ingress prior to capping (for example, via grout ports)
- container life before significant degradation and protection of the containers from the elements, for example design, paint systems, protective covers or caps
- minimisation of environmental impacts through raw material use
- means to minimise total potential voidage within containers
- ability to optimise packing of containers
- other relevant factors such as safety, transport and costs

Optimisation of restoration sequencing, vault construction and timing should consider, but not be limited to:

- optimised waste container design, in particular the demonstrable lifetime prior to significant degradation
- vault size and design options for partial vault capping or provision of interim cover/protection
- container stack heights, placement and movement
- the best available technique identified for the protection of trench waste
- the need for flexibility in waste management to take account of uncertainties in waste disposal rates
- the chosen procurement strategy for engineering works
- cap settlement potential and the need to ensure container integrity over extended timescales following capping
- interactions with other detailed design developments

It may also be relevant to consider other means of protecting the waste prior to final capping to prevent waste container degradation and discharges. For example, systems to prevent water accessing wastes at a vault, stack or container level. Such considerations should take account of wider optimisation studies for waste disposal at the LLWR.

Taking account of the above points and expectations, we expect LLW Repository Ltd to:

- present clear decision making criteria
- provide and justify optimised approaches/strategies
- present timescales and plans for implementation
- continue to liaise with the Environment Agency and to establish appropriate regulatory review points in the design and implementation process

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Any resulting changes should be considered within the ESC and engineering performance assessment.

We consider it a high priority that, in the short-term, LLW Repository Ltd assesses container design and/or protection measures to minimise further discharges to the environment.

References

Environment Agency, 2014. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Container Condition Investigations.

Environment Agency, 2015. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Optimisation and Engineering.

Jefferies, N., 2012. LLWR, Vault 8 Containers Issues Project: Position Paper. LLW Repository Ltd Report RP/LLWRGR/PROJ/00139 ISSUE A.

Jefferies, N., 2013. LLWR Vault 8 Containers Issues Project: Action Plan. LLW Repository Ltd Report RP/LLWRGR/PROJ/00141 ISSUE A.

Forward Issue Summary

ESC-FI-025.a	LLW Repository Ltd should provide a programme of work, with timescales, to address the issues raised within this FI.
ESC-FI-025.b	LLW Repository Ltd should develop an optimised design that provides adequate protection to waste containers and minimises discharges to the environment, taking into account the points raised within this FI.
ESC-FI-025.c	LLW Repository Ltd should implement an agreed work programme of optimisation measures associated with this FI, in liaison with the Environment Agency.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

Forward Issue Form
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<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-026

FORWARD ISSUE

ESC-FI-026: Engineering delivery

Title	Engineering delivery
Date raised	02/12/2014
Review group / area	Optimisation and engineering
Related FIs	ESC-FI-023, ESC-FI-024, ESC-FI-025 and ESC-FI-027
Related or source IRFs	ESC-RO-SUE-009
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The 2011 ESC presented a conceptual engineering design for the repository. This design was able to demonstrate the required level of safety could be achieved. LLW Repository Ltd recognises the need for a substantial programme of engineering design and performance investigation prior to the finalisation of the design to be built and the commencement of further repository construction.

We believe that, in order to assist the development and validation of a final engineering design, the following work areas and programmes are needed:

- Development and implementation of an engineering R&D (or investigation) programme which aligns with engineering knowledge gaps identified in the 2011 ESC, the engineering forward plan, our review of the 2011 ESC (Environment Agency 2015 a, b), or elsewhere.
- Development and implementation of an engineering performance monitoring programme setting out engineering performance monitoring objectives, methods and reporting timeframes.
- Scoping of a proportionate engineering performance assessment (EPA) framework for use in future updates to the ESC. The EPA should take into account the outputs of different engineering work streams.
- Reassessment of the engineering features, events and processes (FEPs) taking into account engineering performance and characterisation of associated uncertainties, to include relevant aspects of predicted engineering barrier degradation and system performance.
- Demonstration of how the outcomes of the above programmes will be used to inform the engineering design and future updates to the ESC.
- Updating of the EPA model in future updates to the ESC, so as to model the performance of the reference repository design.

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The outputs of this Forward issue (FI) should form part of a wider integrated engineering justification process that will provide the necessary engineering design and performance demonstration. We would expect the programme to cover activities carried out before, during and after construction activities and provide information for both the ESC and the engineering design process.

We recommend that all of the LLWR forward engineering work elements are incorporated into a single engineering delivery framework, which sets out how the elements will be integrated during the design justification process, prior to and during the commencement of construction activities.

The programme should take account of the points raised within this FI and further discussion provided within our review of the 2011 ESC (Environment Agency 2015b).

References

Environment Agency, 2015a. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Issue Assessment Forms.

Environment Agency, 2015b. Review of LLW Repository Ltd's 2011 Environmental Safety Case: Optimisation and Engineering.

Forward Issue Summary

ESC-FI-026.a	LLW Repository Ltd should provide a scope and programme for implementation of forward engineering work required to deliver the disposal system at the repository, taking account of the points raised within this FI. The programme should identify when regulatory review is expected to occur and interactions with other work streams. Indicative timescales and delivery mechanisms should be provided.
ESC-FI-026.b	LLW Repository Ltd should implement an agreed work programme in liaison with the Environment Agency.

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
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FORWARD ISSUE

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-027

FORWARD ISSUE

ESC-FI-027: Cap performance assessment

Title	Cap performance assessment
Date raised	02/12/2014
Review group / area	Optimisation and engineering
Related FIs	ESC-FI-025 and ESC-FI-026
Related or source IRFs	ESC-RI-INF-005 and ESC-RO-SUE-009
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	X
A2	
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The long-term performance of the capping system prior to site disruption is an important element of the ESC. This Forward Issue (FI) describes the need for the identification and assessment of a wider range of cap performance and failure investigations, taking into account the improved understanding of settlement potential derived from the container condition investigations. LLW Repository Ltd should use the outputs of this FI to inform future versions of the ESC. The work required to address this FI should complement the wider engineering design and R&D programme and address, although not necessarily be limited to, the following aspects:

Design justification for cap functional layers

For each functional layer of the cap, LLW Repository Ltd should identify the key safety function(s), provide the proposed material specification and present evidence to demonstrate the required performance will be achieved. In addition to the functionality of individual layers, information should be provided for the assumed safety functions derived from the whole capping system, such as robustness and isolation of the waste. The ability to effectively construct the cap design over a phased restoration system should be demonstrated. Where necessary, reference to the means of demonstrating performance during the design justification process should be made.

Assessment of cap failure mechanisms

Using the latest predicted settlement rates for existing and future wastes and taking account of uncertainties, LLW Repository Ltd should investigate the nature and significance of potential settlement on the repository cap. This work should:

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- identify the consequences of predicted settlement on the integrity and functionality of the individual layers of the cap and the cap as a whole, including settlement which does not result in loss of containment
- identify and assess realistic cap failure mechanisms that could occur in the period up to around 7000AD (that is, assuming delayed coastal erosion) either within an engineering performance assessment or separately
- identify and assess the potential location, timing, size and frequency of realistic and worst case settlement failures taking account of the current understanding of the Vault 8 waste form and voidage and optimisation of the container and cap design in future vaults
- identify and assess the consequences of feedback processes, such as erosion associated with increased infiltration rates due to settlement, which could increase the impact of any cap failure
- consider the respective settlement resistance benefits of compacted clay and Bentonite enhanced sand to inform the material specification project
- demonstrate that the repository cap design can withstand the predicted settlement using material-specific geotechnical information. Of particular importance is the role the profiling material plays in the mitigation of settlement
- using a revised engineering performance assessment model based on the reference design, investigate the hydrogeological consequences of realistic cap failure scenarios

Assessment of the impact of extended exposure on container integrity

In order to better inform the settlement assessment we would like to see the following investigations into container degradation:

- predicted period of structural integrity and degradation rates for structural elements, taking account of the containers use, exposure prior to capping, chemical and physical environment and loading
- consideration of any container optimisation measures which may be necessary and which could influence structural integrity and lifetime

These investigations should consider uncertainties in timing of degradation. Elicited or empirical information may be used (in addition to that information presented by Jackson et al. 2011). Where appropriate this information should inform the engineering performance assessment and understanding of the eroding repository.

Reference

Jackson, C. P., Couch, M., Yates, H., Smith, V., Kelly, M. and James, M., 2011. Elicitation of Uncertainties for LLWR. Serco Report SERCO/E.003796/010 Issue 2.

Forward Issue Summary

ESC-FI-027.a	LLW Repository Ltd should provide proposals for the delivery of the investigations set out above, where necessary referring to other work streams.
ESC-FI-027.b	LLW Repository Ltd should implement an agreed work programme in liaison with the Environment Agency.
ESC-FI-027.c	Where appropriate, LLW Repository Ltd should incorporate the outcome of the investigations into the repository engineering design and updates, to the ESC.

**Forward Issue Form
ESC-FI-027**

FORWARD ISSUE

LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-028

FORWARD ISSUE

ESC-FI-028: Improved understanding of the repository erosion process

Title	Improved understanding of the repository erosion process
Date raised	02/12/2014
Review group / area	Inventory and near field
Related FIs	
Related or source IRFs	ESC-TQ-SUE-011
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	X
B1	
B2	
C	

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

LLW Repository Ltd has characterised the behaviour of eroding waste entering the environment during erosion in the 2011 ESC. We consider that the company has demonstrated a good understanding in this work and has demonstrated compliance with our regulatory requirements.

Our review of the 2011 ESC identified some potential future improvements that could be gained from improvements to the conceptualisation, understanding and assessment of the repository for the period during which it is being eroded. This corresponds with the uncertainties associated with the FEP on erosion of wastes (CB_E_NTE 01 to CB_E_NTE 07).

This Forward Issue (FI) seeks the development of a forward work programme that includes further investigation and characterisation of the repository erosion sequence with the specific objective of reducing a number of uncertainties and improving the conceptualisation of the repository erosion assessment.

Examples of areas of potential investigation include, but should not be limited to:

- the impact of changes from anaerobic to aerobic conditions in the waste during the erosion process
- the potential introduction of large volumes of infiltration into the remaining waste mass as a result of the complete or partial removal of the engineered barriers during coastal erosion
- the nature, rate and extent of waste degradation and its impact on the rate and form of repository erosion
- consideration of the heterogeneity of wastes and its impact on the erosion and PEG-beach interactions

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FORWARD ISSUE

- improved understanding of PEG usage patterns during the erosion process

Forward Issue Summary

ESC-FI-028.a	LLW Repository Ltd should include work to improve the conceptualisation of the repository erosion sequence and reduce uncertainties within its forward work programme.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

Forward Issue Form
ESC-FI-029

FORWARD ISSUE

ESC-FI-029: Management of elicited data

Title	Management of elicited data
Date raised	02/12/2014
Review group / area	Safety case management
Related FIs	
Related or source IRFs	
Originated by	Environment Agency
Approved by	Environment Agency

Category

A1	
A2	
B1	
B2	
C	X

History

Status	Date	Description
Raised	02/12/2014	
Change of owner		
LLWR response		
Response assessed		
Closed		

Statement of Forward Issue

The 2011 ESC identifies and uses a significant number of parameters. These parameters have a level of uncertainty associated with them. LLW Repository Ltd has used an expert elicitation process to generate and justify some of the data used in the 2011 ESC (Jackson et al. 2011).

In section 2.2 of Jackson et al. (2011), a methodology for the elicitation of uncertain parameters is set out. The methodology stops at the production of the elicited information. The 2011 ESC does not describe how elicited parameters will be managed between and at major updates of the ESC. We would like to see documented proposals for the future management of the elicited data, which refer as appropriate to documented procedures or methodologies, in particular the LLWR data management procedures. These proposals should include, but not necessarily be limited to, the following aspects of the elicitation process:

- how the elicited data utilised in the 2011 ESC will be reviewed, including the frequency and triggers for reviews
- how site-derived performance information will be used to improve the elicited data
- how synergies between processes, for example performance of individual engineering components, are taken into account
- how improvements can be made to the recording and documentation of the elicitation process, to aid reproducibility
- how consistency in the elicited information will be maintained between and at major updates to the ESC, taking into account the subjective nature of the process and the potential for differing opinions of experts

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- how uncertainties in the data will be reduced, for example through use of the forward programme of work and R&D

Reference

Jackson, C.P., Couch, M., Yates, H., Smith, V., Kelly, M. and James, M., 2011. Elicitation of Uncertainties for LLWR. Serco Report SERCO/TAS/E003796/010, Issue 2.

Forward Issue Summary

ESC-FI-029.a	LLW Repository Ltd should present documented proposals for the future management of elicited data.
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LLW Repository Ltd Response

Provided by:

<name>	<position>	<date>
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<To be completed on conclusion of FI, timescales dependent upon issue and category, to be agreed with the Environment Agency. All FIs to be completed prior to the next major review of the ESC>

<LLW Repository Ltd response or summary, referencing attachments as necessary>

Assessment of LLW Repository Ltd Response

By:

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

<Owner's assessment of adequacy of response, including definition of any outstanding or follow-up actions needed to close issue>

<Iterate previous stages if necessary>

Actions completed, Forward Issue resolved and Form closed

Owner: <name>	Date: <date>
Approved by: <name>	Date: <date>

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