

The Importance of Getting it Right – Lessons from the Failure and Subsequent Approval of the LLWR Environmental Safety Case 16691

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ABSTRACT

The Low Level Waste Repository (LLWR) in the UK submitted an Environmental Safety Case in 2002 which was rejected by the Environment Agency 3 years later. Almost a decade after the rejection, the LLWR submitted a completely different document which was approved in November 2015. This paper looks at the lessons learned from the failed submission and documents the strategy employed by the Site's new contractor to overcome both the challenging technical issues that led to the initial rejection and overcome the resistance to long term disposal by the local community. It will describe the journey it has taken to move from a flawed safety case, to a technically sound safety case, to one that is approved by the regulator, and accepted by the community.

INTRODUCTION

Ever since the dawn of the nuclear era, the Low Level Waste Repository outside of the quiet village of Drigg has been the designated site for the disposal of low level radioactive wastes (LLW). Like most LLW facilities world-wide, it has gone through the evolution of "Best Available Technology" and has moved from tumble tipping in open trenches to today's disposal in engineered concrete vaults using grouted containers. Part of this evolution involved the requirement for an Environmental Safety Case (ESC), designed to demonstrate the long term viability of the disposal system.

The initial ESC was developed and submitted to the UK environmental regulator, the Environment Agency (EA) in 2002, and after a three year review was rejected. The case was not made, and perhaps, even worse, there were cases where the dose to the public exceeded regulatory guidelines. The rejection reverberated throughout the UK nuclear industry with the many generators questioning the long term viability of the LLWR and beginning to draft up contingency plans. Low level waste disposal quickly became one of the (newly formed) NDA's top 10 risks.

Fast forward a decade. The LLWR has resubmitted a new safety case, which has been thoroughly reviewed and endorsed by the regulator. The new ESC not only makes the technical case for long term disposal, but now provides insight into what the total radiological capacity is. Coupled with significant waste reduction through application of the waste hierarchy, the UK now has a LLW repository that has both physical and radiological capacity that should last well into the next century. This paper briefly describes this journey and spells out some of the lessons and observations made along the way.

History of the Development of the ESC

The previous operator of the UK's Low Level Waste Repository (LLWR) submitted an ESC to the regulator in 2002. This ESC was based on a systematic approach to describing the elements of the disposal facility, assessing how the system will evolve over time, and calculating the radiological impacts.

The assessment calculations were undertaken for different scenarios to provide alternative descriptions of the anticipated evolution of the system, for example due to future human actions. A central scenario was assessed and also variant cases that represented different future climate and sea level change outcomes. The main variants considered were termination and disruption of the site by glaciation and coastal erosion but with a focus on the former.

The regulator reviewed and considered the 2002 ESC and published their decision in 2006. The regulator was not fully satisfied with the submission as they felt that it had not adequately addressed radiological optimisation, had not properly addressed the potential for coastal erosion, had not determined the radiological capacity of the site and resulted in estimates of doses and risks to members of the public that exceeded regulatory guidance.

The outcome of the regulatory review and public consultation on the 2002 ESC was the issue of a restricted authorisation (now termed permit). The authorisation meant that:

- Disposals could continue to the existing vault that was in operation;
- Disposals to the proposed new vault would not be authorised until planning permission was also granted and a safe radiological capacity of the site was determined;
- Until the proposed new vault was authorised, any waste consigned to the LLWR would be for temporary storage only;
- Final capping of the existing disposal vault and trenches would not be allowed until completion of a management study to demonstrate that future impacts will be ALARP (As Low As Reasonably Practicable).

The authorisation also placed a number of requirements on the operator to make improvements and provide further information. One of these requirements was the submission of an updated ESC, taking into account the regulatory review comments by 1st May 2011.

The current operator of the LLWR (a consortium including AECOM, Studsvik, and Areva) took over management of the site in 2008 and immediately started work on creating a new technical team to deliver the 2011 ESC, and planning and delivering the Safety Case. The team appointed were scientists and engineers experienced in ESC and focussed on delivering a successful case against a deadline (and not just undertaking an R and D programme). The team recognised the importance of identifying and focussing on the key factors affecting environmental performance.

The LLWR's 2011 ESC is presented as a set of twenty-six key safety arguments. The arguments are structured into four sets around a high-level statement of our safety case:

- We have worked within a sound management framework and firm safety culture, while engaging in dialogue with stakeholders.
- We have characterised and established a sufficient understanding of the LLWR site and facility, and their evolution, relevant to its environmental safety.
- On this basis, we have carried out a comprehensive evaluation of options to arrive at an optimised Site Development Plan for the LLWR.
- We have assessed the environmental safety of the Site Development Plan, showing that impacts are appropriately low and consistent with regulatory guidance. Using our assessments, we have determined the radiological capacity of the facility and conditions under which waste may be safely accepted and disposed.

The four sets of arguments are:

- Management and dialogue;
- System characterisation and understanding;
- Optimisation and Site Development Plan;
- Assessment and conditions for waste acceptance.

The structure of the ESC allows clear links between the key safety arguments and the supporting evidence.

One of the main considerations was to produce an ESC that addressed the main criticisms of the previous submission, for example:

- The 2011 ESC had a strong focus on radiological optimisation of the design. This included the development of a hydrogeological model of sufficient detail to allow the representation of the engineered features of the repository. This meant that the hydrogeological model was able to support optimisation studies and provided a key input into decision making. Optimisation was an iterative process used throughout the development of the 2011 ESC, which meant the design evolved and was refined as the work progressed. The reference scenario of facility evolution used in the 2011 ESC considered that the end point of the site would be by disruption due to coastal erosion (disruption by glaciation was not considered to be a credible case).
- New assessment models that focussed on key factors affecting the environmental impacts were also developed based on refined conceptual models, underpinned by technical work in areas such as waste form evolution and climate change and coastal evolution. A comprehensive range of assessments have been undertaken, covering radiological impacts to humans and non-human biota, non-radiological impacts, during the periods of authorisation and after this period, and the likelihood of criticality, as required by the regulatory guidance. In some cases, the models were based

on novel approaches developed for this ESC, including for coastal erosion and radon release. New assessment models were used to estimate doses and risks to members of the public that were found to be consistent with regulatory guidance.

- In order to demonstrate that the LLWR would be sufficient to fulfil the UK's requirement for LLW disposal, the radiological capacity for the site was calculated using the Sum-of-Fractions (SoF) methodology. This approach enables management of the site capacity at a waste stream level to ensure that capacity will be available throughout the whole lifetime of the repository. Based on the SoF approach, we have been able to demonstrate that the LLWR has the capacity to accept all the appropriate LLW in the UK requiring vault disposal.ⁱ

Peer Review

A key approach to improving the ESC and building confidence in it was to use an independent peer review. A standing peer review group was set up involving internationally recognised experts in different aspects of ESCs. The approach adopted was interactive. An additional one-off review by a different group of international experts was also held.

Regulatory Review

The Environmental Safety Case was completed as scheduled and on 1st May, 2011 it was submitted to the regulator, immediately after submission, we held several technical workshops with the regulator to present the work undertaken in key technical areas, such as hydrogeology, inventory and assessment. The regulator then undertook their technical review of the submission, and later, the permit application. Throughout the review process, we held regular meetings with the regulator to discuss the review and answer queries. These meetings followed on from regular meetings held with the regulator during the development of the 2011 ESC. There was also a more formal process instigated to respond to written requests for further information. Both LLWR and the regulator held stakeholder events to inform people both about the technical content of the ESC and permit application but also about the regulatory process being undertaken.

During this early review period, most of the interaction was between the authors of the document and the Environment Agency who would eventually be required to approve or reject the submission. The regulator sought to understand the case and ensure that the document itself could stand on its own. The overall tenor of these interactions was positive and a useful and constructive dialogue was maintained throughout. We felt that we received good technical challenges on the scope and content of the ESC which has led to a Safety Case that is comprehensive and better demonstrates the safety of the facility.

The review and permitting process took longer than we anticipated; almost half of the ten-year period set by the regulator for production of a revised ESC. The uncertainty around completion dates made planning of future implementation

activities difficult and we have had less time to plan for and address recommendations made by the regulator than we would have liked.

A more staged and interactive approach to the development and review of the next major revision of the ESC would be beneficial to both parties. This would enable agreement to be reached with the regulator on certain aspects ahead of final submission and also to agree approaches and methodologies as a basis for our submission at an early stage.

Approval and New Permit

The regulator issued a revised permit to the LLWR on 1st November 2015 which will allow disposals to recommence at the repository. All waste receipts will be managed using the SoF methodology within the sites radiological capacity as stated in the permit. The regulator published both the review of the 2011 ESC and their decision document on their website:

- 2011 ESC review - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/430235/Overview_report.pdf
- Decision document - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/472214/LLWR_decision_document.pdf

Our permit application, in summary, requested a permit that would enable the LLWR to be managed against the ESC. The regulator considered this to appropriate and issued a revised permit that allows the LLWR to accept disposals of waste consistent with the radiological capacity of the site. One of the aspects we need to consider is managing the disposed wastes against constraints derived from coastal erosion. One control we have placed in our Waste Acceptance Criteria (WAC) is to manage the heterogeneity of levels of radioactivity on items that may be attractive to members of the public if they were to be exposed after coastal erosion.

The permit also includes some requirements for LLWR to undertake further studies to provide additional information on the implementation of the ESC and also future plans for the repository. The last of these requirements is to submit an updated ESC that addresses the review findings from the 2011 ESC to the regulator by May 2021.

Communication and Engagement Strategy

It is unclear what level of engagement was undertaken for the 2002 Safety Case. What is clear, is that the 2002 Safety Case did not have regulatory or stakeholder support.

No matter how technically robust a safety case is it still needs to pass public scrutiny and secure stakeholder endorsement. History has demonstrated that even

the best laid plans can falter if they do not have key stakeholder endorsement and are unacceptable to the general public.

To gain that endorsement requires a considerable amount of effort and in LLWR's case we developed a Stakeholder Engagement and Communication Plan quite early in the development of the ESC so that we could ensure that the relevant and necessary interactions with both internal and external stakeholders could be enacted in a timely fashion to coincide with strategic decision points in the ESC programme of works.

A myriad of groups and individuals were identified as having either a sanctioning role or an interest in the ESC, obviously key to its success was satisfying our regulators and demonstrating that a comprehensive engagement programme had been undertaken that afforded stakeholders with the opportunity to learn more about the ESC and our plans for its implementation.

Separate from, but integrally linked to the ESC, was an overarching planning application. The Site Optimisation and Engineering Closure Works planning application captured both future development of the LLWR site (additional vaults) and closure engineering (final cap) that enabled the delivery of physical works associated with the implementation of the ESC. The planning application was also submitted in 2011 to allow the two separate processes (Environmental Permit and Planning Consent) to run in parallel and avoid overburdening the stakeholder community with consultations. The Repository's host community, the Borough of Copeland, has a population of approximately 70,000 and covers a geographical area of just over 73,000 hectares (281 square miles). It is easy to reach saturation point when you are one of a number of organisations seeking engagement.

In addition to demonstrating open and honest dialogue and trying to ensure no surprises, our Stakeholder Engagement and Communication Plan had a number of objectives:

- Ensure that as far as possible relevant stakeholder groups were informed of the development of the ESC and its conclusions, at suitable times and frequencies;
- Ensure the views and requirements of stakeholders, particularly those with a regulatory or planning role, were clearly understood; and
- Ensure account was taken of stakeholder views in the development and implementation of the ESC programme, where appropriate.

Additionally, it was also important that interfaces with other projects, teams and staff members within LLWR were recognised in the engagement plan and that appropriate lines of communication were maintained to ensure that:

- The LLWR management approach, and associated planning activities, were consistent with the requirements and objectives of the ESC;

- The ESC Programme provided an effective integration and optimisation role, framing the future design and operational management approach for the LLWR; and
- The LLWR Development Programme as set out in the ESC was, as far as practicable, consistent with the commercial objectives of LLWR.

The strategy for deploying the ESC Stakeholder Engagement and Communications Plan was facilitated through:

- A variety of different engagement mechanisms both existing and newly formed to accommodate additional specific engagement approaches where it was deemed important and necessary to do so;
- Internal or external stakeholders with a direct interest in the Project (i.e. funding organisations, key regulatory bodies, other LLWR projects, LLWR management) who were frequently and regularly engaged throughout the programme. The aim, to ensure continuous and effective dialogue through a positive relationship, and to facilitate development of a consistent understanding of relevant technical and regulatory issues;
- Other stakeholders with an interest in the ESC Project and its outcomes were engaged on an appropriate regular basis;
- Stakeholders were also engaged through specific events related to key strategic decisions at particular points in the ESC development process. The nature of these engagements and the range of stakeholders invited to participate, varied depending upon the subject of the engagement.

The table below is indicative of the work streams that required specific external engagements, whether in relation to strategy or technical matters:

TABLE I. Work Streams Requiring Specific External Engagements

ESC PROJECT AREA	NATURE OF ENGAGEMENT
Overall ESC aims, progress & outcomes	Monthly and quarterly regulator/Cumbria County Council (CCC) liaison meetings. Specific NDA and regulatory liaison meetings at key points where required e.g. important ESC approach and strategy developments, prior to and on delivery of the major submission.
Pre- and post-closure engineering optimisation	Specific engagement of NDA, regulators and CCC at scoping and final strategy definition stages. Engagement of regulators, WCSSG (West Cumbria Site Stakeholder Group) and the Parish Council through existing regular arrangements.

Conditions for Acceptance (CFA)/Waste Acceptance Criteria (WAC) development	Specific engagement of regulators and consignors at scoping and final document production stages. Additional liaison with consignors where and when required.
Waste treatment strategies	Monthly and quarterly regulatory liaison meetings.
Waste emplacement strategies	Monthly and quarterly regulatory liaison meetings.
Inventory understanding	Monthly and quarterly regulatory liaison meetings. Specific technical meetings with regulators as required. Liaison with consignors.
Post –closure performance assessment work streams	Monthly and quarterly regulatory liaison meetings. Specific technical meetings with the NDA and regulators as required.
Site understanding including coastal erosion	Monthly and quarterly regulatory liaison meetings. Specific technical meetings with NDA, the regulators and relevant LLWR personnel.

It is estimated that LLWR conducted approximately 600 separate engagements on the ESC and its implementation through the planning application whether that be through formal meetings, community open days or articles in our external newsletter. This does not include the separate engagement conducted by our environmental regulator the Environment Agency nor does it capture the 3,000 visitors that have passed through the LLWR gates during the last six years and who receive a general presentation which covers both the ESC and the planning application.

Community Benefit Package

In association with the construction of the most recent disposal vault (Vault 9) a community benefit package was agreed between the Nuclear Decommissioning Authority (NDA) acting as the Government’s agent and the local authorities (Copeland Borough Council and Cumbria Country Council). This package was endorsed by Treasury and included a one-off payment of £10 million in recognition of the role the host community had played during 50 years of operating the LLWR site and £1.5 million per annum for as long as Vault 9 was receiving waste or until 2018 whichever came first. A special purpose vehicle was set up in the name of Copeland Community Fund to channel the funding in line with the NDA’s Socio-Economic Policy.

The Fund has its own board consisting of representatives from Copeland Borough Council, Cumbria County Council, the NDA and independent representation from the local community. It has a clearly defined mission that looks to provide match

funding to charities and community organisations in the Borough of Copeland and where possible address areas of need and pockets of deprivation.

In 2015 the Copeland Community Fund celebrated its fifth anniversary showcasing schemes that had received assistance from the Fund and raising awareness of the good work conducted throughout the Borough. The Fund was able to demonstrate that for every pound of grant funding awarded an additional 2.2 pounds was raised in match funding. To date the fund has issued over £11 million and secured an additional £24.3 million in match funding bringing the total benefit to approximately £35 million.

The Copeland Community Fund was the first of its kind in the UK connected to the management of radioactive wastes. A similar mechanism was put in place for the Dounreay disposal facility, albeit on a reduced funding scale because the Dounreay facility is reserved for waste arising from the decommissioning of the Dounreay site only, whilst the LLWR facility provides disposal for the UK as a whole.

At the time of writing, renewed community benefit negotiations are underway to realign the benefit package with continued operations at the LLWR site until 2050 and potentially beyond.

CONCLUSION

The benefits of an approved environmental safety case are impossible to quantify; just the risk of removing some of the existing waste and identifying another site is in the billions of pounds, and this does not include the cost of the impact to UK decommissioning. In addition to avoiding the very negative outcome, the LLWR safety case has begun to allow the Site (and as a result the UK) to consider disposing a class of wastes that previously was completely off the table.

It is vitally important for any disposal site or project requiring long term disposal of radioactive waste to (1) invest top notch scientists to the task, (2) apply sound engineering so that the variables that actually affect the outcome are focused on and dealt with, and (3) couple a sound technical basis with a robust communications and stakeholder management plan.

¹ LLWR, The LLWR's 2011 Environmental Safety Case, WM Paper 12143, February 2012.