



PROJECT TITLE:

## D3100 LLW Disposal Facilities

DOCUMENT TITLE:

## Application to SEPA for a variation to EAS/P/1173599 - Supporting Document

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**ABSTRACT:**

DSRL is applying to SEPA to vary EASR permit EAS/P/1173599. This document supports this application, by providing:

- Background information
- A summary of the requested changes to the permit, and
- Detailed requests for changes to individual permit conditions and justification for the requested changes, including reference to supporting assessments and reports.

|              | Name | Position  | Date | Signature |
|--------------|------|---|------|-----------|
| Prepared by: |      | Senior Waste Specialist                           |      |           |
|              |      | Environmental Specialist                          |      |           |
|              |      | D3100 Compliance Manager                          |      |           |
| Reviewed by: |      | Environmental Safety Case Manager                 |      |           |
| Approved by: |      | D3100 Compliance Manager                          |      |           |
| Endorsed by: |      | Environment Review Committee Chair                |      |           |
| Endorsed by: |      | Dounreay Nuclear Safety and Environment Committee |      |           |

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## 1 INTRODUCTION

- 1 Dounreay Site Restoration Limited (DSRL) operates facilities for the disposal of low-level radioactive waste (LLW) adjacent to the Dounreay nuclear licensed site in Caithness, in the north of Scotland. These facilities are permitted for the disposal of LLW by the Scottish Environment Protection Agency (SEPA) under the Environmental Authorisations (Scotland) Regulations 2018 (EASR).
- 2 The EASR permit (EAS/P/1173599) [1] specifies a series of conditions relating to the waste that can be accepted for disposal, including limits on the quantities of radionuclides that can be disposed of within the facilities, and conditions relating to the design, construction and management of the facilities.
- 3 These radionuclide limits were based on the anticipated inventory at the time of the original permit application, are not risk based and are unnecessarily constraining disposal of LLW to the facilities. This situation is preventing optimised management of radioactive waste on the Dounreay site.
- 4 Furthermore, operational experience has identified instances where some conditions are no longer consistent with current regulations or are expressed such that compliance cannot be demonstrated.
- 5 DSRL is therefore applying to SEPA to vary EASR permit EAS/P/1173599. This document supports this application, by providing:
- Background information
  - A summary of the requested changes to the permit, and
  - Detailed requests for changes to individual permit conditions and justification for the requested changes, including reference to supporting assessments and reports.

## 2 BACKGROUND

### 2.1 D3100 LLW Disposal Facilities

- 6 DSRL is carrying out a site decommissioning and environmental remediation programme at the Dounreay site. This decommissioning and remediation programme is being undertaken over several decades, during which a significant volume of treated and packaged solid LLW will be produced. This waste is being managed, and must continue to be managed, in line with UK and Scottish radioactive waste policy and in accordance with safety and environmental regulations.
- 7 Following the completion of a Best Practicable Environmental Options (BPEO) study [2] a strategy for the management of this LLW was published in 2005 [3]. This strategy was aligned with UK policy and was to be progressed in three principal areas:
- the application of the Waste Hierarchy to minimise the production of LLW as far as practicable,
  - the construction of new LLW disposal facilities (LLWDF) at Dounreay, and
  - the retrieval of the LLW from the existing authorised LLW Pits Complex and re-disposal within the LLWDF.
- 8 A project to undertake the design and permitting of the new LLWDF was initiated in 2005, construction commenced in 2012 and the facilities commenced operation in 2015.

### 2.2 EASR Permit for Disposal within the LLWDF

- 9 Permitting by SEPA under EASR 18 is required for all disposals of solid radioactive waste in Scotland. The permit granted by SEPA under EASR 18 considers safety to the public and the environment from routine exposures and discharges of radioactivity during operations and the potential impact of releases after closure.
- 10 There are no specific requirements in EASR 18 relating to solid radioactive waste disposal facilities. To address the need for guidance on the requirements for authorisation, the UK environment agencies have published a document entitled *"Near-surface Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on the Requirements for Authorisation"*, commonly termed the GRA [4]. A key requirement within the GRA relates to the production of an Environmental Safety Case (ESC).
- 11 The LLWDF ESC has, and will be, developed in an iterative manner with the staged design and construction of the facilities. The EASR permit granted by SEPA makes reference to Environmental Safety Case 2010, which was published prior to construction [5], but up-issued prior to the facilities becoming operational [6]. A complete review and update of the ESC has been undertaken in support of this application [22].
- 12 It is noted that the LLWDF was originally authorised for the disposal of LLW under the Radioactive Substances Act 1993 (RSA 93) by SEPA in January 2013 [7] and thereafter varied by SEPA in 2015 [8]. RSA 93 was superseded by the Environmental Authorisations (Scotland) Regulations 2018 (EASR) on 1 September 2018, and a new disposal permit (EAS/P/1173599 [1]) issued on 1 April 2019. The RSA 93

Authorisation was deemed a permit under EASR 18, such that the new Permit was enacted by means of a variation (EAS/P/1173599 VN01 [9]).

13 The permit sets out a series of bespoke conditions specific to disposal in LLWDF and is also subject to the EASR Standard Conditions [10]. The bespoke conditions can be broadly split into:

- Authorised Waste Acceptance Criteria (WAC), and
- Other conditions that specify management requirements.

14 This second set of conditions can be considered to support and develop the Standard Conditions in relation to solid waste disposal and/or enact GRA considerations.

15 The Authorised WAC assure that waste disposed of within the facilities satisfy ESC assumptions relating to the disposed inventory. The Authorised WAC are supported by Schedule 2 of the permit, which specifies a maximum authorised disposal inventory and which limits key radionuclides in terms of total Becquerels (Bq). This maximum disposal inventory reflects the inventory used in the safety assessment calculations that supported ESC2010. This inventory was based on best estimates derived from the Dounreay Radioactive Waste Inventory (DRWI) in 2009 [11].

16 It is noted that the Authorised WAC are reflected in a broader suite of Waste Acceptance Rules detailed in the ESC and which are applied during the waste acceptance process.

## 2.3 Drivers for Change

17 During 2016 it was identified that some of the limits within Schedule 2 of the permit were preventing the disposal of LLW that was being, or was expected to be, generated by the Dounreay decommissioning programme. This issue was recognised to stem from uncertainty in the estimated inventory on which these limits were based. Furthermore, it was recognised that because these limits were not risk-based they would unnecessarily limit the quantity of LLW that could be disposed of to the LLWDF and therefore effectively constrain the optimised management of the LLW produced during the decommissioning programme. A project was therefore initiated to develop proposals for alternative Authorised WAC, update the LLWDF ESC accordingly, engage with stakeholders and submit an application to SEPA to vary the permit [12].

18 Following a non-compliance with the permit in 2017, a project was initiated to verify the waste disposed of within the LLWDF against the Waste Acceptance Rules (including the Authorised WAC). This verification project was undertaken from 2018 to 2020 [13]. This project identified several instances where a demonstration of compliance with the Authorised WAC and other related conditions could not be easily demonstrated. In particular, it was recognised that one of the Authorised WAC relating to non-radiological hazards could no longer be aligned with current regulation. The ambiguity in this condition was raised with SEPA in October 2018 [14] and at this time SEPA proposed to address this issue through a SEPA-initiated review of the permit [15]. It was subsequently proposed that this issue would be more efficiently addressed in tandem with DSRL's proposed application to vary the permit [16]. This project also identified a number of waste packages that contained high levels of voidage and were therefore considered non-compliant. Following further assessment, it was recognised that these non-compliant waste packages did not compromise the ESC and that remedial options within the disposal facility were

possible. In this particular case, SEPA agreed that the re-distribution of these waste packages with higher voidage was the optimised remedial action [17].

19 SEPA's consultation on the draft EASR permit in 2019 prompted a full consideration of the permit conditions by DSRL in the context of the new regulations and the publication of the EASR Standard Conditions. This process identified some inconsistencies and/or ambiguity between the Standard Conditions and some of the 'managerial' bespoke conditions. Proposed administrative changes to the draft permit were therefore included in DSRL's consultation response to the draft EASR permit [18]. SEPA identified that several of these proposals could be addressed as part of their planned review of the permit [19]. As indicated above, it was subsequently agreed that this review would be undertaken as part of the determination of DSRL's application to vary the permit.

20 The LLWDF has now been operational for 6 years, allowing both SEPA and DSRL to gain experience of regulating and being regulated under both the RSA and EASR permits. Recent inspections undertaken by SEPA have raised a number of opportunities to improve or provide further clarity to the Permit. When considering the proposals made within this application, DSRL primarily considered previous operational experience and also applied a number of tests to each condition to identify any opportunities for improvement. These tests were discussed with SEPA, and considered:

- The risk posed by the activity the condition relates to, and whether the condition is proportionate to the risk.
- Whether it is possible for DSRL to demonstrate compliance with the condition.
- Whether the condition is enforceable by SEPA, taking into account current legislation, clarity of the condition and whether the LLWDF has the ability to control the requirement of the condition.

21 Though the results of these tests have not necessarily been referenced in the proposals identified in 3.2.7 Appendix A, the information is held within our project files and can be made available. All proposals should align with the tests.

## 2.4 Impact of Proposed Changes

22 This proposal does not change the purpose or use of the disposal facility, rather it is intended to ensure that both waste management and operations at the disposal facility are optimised. DSRL consider that the proposed changes requested in this document provide clarity and are in line with legislative requirements, it is intended that these changes provide benefit to both DSRL and the Regulators.

23 The Environmental Safety Case (ESC) has been updated in support of this application [22], this demonstrates that the changes proposed by DSRL continue to meet the relevant legal requirements and that safety of the environment and members of the public are assured both now and in the long term.



### 3 SUMMARY OF APPLICATION

24 This section summarises the key changes to the EAS/P/1173599 Permit that are being requested in this application. The detail of the requested changes for individual conditions and the supporting justification is then provided in 3.2.7 Appendix A. This section has been split into two sections to reflect:

- Proposed changes to the Authorised WAC, and
- Proposed administrative changes to managerial conditions.

25 The documents referred to in this section and within the appendices will be provided to SEPA in support of this application. 3.2.7 Appendix B shows the hierarchy of the key references which have undergone external peer review in line with DSRL procedure [20].

26 It is noted that pre-application dialogue with SEPA has been undertaken, including Technical Exchange meetings during the development of the reference documents, and focussed discussion on the proposed changes detailed below. Records of dialogue are maintained within the LLWDF project documentation.

#### 3.1 Proposed Changes to Authorised Waste Acceptance Criteria

##### 3.1.1 Adoption of a Sum of Fractions Approach

27 DSRL request that the current approach of using an estimated inventory to set radionuclide limits is replaced with a risk-based 'sum of fractions' (SoF) approach. In such an approach, activity levels are derived directly by relating the performance of the facility, the individual radionuclide properties and specified performance measure(s).

28 It is highlighted that the extant radionuclide limits are currently preventing optimised waste management, with some LLW packages exceeding the individual radionuclide limits and therefore having to be stored on the Dounreay site. A review of the inventory of LLW in store and expected to arise from decommissioning has also identified an overall estimated increase in the radionuclide inventory to be consigned for disposal but recognises remaining uncertainties [21]. Updates to the Environmental Safety Case (ESC) [22] and supporting performance assessment (PA) model [23] has confirmed that this LLW can be safely disposed of in the LLWDF.

29 Adoption of this SoF approach will allow for control of disposals that is consistent with the ESC and regulatory guidance levels, whilst also optimising the acceptance of LLW from the Dounreay Site. A full description of this proposed approach and associated justification is provided in the supporting reference "*Application of Sum of Fractions for D3100*", D3100/4/REP/GAL/40092/IS/03, Issue 3 [24].

30 This request involves modification to Condition 1.2 and 3.1(f) of EAS/P/1173599. It also involves replacing Schedule 2 with a schedule of Calculated Activity Concentration Levels (CACs), as detailed in 3.2.7 Appendix C.

##### 3.1.2 Criticality Safety Limits

31 DSRL request that the current fissile package limits are replaced with a revised set of limits that take due account of additional fissile isotopes that may be present in the estimated inventory expected to be consigned for disposal (namely Pu-239) [21] and



also account for specified content of common neutron moderating and reflecting materials (graphite and beryllium). The basis for the proposed set of limits and associated justification is provided in the supporting reference “D3100 Criticality Safety Assessment 2020”, D3100/4/REP/GAL/40019/IS/01.3, Issue 1.3 [25]. The revised limits have been modelled in the Criticality Safety Assessment, which demonstrates their considerable safety margins.

32 This request will require replacement of Condition 3.1(g) to 3.1(k) with a proposed new schedule of Criticality Safety Limits, as detailed in 3.2.7 Appendix D.

### 3.1.3 Non-Radiological Hazards (NoRaH)

33 DSRL request that requirements are included in the Authorised WAC to declare *properties that would be considered hazardous if the waste was not radioactive*, and to make *all materials that would be considered hazardous* safe for transport and operations and justify the method(s) used.

34 Currently the permit includes exclusions for specific hazardous materials, which causes demonstration of compliance to be difficult as the permit holder is reliant on the consignment information provided and is essentially required to prove a negative. It should be recognised that the ability to ensure the content of waste packages rests with the waste consignor during generation, characterisation and packaging. The permit holder can only assure themselves that the waste acceptance criteria are being met, this assurance is undertaken by way of auditing, waste compliance testing (see Section 3.2.4) and application of a robust waste acceptance process.

35 Thereafter, DSRL request that Conditions 3.1(d) and 4 relating to non-radiological hazards (NoRaH) are replaced with an overarching condition, included in the Authorised WAC requiring:

*No waste will be accepted for disposal unless it has been assured that:*

- a) any properties that would be considered hazardous if the waste was not radioactive have been declared by the consignor; and*
- b) all materials that would be considered hazardous if the waste was not radioactive have been made safe for transport and operations, and the method(s) used justified by the consignor.*

36 This proposed change also addresses the issue with obsolete terminology within the extant conditions and future proofs the requirements against future changes to NoRaH legislation and guidance.

37 While DSRL recognise that hazardous waste legislation specifically excludes radioactive waste, it is considered that aligning management of waste with these requirements provides a proportionate approach for non-radiological hazards. It is expected that the consignor will classify any hazardous waste in line with the hazardous waste legislation current at the time of consignment, currently DSRL will expect consignors to declare hazards in line with WM3 [31] and apply appropriate classification. This is standard for clean wastes being produced on the Dounreay site.

38 DSRL consider that the proposed overarching condition will drive better characterisation, management and risk reduction of potential hazards by the waste consignor, rather than focussing attention on a sub-set of potentially hazardous materials.

- 39 Further details and assurance of environmental safety with regard to NoRaH is detailed in “*Management of Non-Radiological Hazards in D3100 - ESC 2020*”, D3100/4/REP/GAL/40018/IS/02, Issue 2 [26].

## 3.2 Administrative Changes

### 3.2.1 Alignment with EASR Terminology

- 40 Implementation of the EASR permit and subsequent experience has identified where the terminology within the permit should be revised to ensure consistency with EASR, namely in relation to the use of the terminology ‘management’ and ‘transfer’, as discussed below.

#### ***Management***

- 41 DSRL request that the term ‘storage’ within the extant permit is replaced with term ‘management’ to ensure consistency with the terminology used in EASR. The use of the term ‘storage’ within the Permit remains from the previous RSA Authorisation where ‘accumulation’ was an authorised activity. ‘Storage’ is not a defined term within EASR rather, it is an activity that falls within the scope of the term ‘management’ which is specified as the authorised activity in the Permit. This change in terminology has previously been confirmed by SEPA [19].

- 42 Notwithstanding this, it is highlighted that the LLWDF has been designed and constructed with the operational intent to dispose of LLW. The proposed change will ensure alignment of the permit with current legislative requirements.

- 43 This request relates to Conditions 1.3, 8.1 and 8.2.

#### ***Transfer***

- 44 DSRL request that conditions relating to the transfer of radioactive substances are removed from sections that relate to the disposal of radioactive waste. The definition of disposals has changed with the implementation of EASR. Unlike RSA93 where disposals included transfers, under paragraph 4, Schedule 8 of EASR disposals are now defined as including discharge, abandonment, burial and deposit.

- 45 In addition, Standard Condition Section C has been applied to the permit during the implementation of EASR. This introduces an overarching set of requirements relating to transfer of radioactive waste that had previously been covered by a small number of specific conditions in the previous RSA Authorisation. This change in definition has affected Row 3 of Table 1 and Condition 8.1. DSRL request that the bespoke conditions relating to transfers are removed due to the application of Standard Condition Section C.

### 3.2.2 Definition of LLW

- 46 DSRL request that the EASR definition of LLW is amended or clarification is provided, (e.g. through a bespoke condition), that in accounting for activity against the LLW limits, the activity of daughter radionuclides with half-lives of less than three months shall not be included unless they are not in secular equilibrium. This clarification is required to ensure consistency with industry working practices. Clarification is also sought that, as the conditioning grout and container are part of the consigned waste received at the D3100 gate, it is the gross weight of the waste package that should

be used to determine that disposals to D3100 are LLW. A full account of the issues with the current definition and justification for the clarification is provided in *“Radionuclides Accounted for in Total Low Level Waste Activity Limits”*, D3100/4/REP/INT/40088/IS/02, Issue 2, December 2019 [27] and *Definition of Low-Level Waste*, D3100/4/REP/GAL/40064/IS/01, Issue 01, 25 March 2020 [35].

### 3.2.3 Reference to the Environmental Safety Case

- 47 DSRL request that there is a requirement to agree the Environmental Safety Case with SEPA, and thereafter any reference to “Environmental Safety Case” or “Environmental Safety Case 2010” is replaced with reference to an “agreed Environmental Safety Case”.
- 48 In addition, there are areas within the permit that currently reference specific wording from the Environmental Safety Case 2010, for example the use of anticipated vault names and layouts of future phases of construction. These should be replaced with wording that refer to the ‘agreed Environmental Safety Case’.
- 49 This change is required to ensure compliance with Condition 6.2 and to facilitate ongoing optimisation of the facility design and operations in line with regulatory requirements, including Requirement 8 (Optimisation) of the GRA [4]. The current reference to a timestamped version of the Environmental Safety Case precludes DSRL ability to optimise. This request relates to Table 1, Conditions 6.1, 7.1, 9.1, 10.1, 11.1, the Interpretation of Terms and Schedule 3.
- 50 It is highlighted that during the pre-application dialogue with SEPA, it was identified that for the Site Plan in Schedule 3 to remain valid it should reflect the ‘as-built’ status of the vaults and will therefore require to be updated for each future phase of vault construction. A revised Site Plan is presented in Appendix E. Future updates to Schedule 3 will require a minor variation to the EASR permit.
- 51 In addition, DSRL request that Condition 6.3 is amended to require a management plan to be agreed with SEPA. An ESC management plan is anticipated to include timescales and scope of reviews and define project stages that may warrant a review of the ESC, such as future phases of construction. This change, alongside the proposed reference to the agreed ESC allows for reviews and updates to be undertaken as appropriate with SEPA consultation and will ensure timely identification of any permitting implications, e.g. refinements to Schedule 3 outlined above.

### 3.2.4 Waste Compliance Testing and Auditing

- 52 DSRL request that Condition 2 “Waste Characterisation” and Condition 5 “Waste Compliance Testing” are combined. Recent work to revise the Waste Compliance Test Plan (WCTP) [28], which has been agreed with SEPA, has demonstrated that a programme of consignor audits is considered to be a key tool in providing assurance that the consignor has complied with the Authorised WAC. Furthermore, a selection of compliance testing techniques, including sampling, employed on a risk-informed basis, was considered to align with industry good practice.

- 53 It has been agreed with SEPA that no destructive testing is required since the original RSA Authorisation was granted<sup>1</sup>. This has been reflected and justified in the revised WCTP, and as such it is requested that this requirement is removed from the permit.
- 54 DSRL request that the revised conditions reflect that it is the role of the consignor to ensure the information provided with a waste consignment is true and accurate, and the role of the permit holder is to provide assurance that the required information is provided by the consignor.

### 3.2.5 Non-compliant Waste – Optimisation of Remedial Action

- 55 DSRL request that Condition 3.2 is varied to facilitate the optimisation of any remedial actions required in response to the mis-consignment of non-compliant waste.
- 56 Since the conception, in 2017, of a dedicated team to run the LLWDF, a revised waste acceptance process has been implemented, which includes in depth reviews of LLW packages and audits of consignors. This waste acceptance process is designed to ensure that only waste that complies with the Waste Acceptance Rules, and therefore the Authorised WAC is accepted for disposal.
- 57 Further to the revised waste acceptance process, DSRL also undertook a project to verify all waste previously disposed of to the vaults [13]. The findings of the verification project have informed updates to both the LLWDF's waste acceptance process and DSRL's waste management process.
- 58 Historically, mis-consignments arose at the LLWDF due to the management processes in place at the time, as recognised by the verification project. The revised LLWDF waste acceptance process alongside the revised Waste Compliance Test Plan provide adequate mitigation to this. Future mis-consignment is considered to be very unlikely. However, though unlikely, DSRL recognise there is the potential that mis-consignments may not be recognised until after disposal, primarily due to additional waste stream information being provided with later consignments. This type of mis-consignment has been experienced across the industry, in particular at the Low Level Waste Repository in Cumbria.
- 59 DSRL recognise that, in general, the Authorised WAC ensure that the assumptions within the ESC are assured at an inventory scale and that environmental safety is not compromised. However, it is also recognised that not all mis-consignments would necessarily result in environmental detriment or compromise the Environmental Safety Case, particularly when considered on an individual package basis. Previous experience from the verification project has shown that, although a non-compliance was identified due to the disposal of LLW packages with high levels of voidage, this was not considered to have compromised the ESC, and redistribution of these packages within the facility was agreed with SEPA as being the optimal remedial option.
- 60 The experience of the verification project has identified that responding to mis-consignments requires a measured approach, involving the review of data and the assessment of options in order to ensure the optimal remedial actions are undertaken. Such an approach is aligned with Standard Conditions A.9

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<sup>1</sup> Condition 5.3 requires a frequency for destructive testing to be agreed with SEPA. The agreed frequency since the RSA Authorisation was granted is zero.

“Contraventions of your authorisation” and B.5 “Contamination control and remediation”.

### 3.2.6 Consistency Between Condition 11 and Standard Condition J

- 61 DSRL recognise the importance of Standard Condition J Environmental Monitoring Programme in assessing the impact from radioactive waste disposals. It is noted, however that this Standard Condition makes an implicit assumption about the nature of the disposal, the pathways to the environment and the associated receptors by requiring monitoring of the environment and food stuff during the period of operation. This is wholly appropriate for disposals that involve liquid and gaseous discharges, but less appropriate for a facility such as the LLWDF where there are no operational discharges and public dose during operations via sky-shine is trivial. Consequently, bespoke Condition 11 introduces specific requirements to monitor the groundwater pathway, which will be the dominant pathway post-closure and following the period of authorisation.
- 62 Condition 11 introduces inconsistencies with the reporting timescales and methodologies listed in Standard Condition J (and associated Schedule 2). The relationship between Condition 11 and Standard Condition J is unclear and DSRL request clarity on any precedence between these conditions and clarity on the reporting requirements. Additional opportunities to rationalise Condition 11 are also requested in 3.2.7 Appendix A.

### 3.2.7 Other

- 63 During the implementation of the EASR permit and from the experience gained through its use (including during regulatory inspections) several opportunities to improve clarity and consistency have been identified. These have been discussed with SEPA during pre-application dialogue and include:
- Removing duplication,
  - Minor re-structuring, and
  - Clearer identification of relationship to associated Standard Conditions
- 64 Changes to the permit in order to realise these opportunities and thereby improve future demonstrations of compliance are fully detailed in Appendix A.

## APPENDIX A REQUESTED CHANGES AND JUSTIFICATION

Table 1: EASR Bespoke Conditions

| EASR Bespoke Condition | EASR Bespoke Condition wording   | Request  | Justification  |
|------------------------|--|--|--|
| 1                      | Receipt of radioactive waste   |  |  |
| 1.1                    | You are authorised to dispose only of the radioactive waste arising from the Dounreay Nuclear Establishment, the Vulcan Naval Test Establishment and from your authorised activities at the authorised place only of the types of radioactive waste identified in Table 1, only by the disposal routes specified in Table 1. | DSRL request that this condition is amended to include explicit authorisation to receive low level radioactive waste.  | <p>There is currently no explicit condition in the permit that authorises the facility to receive low level radioactive waste.</p> <p>Amending the condition as requested will provide a clear link to Standard Condition B.3.1.</p> <p>Additionally, the requested amendment more accurately reflects both the section heading, and the facilities primary undertaking of receiving low level radioactive waste for the purpose of disposal.</p>                |
| Table 1                |  | DSRL request that this table is moved to Condition 8 and replaced with a condition that requires radioactive waste to be disposed in the appropriate waste vault, in line with the agreed Environmental Safety Case. | <p>Row 3 of the table is no longer required as this is now considered under EASR to be a transfer, and is therefore controlled by Section C of the Standard Conditions.</p> <p>Rows 1 and 2 of the table add confusion due to the specific naming of vaults as represented in the Environmental Safety Case (ESC). Operationally vaults will be named according to standard site process once built, this does not align with the names assigned in the ESC.</p> |



| EASR Bespoke Condition | EASR Bespoke Condition wording  | Request   | Justification  |
|------------------------|---|---|--|
|                        |   |   | <p>Further, it is considered that Conditions 7.1, 9.1 and 9.5 adequately control how vaults are constructed and how waste is managed within these vaults during disposal. These conditions allow for vault layout and numbers to be revised as appropriate to ensure continued optimisation, with any revision being fully controlled by SEPA through agreement of a revised ESC and Operational Management Plan (OMP).</p> <p>It is noted that the current permit includes section heading 1 - Receipt of radioactive waste and section heading 8 - Disposal of radioactive waste. It is considered that this condition should be included under Section 8 as it specifically relates to the disposal of radioactive waste.</p> |
| 1.2                    | The maximum radionuclide activities that are to be disposed of at the authorised place are specified in Schedule 2. | <p>DSRL request that Condition 1.2 and the associated Schedule 2 are replaced with the requirement to control disposals using a Sum of Fractions approach in accordance with the Environmental Safety Case (ESC), using control levels termed Calculated Activity Concentration Levels (CACLS).</p> <p>The CACLS are set such that each radionuclide, if disposed of separately in the manner assumed in the ESC and supporting performance assessment model, would give a calculated impact equivalent to the relevant</p> | <p>The justification for this request is laid out fully in "Application of Sum of Fractions for D3100", D3100/4/REP/GAL/40092/IS/02, Issue 3 [24] and is summarised below:</p> <p>The current activity limits within Schedule 2 of EAS/P/1173599 are derived from the 'best estimate' of the 2009 predicted LLW inventory [11]. These limits have insufficient allowance for the uncertainties inherent in these predictions.</p> <p>There are several of the radionuclide activity</p>  |

| EASR Bespoke Condition | EASR Bespoke Condition wording | Request  | Justification  |
|------------------------|--------------------------------|--|--|
|                        |                                | <p>regulatory guidance level from the Guidance on Requirements for Authorisation (the GRA). The CACLs are specified in units of GBq/tonne, and two sets of CACLs have been determined for the two types of waste and two engineering solutions being followed at the LLWDF, namely LLW and Demolition LLW. The requested CACLs are detailed in Appendix C.</p> <p>Limiting disposals such that the sum of the total activity concentration for each radionuclide within each vault divided by the CACL for the respective radionuclide is less than 1 will ensure compliance with the GRA performance measures based on the modelling approaches adopted. Full details of the requested approach are provided in "Application of Sum of Fractions for D3100", D3100/4/REP/GAL/40092/IS/02, Issue 3 [24].</p> | <p>limits in the Authorised WAC that are exceptionally low. As a consequence of the inventory-based approach to setting limits, radionuclides with low limits only contribute a small proportion of the overall estimated inventory and are not significant in respect of their contribution to calculated post closure risks.</p> <p>These circumstances have led to the situation where the declared inventories of some radionuclides in stored LLW already exceed the Schedule 2 limits and the waste cannot therefore be disposed despite there being a very low associated risk. Furthermore, the inventory estimates have been recently updated [21] and this has confirmed that the Schedule 2 limits as a whole are lower than the current best expectations of the Dounreay decommissioning programme. The revised ESC [22] shows that a case can be made that the disposal of these expected wastes is safe and compliant with extant legislation.</p> <p>DSRL are therefore requesting a change to the Schedule 2 limits to enable efficient use of available waste routes for wastes either in storage or expected to arise. DSRL has undertaken a review, "Alternative Approaches to Setting and Managing Revised D3100 Activity Limits" D3100/4/REP/GAL/40017/IS/01</p> |

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|                        |  |  | <p>[29], of the different approaches to setting and managing radionuclide activity limits for the LLWDF and their potential use during acceptance of waste that contains a mixture of radionuclides. The associated advantages and disadvantages of various approaches were identified, and a recommendation made that the optimal approach would be to utilise a sum of fractions (SoF) / sum of quotients approach. The preferred approach was endorsed by the DSRL Environmental Review Committee (ERC) and the Dounreay Nuclear Safety and Environmental Committee (DNSEC).</p> <p>The preferred SoF approach has been developed and is documented in reference [24]. The SoF approach is risk-based and utilises performance assessment modelling to assess what radionuclide content the disposal facilities can safely contain. This approach provides far greater flexibility to accommodate uncertainties in future waste arisings and will therefore facilitate optimised waste management during the management of stored waste and waste produced during future decommissioning.</p> |
| 1.3                    | You are authorised to store radioactive waste arising from the Dounreay Nuclear Establishment and from your authorised activities at the authorised place. | DSRL request that this condition is removed. | It is clear within the EASR and based on previous correspondence with SEPA [19] that storage is included under the term 'management'.  |

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|                        |  |  | <p>The LLWDF is a facility that is designed and operated to receive LLW for the purposes of disposal. As such, any waste received is considered to be disposed once located within its designated waste vault. The LLWDF does not store received radioactive waste.</p> <p>In line with EASR, the LLWDF is authorised for the management of radioactive substances and must meet all the Standard Conditions related to the management of radioactive substances. It is possible that small volumes of radioactive waste may be generated as a result of the authorised activity which may require to be stored on site prior to transfer. In the unlikely event that waste generated may require to be stored, it will be managed under the existing Standard Conditions outlined in the permit.</p> <p>There is no requirement for the facility to be specifically authorised to store radioactive waste as this is covered under the term 'management'.</p> |
| 2                      | Waste Characterisation   |  |  |
| 2.1                    | In respect of all radioactive waste accepted for disposal at the authorised place, you must ensure, by appropriate auditing, that the radioactive waste has been | DSRL request that this condition and its requirement is combined with Condition 5 - Waste Compliance Testing | DSRL consider that auditing should not be solely limited to characterisation data, and that a broader requirement should be included in the permit for the LLWDF to undertake consignor audits.  |

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|                        | characterised by the consignor such that all information necessary for the safe disposal of the radioactive waste in the long term is correct, available and recorded.                    |  | Auditing can provide assurance but cannot ensure that information included in every waste record is correct, available and recorded. The requirement to provide a true and accurate description of the waste has been placed on the consignor through Condition C.2.1(a). The wording in a revised Condition 5 should reflect that the role of the consignor is to ensure that information is true and accurate, and the role of the disposal facility is to provide assurance that the required information is provided by the consignor. |
| 3                      | Authorised waste acceptance criteria  |  |  |
| 3.1                    | The following Authorised Waste Acceptance Criteria shall apply to radioactive waste accepted at the authorised place:   | No change proposed   |  |
|                        | a. No waste will be accepted for disposal at the authorised place unless it has been demonstrated by the consignor that best practicable means and the waste hierarchy have been applied; | DSRL request that the requirement for demonstration of best practicable means (BPM) and waste hierarchy is applied to generation, characterisation, management and disposal. | Views on what is considered to be best practicable means (BPM) often varies between the waste consignor and the disposal facility. Requiring the consignor to specifically consider it for generation, characterisation, management and disposal ensures that the consignor does not solely consider BPM in relation to how the waste is managed within their project/facility.  |
|                        | b. The physical characteristics of the waste package shall be such that safety  | No change proposed   |  |

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|                        | is not compromised during any stage of management;  |   |  |
|                        | c. Best practicable means shall be applied to the disposal of each bulk item at the authorised place;       | DSRL request that this condition is removed alongside the definition of 'bulk item'.  | <p>Condition 3.1(a) already requires best practicable means (BPM) to have been demonstrated by the consignor, the requested change ensures that disposal aspects are considered for all waste. Condition 3.1(c) is considered to be a duplication.</p> <p>The definition of 'bulk item' has caused confusion with regards to containerised bulk items and non-containerised items, in addition it has also caused unnecessary confusion during production of the Criticality Safety Assessment [25]. Given the requested removal of this condition, there is no longer a requirement for it to be defined.</p> |
|                        | d. Waste in its untreated form shall contain < 0.1%wt very toxic substances and <3%wt for toxic substances; | <p>DSRL request that this condition is replaced with a requirement that no waste will be accepted for disposal unless it has been assured that:</p> <ul style="list-style-type: none"> <li>a) any properties that would be considered hazardous if the waste was not radioactive have been declared by the consignor; and</li> <li>b) all materials that would be considered hazardous if the waste was not radioactive have been made safe for transport and disposal operations,</li> </ul> | <p>The condition at present makes reference to outdated terminology derived from superseded guidance (Technical Guidance WM2 [30]). The extant guidance (Technical Guidance WM3 [31]) does not use the terms 'very toxic' or 'toxic' and efforts to align previous legislation and guidance with current arrangements have not provided further clarity. The ambiguity of the condition has previously been recognised by SEPA [14].</p> <p>Based on a review [26] of engineering design</p>   |



| EASR Bespoke Condition | EASR Bespoke Condition wording | Request  | Justification   |
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|                        |                                | and the method(s) used justified by the consignor. | <p>and performance, waste characterisation, management plans and monitoring, it has been demonstrated that the management of non-radiological hazards within wastes to be emplaced in the LLWDF would be at least equivalent to the management of hazardous waste in a hazardous waste disposal facility. Therefore satisfying the regulatory requirements in the joint environment agencies' 'Guidance on Requirements for Authorisation (GRA) for near-surface disposal facilities for solid radioactive wastes' [4]. Though there are no concerns with regards to the long-term safety of non-radiological hazards disposed of to the LLWDF, the review identifies that operational safety must be demonstrated to have been met prior to disposal. This is particularly relevant to the demolition LLW and non-containerised LLW streams [Section 5.1, 26].</p> <p>The proposed condition ensures operational safety at the disposal facility by requiring all properties that would be considered hazardous if the waste was not radioactive to be declared and all materials that would be considered hazardous if the waste was not radioactive have been made safe for transport and disposal operations prior to acceptance to the LLWDF. The proposed condition allows for future changes in legislation and guidance and</p> |

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|                        |   |   | <p>ensures that compliance with the condition can be demonstrated against arrangements current at the time.</p> <p>For further information, please see 'Management on Non-Radiological Hazards in D3100 - ESC2020', D3100/4/REP/GAL/40018/IS/01 [26]</p>  |
|                        | e. Biodegradable waste must be excluded as far as is practicable and must not exceed 1%wt of the untreated waste package;         | DSRL request that this condition is amended to apply to the waste package, rather than the untreated waste package. | The proposed change ensures that the Waste Acceptance Criteria is applied at the point of acceptance to the LLWDF. This aligns the condition with the other Waste Acceptance Criteria.  |
|                        | f. Only the radionuclides up to the activity specified in Schedule 2 shall be disposed of at the authorised place;                | Duplication of Condition 1.2. DSRL request that SEPA remove unnecessary duplication.                                | SEPA recognised during a previous inspection that Conditions 1.2 and 3.1(f) appear to be duplications of the same requirement. Request that unnecessary duplication is removed [SEPA inspection 07/10/2020].  |
|                        | g. Compacted waste packaged in Half Height ISO containers shall contain no greater than 600g Uranium-235;                         | DSRL request conditions 3.1(g) - (k) are amended to refer to a separate schedule which aligns with Appendix D.      | The Criticality Safety Assessment (CSA) [25] gives the safety justification for increasing the fissile content for some waste packages and also now derives limits that account for specified content of common neutron moderating and reflecting materials (graphite and beryllium). The latter were specifically included in the revised CSA as operational experience indicated that there was a lack of clarity regarding their impact on criticality safety and acceptable waste package fissile |
|                        | h. Mixed compacted and non-compacted waste packaged in Half Height ISO containers shall contain no greater than 600g Uranium-235; |   |   |
|                        | i. Non-compacted waste packaged in Half Height ISO containers shall contain no greater than 60g Uranium-235;                      |   |   |

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|                        | j. Non-containerised Low Level Waste shall contain no greater than 60g Uranium-235 per item;  |   | limits. The proposed limits in Appendix D have been modelled in the CSA, which demonstrates their considerable safety margins. The waste package fissile limits have not been increased for Demolition LLW or HHISOs containing only pucks and 200 l drums (Scenarios A and D in Appendix D) , as review of the available data indicates that these limits are sufficient. Scenario E seeks to allow the rare case that may arise where a package outside of the proposed limits, due to its fissile and/or moderator/reflector content or the waste package, but where it could be managed and disposed of safely in D3100 through load management arrangements and where a package-specific criticality safety case has been developed and agreed in writing with SEPA. It is emphasised that this condition is only anticipated to be a rare occurrence - in an assessment of stored waste records only a single package was identified that could not be accepted with the revised limits. |
|                        | k. Packages of Demolition Waste shall contain no greater than 6g Uranium-235.   |   |  |
| 3.2                    | In the event that radioactive waste or its packaging does not meet any of the authorised waste acceptance criteria set out in condition 3.1, it shall be rejected by the authorised person. Rejected radioactive waste shall be returned to the Dounreay Nuclear Establishment forthwith and you must inform SEPA in writing without delay. | <p>DSRL request that the condition is amended to allow for a more proportionate response to be taken in line with best practicable means (BPM) where it may be identified that previously disposed waste does not meet the waste acceptance criteria.</p> <p>It is suggested that the amended condition could align with the requirements of Standard</p> | <p>The proposed amendment facilitates the optimisation of any remedial actions required in response to the mis-consignment of non-compliant waste.</p> <p>Since the conception, in 2017, of a dedicated team to run the LLWDF, a revised waste acceptance process has been implemented, which includes in depth reviews of LLW</p>   |

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|                        |                                | <p>Conditions A.9.2 and B.5.2 by including a requirement to undertake an investigation which takes account of the long term safety implications of the package and to use BPM to identify any remedial actions.</p> | <p>packages and audits of consignors. This waste acceptance process is designed to ensure that only waste that complies with the Waste Acceptance Rules, and therefore the Authorised WAC is accepted for disposal.</p> <p>Further to the revised waste acceptance process, DSRL also undertook a project to verify all waste previously disposed of to the vaults [13]. The findings of the verification project have informed updates to both the LLWDF's waste acceptance process and DSRL's waste management process.</p> <p>Historically, mis-consignments arose at the LLWDF due to the management processes in place at the time, as recognised by the verification project. The revised LLWDF waste acceptance process alongside the revised Waste Compliance Test Plan provide adequate mitigation to this. Future mis-consignment is considered to be very unlikely. However, though unlikely, DSRL recognise there is the potential that mis-consignments may not be recognised until after disposal, primarily due to additional waste stream information being provided with later consignments. This type of mis-consignment has been experienced across the industry, in particular at the Low Level Waste Repository in Cumbria.</p> |

| EASR Bespoke Condition | EASR Bespoke Condition wording | Request | Justification   |
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|                        |                                |         | <p>DSRL recognise that, in general, the WAC ensure that the assumptions within the ESC are assured at an inventory scale and that environmental safety is not compromised. However, it is also recognised that not all mis-consignments would necessarily result in environmental detriment or compromise the Environmental Safety Case, particularly when considered on an individual package basis. Previous experience from the verification project has shown that, although a non-compliance was identified due to the disposal of LLW packages with high levels of voidage, this was not considered to have compromised the ESC, and redistribution of the packages within the facility was agreed with SEPA as being the optimal remedial option.</p> <p>The experience of the verification project has identified that responding to mis-consignments requires a measured approach, involving the review of data and the assessment of options in order to ensure the optimal remedial actions are undertaken. Such an approach is aligned with Standard Conditions A.9 "Contraventions of your authorisation" and B.5 "Contamination control and remediation".</p> |
| 4                      | Excluded hazardous materials   |         |   |

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| 4.1                    | You must ensure that radioactive waste containing any of the following hazardous properties are excluded from disposal at the authorised place:   | DSRL request that these specific conditions are removed in favour of the proposed change to Condition 3.1(d). | <p>The condition as worded requires the exclusion of materials, this causes demonstration of compliance to be challenging as it requires to prove a negative.</p> <p>The terminology used has become and could become redundant through legislative changes. By having an overarching requirement as proposed in 3.1(d) this will drive better characterisation, management and risk reduction of any potential hazards.</p> <p>Based on a review [26] of engineering design and performance, waste characterisation, management plans and monitoring, it has been demonstrated that the management of non-radiological hazards within wastes to be emplaced in the LLWDF would be at least equivalent to the management of hazardous waste in a hazardous waste disposal facility. Therefore satisfying the regulatory requirements in the joint environment agencies' 'Guidance on Requirements for Authorisation (GRA) for near-surface disposal facilities for solid radioactive wastes' [4]. Though there are no concerns with regards to the long-term safety of non-radiological hazards disposed of to the LLWDF, the review identifies that operational safety must be</p> |
|                        | a. Combustible metals, such as uranium, lithium, magnesium, zinc, zirconium, sodium, potassium, calcium and other metals, in finely divided form; |   |   |
|                        | b. Other pyrophoric materials;  |   |   |
|                        | c. Phosphorus;  |   |   |
|                        | d. Fixed liquids (e.g. immobilised in cement) with flash points less than 21C;  |   |   |
|                        | e. Chemical compounds representing a high fire hazard;  |   |   |
|                        | f. Materials that react with water to evolve heat and flammable gases (e.g. hydrides, nitrides and carbides);                                     |   |   |
|                        | g. Strongly acidic or alkaline compounds.   |   |   |



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| 4.2                    | Notwithstanding condition 3.1, you must ensure that radioactive waste to be disposed of at the authorised place shall comply with the following conditions:  |         | demonstrated to have been met prior to disposal. This is particularly relevant to the demolition LLW and non-containerised LLW streams [Section 5.1, 26].   |
|                        | a. waste containing loose powders or asbestos must be in sealed containers;  |         | <p>The proposal for Condition 3.1(d) ensures operational at the disposal facility by requiring all properties that would be considered hazardous if the waste was not radioactive to be declared and all materials that would be considered hazardous if the waste was not radioactive have been made safe for transport and disposal operations prior to acceptance to the LLWDF. The proposed condition allows for future changes in legislation and guidance and ensures that compliance with the condition can be demonstrated against arrangements current at the time.</p> <p>For further information, please see 'Management on Non-Radiological Hazards in D3100 - ESC2020', D3100/4/REP/GAL/40018/IS/01 [26].</p> <p>It is recognised that the proposed condition appears more generic than the current list of individual requirements, however the intent of the change is that it will drive the consignor to</p> |
|                        | b. waste must not contain strong complexing agents, unless treated and stabilised;   |         |   |
|                        | c. all waste containing ion exchange material must be intimately stabilised to ensure retention of its radioactive content;  |         |   |
|                        | d. no readily leachable/soluble solid wastes are to be disposed of without conditioning. Readily leachable/soluble solid waste must be fixed in a solid matrix (e.g. cement) that will not readily release that component when contacted with water; |         |   |
|                        | e. waste must not contain, or be capable of spontaneously generating, quantities of toxic gases, vapours or fumes harmful to persons transporting, handling or disposing of the waste;   |         |   |

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|                        | f. waste must not contain material capable of detonation or explosive decomposition or reaction at normal pressures, nor of explosive reaction with water;   |         | consider hazards more holistically and in line with conventional waste legislation and guidance. DSRL are of the view that this will ensure all hazards are considered rather than solely those listed. Further guidance will be provided to consignors detailing the expectations to follow Technical Guidance WM3 [31] or any future guidance documents, and specific examples will be provided to explain why these hazards are of concern. |
|                        | g. waste must not contain corrosive material that might prejudice the integrity of the container, including bags used for disposal;  |         |  |
|                        | h. waste must not contain metals or other materials, unless treated and stabilised, that might react with grout;   |         |  |
|                        | i. pressurised gases, including redundant cylinders and aerosols, must be excluded until made safe;  |         |  |
|                        | j. strong oxidising agents (e.g. peroxides, chlorates, nitrates) are to be eliminated wherever practicable. In any event, these materials are not to be in close contact with easily oxidised materials; |         |  |
|                        | k. waste containing pathogens or biologically hazardous material shall be excluded from waste packages accepted for disposal unless demonstrated to have been made safe.                                 |         |  |
| 5                      | Waste compliance testing   |         |  |

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| 5.1                    | You must prepare, implement and maintain a programme of waste compliance testing agreed in writing with SEPA.                            | DSRL request that Conditions 5.1 and 5.2 are amalgamated and for the new condition to make explicit reference to having a programme of consignor audits and undertaking compliance testing on a sample of waste where necessary. We request that all auditing and waste compliance testing should be undertaken using a risk-based approach. | <p>DSRL recently undertook a project to review and revise the Waste Compliance Test Plan (WCTP) [28] produced in compliance with Condition 5.1. The decision was made to employ independent contractors who reviewed DSRL's LLW management system, including the LLWDF waste acceptance processes and undertook a good practice review of waste acceptance across the UK. The findings of these reviews informed the revision of the WCTP.</p> <p>The review recognised that the LLWDF operates under a unique management system, with the Consignor and Consignee operating under the same business, and so not all identified learning was applicable. However, the review highlighted a number of measures that have subsequently been implemented through the revised WCTP to reflect good practice undertaken at other facilities.</p> <p>Implementation of the measures and recommendations within the WCTP align the LLWDF with Industry Best Practice both with other waste accepting facilities and regulatory standards and is considered to represent best practicable means. The revised WCTP has been agreed by SEPA [32].</p> <p><u>Audits</u></p> |
| 5.2                    | Waste compliance testing shall consist of tests which demonstrate that the waste complies with the authorised waste acceptance criteria. |  |  |

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|                        |                                |         | <p>A common learning from all facilities reviewed was the need to audit the waste consignor to ensure the robustness of their processes and general waste management. This has been reflected in the audits in the revised WCTP.</p> <p><u>Compliance Testing</u><br/>         A measure undertaken elsewhere involves the resampling (where necessary) and rebuilding of the Consignor's fingerprint by an independent SQEP on behalf of the accepting facility, with the original fingerprint compared against the rebuilt version. The LLWDF adopts a similar process in the revised WCTP.</p> <p>LLWR undertake assaying of received waste packages at the repository on a risk-based approach. A percentage of received waste packages are subject to gamma spectroscopy, thus enhancing the confidence in consignment figures. A regime of independent non-destructive assaying has been implemented in the revised WCTP. As DSRL have access to waste items as opposed to just waste packages, the assaying, where possible, will target waste items as opposed to the final waste package. This will reduce the uncertainty associated with the assays as it addresses individual items, as opposed to the collective package, therefore allowing greater confidence in the final consignment</p> |

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|                        |   |   | information.<br><br><u>Physical Testing</u><br>DSRL and SEPA have agreed a physical testing frequency of zero since the original RSA Authorisation was granted. The lack of a requirement for destructive testing has been justified as the methods of auditing and compliance testing described above and included in the WCTP provide sufficient confidence in the waste, align with industry best practice and demonstrate best practicable means. |
| 5.3                    | You must select, at a frequency agreed in writing with SEPA, waste consignments, held by the waste consignor, which shall be destructively tested to confirm both content and characterisation against the consignor's waste records. | DSRL request that the requirement to undertake destructive testing is replaced with the proposed Condition 5.1.       | As above.   |
| 6                      | Environmental safety case   |   |   |
| 6.1                    | You must maintain an Environmental Safety Case.   | DSRL request that this condition is amended to include specific agreement of the Environmental Safety Case with SEPA. | There are a number of conditions throughout the permit that relate to the Environmental Safety Case (ESC), with Condition 7.1 making specific reference to ESC 2010. By amending Condition 6.1 to require agreement of the ESC with SEPA, the permit can be simplified to refer to the 'agreed ESC' throughout.<br><br>The proposed change avoids confusion   |

| EASR Bespoke Condition | EASR Bespoke Condition wording   | Request  | Justification   |
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|                        |  |  | <p>between previous iterations of the ESC and allows updates to the ESC with SEPA approval without the need to change the wording within the permit.</p> <p>Please also refer to Condition 7.1.</p>   |
| 6.2                    | You must update and provide to SEPA the Environmental Safety Case at a frequency agreed in writing with SEPA.  | No change proposed   |   |
| 6.3                    | You must provide SEPA a report on the review of the Environmental Safety Case, including any actions needed and timescales for completion by 31 January 2022 and every 3 years from this date. | <p>DSRL request that the condition is amended to refer to an agreed Environmental Safety Case (ESC) maintained through an ESC management plan that would be agreed with SEPA in a similar fashion to Condition 9.2. The management plan should include timescales and scope of reviews and define project phases that may warrant an update to the ESC, such as future phases of construction.</p> | <p>This proposal avoids confusion between previous iterations of the Environmental Safety Case (ESC) and allows updates to the ESC with SEPA approval, without the need for further changes to the permit.</p> <p>There is no mention of specific timescales for reviews and updates of the ESC within the Guidance on Requirements for Authorisation (GRA) [4], but the Guidance on Requirements for Release from Radioactive Substances Regulation (GRR) [33] makes reference to a 10 year timescale for updates to a SWESC. The GRA makes reference to update "the environmental safety case at each step during the development of a disposal facility and at suitable intervals during the period of authorisation" (GRA 7.2.12). An agreed ESC management plan would set out the details and scope of regular reviews to the ESC that may prompt an update to the agreed ESC,</p> |

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|                        |   |   | such as changes to legislation or guidance, or changes to operations detailed within the Operational Management Plan (OMP) and the ESC. However, a review may also find that operations, design and understanding of the authorised facilities have not changed and that an update to the ESC would not be required.  |
| 7                      | Design and construct  |   |   |
| 7.1                    | You must design and construct the vaults in accordance with the Environmental Safety Case 2010. | <p>DSRL request that this condition is amended to refer to the 'agreed Environmental Safety Case (ESC)' rather than make explicit reference to ESC 2010.</p> <p>See Condition 6.1</p> | Requirement 8 (Optimisation) of the Guidance on Requirements for Authorisation (GRA) [4] identifies "that the process of optimising a disposal facility requires the continuous attention of the developer/operator from the design stage through to the end of the period of authorisation. Optimisation of a disposal facility is not concerned with steady-state operation, but with a changing and evolving state, both during the period of authorisation and afterwards." The phased approach to the construction of the LLW disposal facilities provides DSRL with the capability to ensure this requirement is met and facilitates the ongoing optimisation of the design. This condition prevents optimisation in this manner by restricting the design to that presented in the Environmental Safety Case (ESC) 2010. In doing so, this condition also contradicts Condition 6.2 of EAS/P/1173599 which requires the ESC to be updated at intervals agreed with SEPA. |



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| 7.2                    | You must, following excavation of each Phase, provide SEPA with a detailed design for construction of that Phase as soon as practicable and in any event at least two calendar months prior to the commencement of the construction of that Phase. | DSRL request that this condition is amended to replace the requirement to provide the detailed design "following the excavation of each phase" with a requirement to provide SEPA with a detailed design for the construction of the different elements of each Phase. | The development of additional phases of disposal facilities is a multi-staged process involving the detailed design and construction of several different elements, including excavation, drainage and the concrete vaults themselves. In practice, the detailed design of one element will progress in advance, or in parallel, with the construction of the preceding element such that there is a continuous construction programme. Requiring completion of the construction of one element, i.e. excavation, prior to the design of the next element, e.g. the concrete vaults, being submitted and agreed with SEPA will result in sub-optimal scheduling of the construction programme for no obvious environmental benefit. It is recognised that unforeseen conditions may be encountered during excavation work that may impact on the detailed design of the concrete vaults and indeed the Environmental Safety Case (ESC). These potential risks are best managed through a corrective action plan as recognised by 6.4.23 of the Guidance on Requirements for Authorisation (GRA) [4]. |
| 7.3                    | You must provide a copy of any completion certificate(s) issued by the local authority to SEPA as soon as practical.   | DSRL request that this condition is removed.   | This condition does not provide assurance that the facilities have been designed and constructed in accordance with the Environmental Safety Case (ESC), the EASR permit or the Guidance on Requirements for Authorisation (GRA) [4]. Regardless, the  |

| EASR Bespoke Condition | EASR Bespoke Condition wording   | Request              | Justification   |
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|                        |  |                      | facilities are exempt from building control and a completion certificate was not produced for Phase 1, nor is it anticipated for future phases. Furthermore, the condition as written, provides no assurance that any requirements the local authority have will be met. Failure to meet the local authority's requirements would mean that a completion certificate would not be awarded. There would therefore be no certificate to provide to SEPA and the condition would be satisfied. |
| 7.4                    | The base, sides and final cap of the disposal vaults at the authorised place shall consist of an artificially established, engineered barrier constructed to ensure as a minimum the following standards:<br>a. Permeability of less than or equal to $1.0 \times 10^{-9}$ metres/second; and<br>b. The artificial barrier with a thickness of not less than 0.5metres, giving equivalent or greater protection than a 5 metre thick mineral layer; and<br>c. The artificial barrier shall provide sufficient attenuation capacity to prevent an unacceptable risk to groundwater. | No change requested. |   |
| 7.5                    | You must at least 28 days prior to construction of each Phase, provide to SEPA a detailed programme of Construction Quality Assurance  | No change requested. |   |

| EASR Bespoke Condition | EASR Bespoke Condition wording  | Request                                      | Justification   |
|------------------------|---|--|---|
|                        | monitoring and reporting, including the demonstration of compliance with the standards required in condition 7.4.               |  |   |
| 8                      | Disposal of radioactive waste   |  |   |
| 8.1                    | You must dispose of stored radioactive waste as soon as it is practicable to do so and in any event within 24 hours of receipt. | DSRL request that this condition is removed. | <p>This condition was originally included as Condition 2.5.2 in the Authorisation granted under the Radioactive Substances Act under Condition 2.5 "Accumulation of Radioactive Waste". During implementation of the EASR, RSA Condition 2.5.2 was transferred as a bespoke condition under Condition 8 "Disposal of radioactive Waste" within the EASR Permit. The majority of Conditions within 2.5 are now considered in Standard Condition B.4 "Safe management of radioactive substances".</p> <p>It is clear within the EASR and based on previous correspondence with SEPA [19] that storage is now included under the term 'management'.</p> <p>One of the notable changes during the implementation of the EASR was the change in definition of 'disposal' and the inclusion of the term 'transfer'. Unlike the Radioactive Substances Act 1993 where disposals included transfers, under paragraph 4, Schedule 8 of EASR disposals are defined as including discharge, abandonment, burial and deposit.</p> |

| EASR Bespoke Condition | EASR Bespoke Condition wording | Request | Justification  |
|------------------------|--------------------------------|---------|--|
|                        |                                |         | <p>The transferred condition was amended to replace the word 'accumulation' with 'storage', but continued to reference the word 'dispose'. Given the changes to the definition of disposal noted above, this has caused the condition to become limited in scope to relate only to waste being received for the purpose of disposal. This change in scope has caused significant confusion.</p> <p>Condition 8.1 as worded only relates to waste being disposed of. The LLWDF is a facility that is designed and operated to receive low level radioactive waste for the purposes of disposal. As such, any waste received is considered to be disposed once located within it's designated waste vault. The LLWDF does not store received radioactive waste.</p> <p>Condition 8.1 as worded does not apply to waste being stored prior to transfer (e.g. waste generated by the authorised activity that is to be transferred to Dounreay site for conditioning). In line with EASR, the LLWDF is authorised for the management of radioactive substances and must meet all the Standard Conditions related to the management of radioactive substances. It is possible that small volumes of radioactive waste may be generated as a result of the authorised activity</p> |

| EASR Bespoke Condition | EASR Bespoke Condition wording  | Request  | Justification  |
|------------------------|---|--|--|
|                        |   |  | <p>which may require to be stored on site prior to transfer. In the unlikely event that waste generated may require to be stored, it will be managed under the existing Standard Conditions outlined in the permit. It is considered that Standard Condition B.7.3 is adequate to ensure all waste is transferred or disposed as soon as reasonably practicable, any further time limit imposed on waste prior to transfer would be disproportionate considering the negligible risk and lack of legislative requirement.</p> <p>There is no requirement for the facility to be specifically authorised to store radioactive waste as this is covered under the term 'management'.</p> |
| 8.2                    | There shall be no storage or disposal of radioactive waste in any Phase until:  | DSRL request this condition is amended to replace 'storage and disposal' with the term 'management'. | Storage is no longer a defined term within EASR. Use of the term management is consistent with EASR and the intent of the condition.   |
|                        | a. You have provided SEPA with documentary evidence that the relevant Phase has been designed and constructed in accordance with condition 7.2; and | No change proposed   |  |
|                        | b. SEPA has provided confirmation in writing to you that storage and disposal of radioactive waste in the relevant Phase may commence.              | DSRL request this condition is amended to replace 'storage and disposal' with the term 'management'. | Storage is no longer a defined term within EASR. Use of the term management is consistent with EASR and the intent of the condition.   |

| EASR Bespoke Condition | EASR Bespoke Condition wording  | Request  | Justification  |
|------------------------|---|--|--|
| 9                      | Operation   |  |  |
| 9.1                    | You must operate the authorised place in accordance with the Environmental Safety Case. However, in the event of any conflict between the Environmental Safety Case and the conditions of this permit or the standard conditions, the conditions of this permit or the standard conditions shall take priority.   | DSRL request the Environmental Safety Case (ESC) is referred to as the "agreed ESC"        | The proposed change avoids confusion between previous iterations of the Environmental Safety Case (ESC) and allows updates to the ESC with SEPA approval without the need to change the wording within the permit.   |
| 9.2                    | You must prepare, maintain and implement a Management Plan which includes, but is not limited to:<br>a. Load management<br>b. Leachate management<br>c. Water management<br>d. Packaging<br>e. Criticality Safety Case<br>f. Authorised Waste Acceptance Criteria implementation<br>g. Waste receipt and disposal<br>h. Capping<br>i. Environmental monitoring<br>j. Records management<br>k. Training of staff | DSRL request that the link between condition 9.2 and Standard Condition G.1.2 is clarified | SEPA recognised during a previous inspection that the link between Condition 9.2 and Standard Condition G.1.2 could be clarified through use of language or by making clear reference in the bespoke condition to the standard condition that is being expanded on. (SEPA inspection 07/10/2020) |
| 9.3                    | You must produce and maintain an intervention strategy for the retrieval of disposed waste.   | No change proposed.  |  |
| 9.4                    | You must produce, maintain and implement contingency arrangements and emergency plans for reasonably  | No change proposed.  |  |

| EASR Bespoke Condition | EASR Bespoke Condition wording  | Request             | Justification |
|------------------------|---|---------------------|---------------|
|                        | foreseeable events including, but not restricted to, corrosion, explosion, flooding, fire and loss of containment of the waste. Plans should consider steps necessary to limit effects and remedy potential impacts on the surrounding environment.   |                     |               |
| 9.5                    | All operations on the authorised place shall be carried out in accordance with the Management Plan. Where any limit or condition of this permit or the standard conditions conflicts with the Management Plan, the permit and standard conditions shall take precedence over the Management Plan.   | No change proposed. |               |
| 9.6                    | Unless otherwise specified in this permit, any proposed change(s) by you to the Management Plan shall be submitted in writing to SEPA at least 28 days before the implementation of the proposed change(s). The Management Plan shall only be amended in accordance with the proposed change(s) if, and to the extent that, either:<br>a. SEPA gives written approval of the proposed change(s); or<br>b. SEPA has not indicated to the authorised person in writing within 28 days of receiving the proposed | No change proposed. |               |



| EASR Bespoke Condition | EASR Bespoke Condition wording  | Request  | Justification  |
|------------------------|---|--|--|
|                        | change(s) that the proposed change(s) are rejected.   |  |  |
| 10                     | Closure   |  |  |
| 10.1                   | You must produce, maintain and implement a plan for the closure of Vaults consistent with the Environmental Safety Case. You must not commence closure of the Vaults or any part of the authorised place until you have received written confirmation from SEPA that it has approved the said plan. | DSRL request the Environmental Safety Case (ESC) is referred to as the "agreed ESC"  | The proposed change avoids confusion between previous iterations of the Environmental Safety Case (ESC) and allows updates to the ESC with SEPA approval without the need to change the wording within the permit. |
| 10.2                   | You must, prior to the cessation of waste disposal, produce a plan for the maintenance of active institutional control following the closure of the authorised place which must be approved in writing by SEPA prior to its implementation and thereafter maintained and implemented.               | No change proposed.  |  |
| 11                     | Additional sampling, measurements, tests, surveys and calculations  |  |  |
| 11.1                   | You must use best practicable means to prepare, maintain and implement a programme of monitoring the authorised place so as to confirm the assumptions of the Environmental Safety Case.  | DSRL request that Condition 11 is reviewed in whole, ensuring that the requirements of the section are clear, concise and aligned with the requirements of Section J of the Standard Conditions. | The requirements of Section 11 and Standard Condition Section J were originally included under Condition 2.9 "Sampling, measurements, tests, surveys and calculations" of the Authorisation granted                |

| EASR Bespoke Condition | EASR Bespoke Condition wording   | Request  | Justification   |
|------------------------|--|--|---|
| 11.2                   | Any proposed change(s) by you to the programme of monitoring shall be submitted in writing to SEPA at least 28 days before the implementation of the proposed change(s) and not implemented without written agreement from SEPA.   | <p>The amended conditions should include requirements to prepare, maintain and implement an Environmental Monitoring Programme, to agree any changes to the monitoring plan with SEPA and to report the results of the monitoring plan. DSRL consider that a similar approach to Condition 9.2 could be used with a condition detailing topics that should be covered by the Environmental Monitoring Programme. It is considered that an Environmental Monitoring Plan should include, but not be limited to:</p> <ul style="list-style-type: none"> <li>a) Collection of groundwater samples and measurements to confirm the assumptions within the agreed ESC,</li> <li>b) Reassurance monitoring of the groundwater conditions related to the operation of the facilities,</li> <li>c) Construction, Identification, Inspection, maintenance, and accessibility of monitoring locations and,</li> <li>d) Storage of records in relation to this condition</li> </ul> <p>DSRL request that SEPA clarify where bespoke conditions in section 11 supersede Standard Conditions, and data return</p> | <p>under RSA93. The RSA Authorisation required DSRL to report results of the monitoring data by the 31 March each year. The introduction of standard condition J "Environmental Monitoring Programme" with differing reporting timescales required by Standard Condition A.8.1 has caused confusion.</p>  |
| 11.3                   | You must provide to SEPA for each calendar year a summary of the results required by condition 11.1 by 31 March of the following year.   |  | <p>It is noted that this Standard Condition makes an implicit assumption about the nature of the disposal, the pathways to the environment and the associated receptors by requiring monitoring of the environment and food stuff during the period of operation. This is wholly appropriate for disposals that involve liquid and gaseous discharges, but less appropriate for a facility such as LLWDF where there are no operational discharges and public dose during operations, via sky-shine is trivial. Consequently, bespoke Condition 11 introduces specific requirements to monitor the groundwater pathway, which will be the dominant pathway post-closure and following the period of authorisation.</p> <p>The confusion surrounding reporting timescales and the ambiguity of the</p> |
| 11.4                   | You must evaluate all groundwater monitoring data against the baseline agreed in writing with SEPA.  |  |   |
| 11.5                   | Where the evaluation of the monitoring data shows any parameter exceeding baseline levels, you must report this to SEPA, in writing, within 28 days.   |  |   |
| 11.6                   | You must report to SEPA, on the basis of aggregated data once a year, the results of monitoring carried out in compliance with this permit. The report shall give an explanation and interpretation of any trends or exceedances of baseline levels in the monitoring data submitted. This report shall be submitted to SEPA, in writing, by 31 March each year. |  |   |

| EASR Bespoke Condition | EASR Bespoke Condition wording   | Request  | Justification  |
|------------------------|--|--|--|
| 11.7                   | You must ensure that all monitoring boreholes and access to them are maintained to enable samples to be taken.   | requirements as required by Standard Condition A.8.1.  | applicability of Standard Condition Section J were recognised by SEPA during a previous inspection (SEPA inspection 26/08/2020)  |
| 11.8                   | Any borehole that is damaged or destroyed to the extent that sampling or monitoring in accordance with the requirements of this permit or the standard conditions is not possible shall be replaced where necessary as soon as possible. | DSRL request that SEPA consider the applicability of Standard Condition Section J to the LLWDF as a solid waste disposal facility with no liquid or gaseous discharges.  | It is noted when submitting proposed changes to the Environmental Monitoring Programme to SEPA it can often take longer than 28 days for SEPA to respond. We request that the requirement to agree with SEPA any changes to the Environmental Monitoring Plan includes the option of implementation where SEPA has not rejected the proposed changes in 28 days (aligned with Condition 9.6) |
| 11.9                   | You must ensure that damage to boreholes is recorded.  | DSRL request that the requirement to agree with SEPA any changes to the Environmental Monitoring Plan includes the option of implementation where SEPA has not rejected the proposed changes in 28 days (aligned with Condition 9.6) |  |
| 11.1                   | You must ensure that all sample points are constructed, maintained and appropriately identified as sample points so that representative samples may be safely obtained.  |  |  |
| 11.11                  | You must ensure that you retain borehole logs and construction details surveyed to ordnance datum.   |  |  |
| 12                     | Additional records   |  |  |
| 12.1                   | You must implement and maintain a comprehensive system of recording information on all aspects of the authorised place including but not limited to:   | No change proposed.  |  |

| EASR Bespoke Condition | EASR Bespoke Condition wording  | Request             | Justification |
|------------------------|---|---------------------|---------------|
|                        | a. All decisions and reasoning underpinning the Environmental Safety Case;<br>b. Site investigation and characterisation details;<br>c. Design and build documents and drawings<br>d. Waste form and characterisation data;<br>e. Detailed information demonstrating that disposed wastes are Waste Acceptance Criteria compliant;<br>f. Waste emplacement locations;<br>g. Other operational information as required;<br>h. Details of authorised place closure;<br>i. Details of, and data from, monitoring programmes. |                     |               |
| 12.2                   | You must ensure that duplicates of the records relating to this permit and to any other authorisation relating to the authorised place shall be kept at diverse locations, agreed in writing with SEPA, in durable form and, prior to the surrender of the permit, shall be included in the National Nuclear Archive.   | No change proposed. |               |
|                        | Schedule 2  | See Condition 1.2   |               |

| EASR Bespoke Condition | EASR Bespoke Condition wording | Request  | Justification  |
|------------------------|--------------------------------|--|--|
|                        | Schedule 3                     | DSRL request that the site plan is amended to remove the detail of proposed future phases (see Appendix E) | In line with proposals for Conditions 7.1, replacing detailed design assumptions on the Site Plan with a note that the layout of future phases as in the agreed Environmental Safety Case (ESC) ensures ongoing optimisation of the facility design and optimisation in line with regulatory requirements. It also ensures compliance with Condition 6.2 which requires the ESC to be updated at intervals agreed with SEPA. |

Table 2: Interpretation of Terms

| Term                                 | Interpretation  | Request   | Justification   |
|--------------------------------------|---|---|---|
| Active institutional control         | means control of the authorised place by the authorised person involving monitoring, surveillance and remedial work as necessary, as well as land use   | No change proposed  |   |
| Authorised Waste Acceptance Criteria | means quantitative and/or qualitative criteria specified in condition 3.1 of this permit for solid radioactive waste to be accepted for disposal  | No change proposed  |   |
| Biodegradable waste                  | means waste liable to be readily decomposed by micro-organisms (i.e. putrescible waste), such as food, vegetable and animal remains, but excluding paper and similar materials that degrade more slowly                       | No change proposed  |   |
| Bulk item                            | means a large waste item, including any which may have been loaded and grouted into a suitable container or emplaced directly into and grouted in a vault   | DSRL request that this term is removed alongside the requested removal of Condition 3.1(c). | Given that Condition 3.1(c) is requested to be removed, there is no longer a requirement for the permit to define "bulk item".  |
| Closure                              | means technical and administrative actions to put the authorised place in its intended final state after the completion of waste disposal   | No change proposed  |   |
| Consignment                          | means an individual shipment of radioactive was not greater in volume than 40 cubic meters or such lesser volume as specified in writing by SEPA  | DSRL request that this term is removed alongside the requested amendment to Condition 5.3   | Given that Condition 5.3 is requested to be amended and the reference to consignments removed, there is no longer a requirement for the permit to define "consignment". |
| Demolition waste                     | means LLW streams made up of unconditioned material including, but not restricted to, concrete, bricks, metals, stone, sand and soil which have radioactivity levels not exceeding 0.01 GBq/te alpha or 0.4 GBq/te beta/gamma | No change proposed  |   |

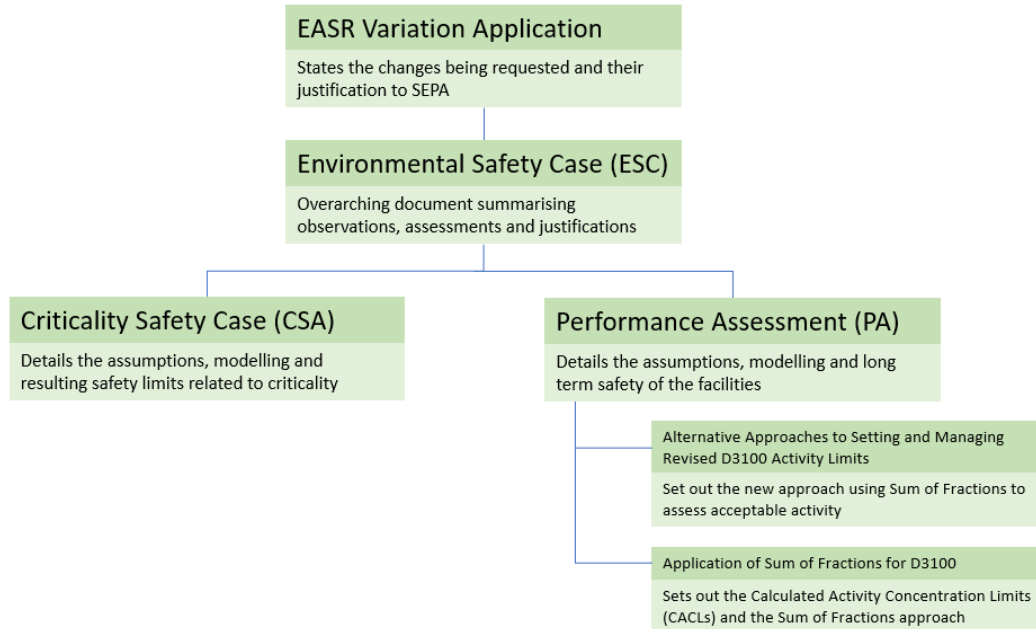
| Term                           | Interpretation  | Request  | Justification  |
|--------------------------------|---|--|--|
| Dounreay Nuclear Establishment | means the decommissioning nuclear site at Dounreay, Caithness, adjacent to the authorised place   | DSRL suggest that this term is updated to align with permit EAS/P/1173600, which refers to the "Dounreay Site" | DSRL consider that the term "Dounreay Nuclear Establishment" is outdated, and would benefit from alignment with EAS/P/1173600.   |
| Environmental Safety Case      | means the collection of arguments, provided by the authorised person, that seek to demonstrate that the required standard of environmental safety is achieved   | No change proposed   |  |
| Environmental Safety Case 2010 | means the version of the Environmental Safety Case issued by Dounreay Site Restoration Ltd dated 27 October 2010 and having reference number "NLLWF/3/ESC/GAL/0425/IS/01"   | DSRL request that this term is removed in line with the request to amend Conditions 6.1 and 7.1                | Given that DSRL has requested the permit is varied to make reference to an agreed Environmental Safety Case (ESC), there is no longer a requirement for the permit to define a specific version of the ESC.  |
| Management Plan                | means a plan produced by the authorised person setting out the manner in which the authorised person shall operate the installation in order to comply with the conditions of this permit and the standard conditions for radioactive substances activities | DSRL request that this term is removed, or that the interpretation is generalised.                             | <p>This term relates to Condition 9.2, DSRL consider that the requirements of the Management Plan are adequately covered in the condition wording.</p> <p>EASR implementation and the variation requested within this application introduce additional management plans for waste (Standard Condition B.8.1) and the Environmental Safety Case (ESC) (proposed Condition 6.3), the definition as currently defined causes confusion.</p> |



| Term  | Interpretation   | Request   | Justification   |
|-------|--|---|---|
| Phase | Means the following parts of the authorised place as shown in Schedule 3:<br>Phase 1 LLW vault (LLW-1)<br>Phase 1 demolition waste vault (DLLW-1)<br>Phase 2 LLW vault (LLW-2)<br>Phase 2 demolition waste vault (DLLW-2)<br>Phase 3 LLW vault 1 (LLW-3-1)<br>Phase 3 LLW vault (LLW-3-2)      | DSRL request that this term is amended to refer to phases as sets of disposal vaults constructed, timed and sized to meet predicted waste arisings, as detailed in the agreed Environmental Safety Case (ESC) and permitted through the Town and Country planning regime. | DSRL has requested that the permit is varied to make reference to an agreed ESC to ensure ongoing optimisation of the facility design and optimisation in line with regulatory requirements. The proposed amendment to the term allows for this ongoing optimisation while ensuring it is clear what the term "phase" makes reference to.                 |
| Toxic | means substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death, as defined in Annex 3 to Directive 91/689/EEC on Hazardous waste | DSRL request that this term is removed in line with the request to amend Condition 3.1(d).  | Given that Condition 3.1 (d) is requested to be removed, there is no longer a requirement for the permit to define "toxic".   |
| Vault | means a vault more particularly show on the Site Plan and forming part of the authorised place   | DSRL request that this term is amended to refer to a vault as described in the agreed Environmental Safety Case.  | DSRL has requested that the permit is varied to make reference to an agreed Environmental Safety Case (ESC) to ensure ongoing optimisation of the facility design and optimisation in line with regulatory requirements. The proposed amendment allows for this ongoing optimisation while ensuring it is clear what the term "vault" makes reference to. |

| Term | Interpretation | Request  | Justification   |
|------|----------------|--|---|
|      |                | <p>DSRL request that a definition for low level waste is included to clarify that daughter products of less than 3 months half-life that are in secular equilibrium with their parents are excluded from the definition of LLW and Demolition LLW, and that the relevant definition is applied at the scale of the waste package/item that is received at the D3100 gate (i.e. including any encapsulating grout and container, if present).</p> | <p>DSRL has discussed application of the LLW definition with SEPA. The established practice on nuclear sites for reporting radionuclide activities is to exclude the activities of short-lived daughters (those less than 3 months) where these daughters are in secular equilibrium with the parent radionuclides. In the long-term, SEPA plans to raise this for consideration in the next revision of national policy documentation and the EASR 18 Standard Conditions [34]. However, in the short-term, explicit clarification of this is being sought by DSRL from SEPA through a bespoke condition and/or definition in the revised Permit [34, 27]. Clarification is also sought that, as the conditioning grout and container are part of the consigned waste received at the D3100 gate, it is the gross weight of the waste package that should be used to determine that disposals to D3100 are LLW. The rationale for this is laid out in reference [35]. It is noted that reference [35] is an unabridged report upon which the DSRL position on the definition of LLW [27] is based.</p> |

## APPENDIX B HIERARCHY OF EXTERNALLY PEER REVIEWED REFERENCES



## APPENDIX C PROPOSED CALCULATED ACTIVITY CONCENTRATION LEVELS (CACLS)

Table C.1 - Proposed CACLS in GBq/te for LLW to be applied at the vault scale. Unless otherwise indicated the limiting scenario for the CACL involves borehole intrusion - see reference [24] for further details.

| Radio-nuclide | Proposed CACL <sup>‡</sup> |
|---------------|----------------------------|
|               | GBq/te                     |
| H3            | 3.1E+03                    |
| C14           | 1.8E+01 <sup>a</sup>       |
| Cl36          | 8.6E-01                    |
| Ca41          | 1.7E+02 <sup>a</sup>       |
| Ni59          | 6.1E+03                    |
| Co60          | 4.7E+02 <sup>b</sup>       |
| Ni63          | 3.6E+03                    |
| Se79          | 2.4E-01 <sup>a</sup>       |
| Sr90          | 3.0E+01                    |
| Nb93m         | 1.0E+05                    |
| Zr93          | 1.7E+03                    |
| Mo93          | 2.4E+01 <sup>a</sup>       |
| Nb94          | 1.6E+00                    |
| Tc99          | 2.9E+00                    |
| Pd107         | 4.3E+03                    |
| Ag108m        | 1.0E-01 <sup>b</sup>       |
| Sn121m        | 1.4E+02                    |
| Sn126         | 1.1E+00                    |
| I129          | 1.2E-01 <sup>a</sup>       |
| Ba133         | 2.1E+02                    |
| Cs135         | 3.6E+01 <sup>a</sup>       |
| Cs137         | 4.7E+00 <sup>b</sup>       |
| Sm151         | 9.2E+03                    |
| Eu152         | 2.8E+01                    |
| Eu154         | 1.1E+02                    |
| Pb210         | 1.0E+01                    |
| Ra226         | 2.2E-02                    |
| Ac227         | 2.4E-01                    |
| Th228         | 1.9E+07                    |
| Ra228         | 1.3E+02                    |
| Th229         | 2.2E-01                    |
| Th230         | 2.3E-02                    |
| Pa231         | 3.9E-02                    |
| U232          | 7.7E-01                    |
| Th232         | 2.7E-01                    |
| U233          | 2.5E-01                    |
| U234          | 6.4E-02                    |

| Radio-nuclide    | Proposed<br>CACL ‡ |
|------------------|--------------------|
|                  | GBq/te             |
| U235             | 6.0E-02            |
| U236             | 8.3E+00            |
| Np237            | 6.4E-01            |
| Pu238            | 8.9E-01            |
| U238             | 8.5E-01            |
| Pu239            | 5.5E-01            |
| Pu240            | 5.5E-01            |
| Am241            | 7.1E-01            |
| Pu241            | 2.2E+01            |
| Pu242            | 5.7E-01            |
| Am242m           | 6.3E-01            |
| Cm243            | 2.9E+00            |
| Am243            | 6.7E-01            |
| Cm244            | 6.7E+00            |
| Other Alpha      | 2.2E-02            |
| Other Non-Alpha  | 1.0E-01            |
| <b>SoF total</b> |                    |

‡ Green and blue highlight show the lowest limits calculated for a non-alpha and an alpha-emitting radionuclide – these are used as the CACLs for “Others” at the foot of the table.<sup>2</sup>

<sup>a</sup> Limiting scenario for CACL is the combined gas and groundwater exposure pathway.

<sup>b</sup> Limiting scenario for CACL is the uncontrolled intruder.

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<sup>2</sup> Others specifically refers to the “Others” radionuclide list within *Application of Sum of Fractions for D3100, D3100/4/REP/GAL/40092/IS/03, Issue 3* [paragraph 63, 24]. Additional radionuclides may be added to this list if ongoing ESC management identifies significant changes in inventory that would require a change.

**Table C.2** - Proposed CACLs in GBq/te for Demolition LLW to be applied at the vault scale<sup>3</sup>. Unless otherwise indicated the limiting scenario for the CACL involves borehole intrusion - see reference [24] for further details.

| Radio-nuclide | Proposed<br>CACL ‡   |
|---------------|----------------------|
|               | GBq/te               |
| H3            | 3.8E+03              |
| C14           | 9.1E-02 <sup>a</sup> |
| Cl36          | 1.1E+00              |
| Ca41          | 7.1E+01 <sup>a</sup> |
| Ni59          | 4.6E+03 <sup>a</sup> |
| Co60          | 7.3E+02              |
| Ni63          | 4.4E+03              |
| Se79          | 1.7E-02 <sup>a</sup> |
| Sr90          | 3.7E+01              |
| Nb93m         | 1.2E+05              |
| Zr93          | 2.1E+03              |
| Mo93          | 8.0E+00 <sup>a</sup> |
| Nb94          | 1.9E+00              |
| Tc99          | 3.5E+00              |
| Pd107         | 5.3E+03              |
| Ag108m        | 1.8E-01 <sup>b</sup> |
| Sn121m        | 1.7E+02              |
| Sn126         | 8.4E-01 <sup>a</sup> |
| I129          | 5.5E-02 <sup>a</sup> |
| Ba133         | 1.4E+02 <sup>b</sup> |
| Cs135         | 1.7E+01 <sup>a</sup> |
| Cs137         | 1.6E+01              |
| Sm151         | 1.1E+04              |
| Eu152         | 3.4E+01              |
| Eu154         | 1.3E+02              |
| Pb210         | 1.3E+01              |
| Ra226         | 2.6E-02              |
| Ac227         | 2.9E-01              |

<sup>3</sup> It should be noted that some radionuclide CACLs for Demolition LLW in Table C.2 are higher than those for LLW (Table C.1). This arises due to the differences in vault design and waste conditioning, the release pathway and mechanism assumptions in the D3100 Run 5 Performance Assessment (PA). Radionuclides that are limited via the human intrusion calculations generally give lower impacts and higher CACLs for the Demolition LLW vaults, mainly because the model assumes a lower vault height (9.1 m compared to 11.1 m) and so less waste is involved in vertical intrusion scenarios. The groundwater and gas pathway calculations give different impacts for disposals to the LLW and Demolition LLW vaults because of different engineering, different waste properties, and different activity release rates. See reference [24] for further details.

| Radio-nuclide    | Proposed<br>CACL ‡   |
|------------------|----------------------|
|                  | GBq/te               |
| Th228            | 2.4E+07              |
| Ra228            | 1.6E+02              |
| Th229            | 2.7E-01              |
| Th230            | 2.8E-02              |
| Pa231            | 4.8E-02              |
| U232             | 9.3E-01              |
| Th232            | 3.3E-01              |
| U233             | 3.0E-01              |
| U234             | 7.8E-02              |
| U235             | 7.3E-02              |
| U236             | 7.5E+00 <sup>a</sup> |
| Np237            | 7.8E-01              |
| Pu238            | 1.1E+00              |
| U238             | 1.0E+00              |
| Pu239            | 6.7E-01              |
| Pu240            | 6.8E-01              |
| Am241            | 8.7E-01              |
| Pu241            | 2.6E+01              |
| Pu242            | 7.0E-01              |
| Am242m           | 7.7E-01              |
| Cm243            | 3.5E+00              |
| Am243            | 8.1E-01              |
| Cm244            | 8.1E+00              |
| Other Alpha      | 2.6E-02              |
| Other Non-Alpha  | 1.7E-02              |
| <b>SoF total</b> |                      |

‡ Green and blue highlight show the lowest limits calculated for a non-alpha and an alpha-emitting radionuclide – these are used as the CACLs for “Others” at the foot of the table<sup>4</sup>.

<sup>a</sup> Limiting scenario for CACL is the combined gas and groundwater exposure pathway.

<sup>b</sup> Limiting scenario for CACL is the uncontrolled intruder.

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<sup>4</sup> Others specifically refers to the “Others” radionuclide list within the *Application of Sum of Fractions for D3100, D3100/4/REP/GAL/40092/IS/03, Issue 3* [paragraph 63, 24]. Additional radionuclides may be added to this list if ongoing ESC management identifies significant changes in inventory that would require a change.



## APPENDIX D PROPOSED FISSILE LIMITS

| Scenario  | Requirements  |
|---|---|
| A) HHISOs with only compacted and uncompacted 200 L drums | Each HHISO container of LLW, which is restricted to compacted and/or uncompacted 200 litre drums, must comply with the following limits:  |
|   | (i) the beryllium content of each puck/drum must not exceed 100 g; and  |
|   | (ii) the fissile mass of each puck/drum must not exceed 20 g ( $^{235}\text{U} + 1.7\ ^{239}\text{Pu}$ ); and   |
|   | (iii) the fissile mass of each HHISO must not exceed 600 g ( $^{235}\text{U} + 1.7\ ^{239}\text{Pu}$ ).   |
| B) HHISOs not meeting the requirements of Scenario A      | (i) for HHISOs containing less than 100 g of beryllium and less than 10 kg of graphite, the fissile material content must not exceed 115 g ( $^{235}\text{U} + 1.7\ ^{239}\text{Pu}$ ); or                |
|   | (ii) for HHISOs containing less than 100 g of beryllium and less than 50 kg of graphite, the fissile material content must not exceed 100 g ( $^{235}\text{U} + 1.7\ ^{239}\text{Pu}$ ); or               |
|   | (iii) for HHISOs containing less than 1,500 g of beryllium and less than 50 kg of graphite, the fissile material content must not exceed 90 g ( $^{235}\text{U} + 1.7\ ^{239}\text{Pu}$ ); or             |
|   | (iv) for HHISOs containing less than 100 g of beryllium and unlimited graphite, the fissile material content must not exceed 90 g ( $^{235}\text{U} + 1.7\ ^{239}\text{Pu}$ ).                            |
| C) Non containerised LLW                                  | Non-containerised LLW items for direct disposal in the LLW vaults must not exceed the mixed LLW fissile mass (Scenario B), beryllium and graphite limits applied pro rata per 20 m <sup>3</sup> of waste. |
| D) Demolition LLW   | The fissile mass of Demolition LLW must not exceed 6 g $^{235}\text{U}$ per 1 m <sup>3</sup> of waste.  |
| E) Waste packages not meeting Scenarios A, B, C or D      | Package specific safety cases assessed in agreement with SEPA.  |

## APPENDIX E PROPOSED SITE PLAN



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