Draft decision document: Sellafield Ltd and Sellafield site

Environmental permitting: radioactive substances activities

October 2019

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Executive summary

The Sellafield site occupies an area of approximately 4 square kilometres on the west coast of Cumbria. Activities that currently take place on the site include reprocessing spent Magnox nuclear fuel, storing spent nuclear fuel and nuclear materials, processing liquid waste, retrieving, processing and storing solid waste, decommissioning (including cleaning out nuclear reactors and redundant facilities after operations have ended), and research and development.

Sellafield Ltd has reprocessed spent nuclear fuel in its Thermal Oxide Reprocessing Plant (THORP) and its Magnox reprocessing plant for many years. Fuel reprocessing at THORP ended in November 2018 and Magnox reprocessing is expected to end in 2020. This will result in a significant reduction in radioactive waste discharges into the environment. Sellafield Ltd's future mission will focus on decommissioning and environmental clean-up (remediation) of the Sellafield site. This will include cleaning up high hazard legacy facilities through a programme of high hazard and risk reduction activities. The aim of this radioactive substances activity environmental permit change (variation) is to make sure that this work can continue while, at the same time, protecting people and the environment.

The existing permit for the Sellafield site contains limits on the total amount of radioactive waste that Sellafield Ltd is allowed to discharge into the environment to ensure that any radiation exposure of people that results is small and well below statutory limits. It also includes annual limits on discharges from individual plants and quarterly notification levels, both of which provide measures for controlling discharges. This structure of limits and notification levels was first implemented around 20 years ago and reflects the guidance, legislation and operations at the site at that time. The permit also requires Sellafield Ltd to use best available techniques (BAT) to minimise radioactive waste disposals (including discharges) and their impact on people and the environment.

In October 2018, Sellafield Ltd applied for a number of changes to the permit, mainly to reflect the change in its operations and the discharges following the application of BAT. The application included a 2-phase approach of reducing site permit limits for discharging radioactive waste and replacing annual plant limits with annual plant notification levels. Phase 1 of the site limit reductions was intended to be introduced after THORP had closed, but before Magnox reprocessing had ended. Phase 2 was to be implemented when Magnox reprocessing ended. The application proposed a 2-tier (upper and lower) limit structure in phase 2 and significant reductions in discharge limits. We advertised the application and consulted on it between 26 October and 21 December 2018. We considered the consultation responses when assessing Sellafield Ltd’s application to change (vary) its permit.

Sellafield Ltd has amended the proposal for site limits in its application since our consultation. This is mainly because we asked it to provide further information on how it had derived the proposed site limits. This related to consistency with other published information, changes in the sources of discharges, and the margin Sellafield Ltd requested between estimated discharges and limits (headroom). In response, Sellafield Ltd amended its application to a single change in site limits rather than a 2-phase change. This offered further significant reductions in discharge limits compared with the original application and would retain a 2-tier structure. Sellafield Ltd proposed that the new limits would come into effect from the date of the permit change and so before the end of Magnox reprocessing operations. These developments became possible due to THORP closing in November 2018, the progress being made towards Magnox reprocessing ending, and by assessing predicted future discharges further.

This decision document details how we assessed the application and the decisions we made on the following main changes:

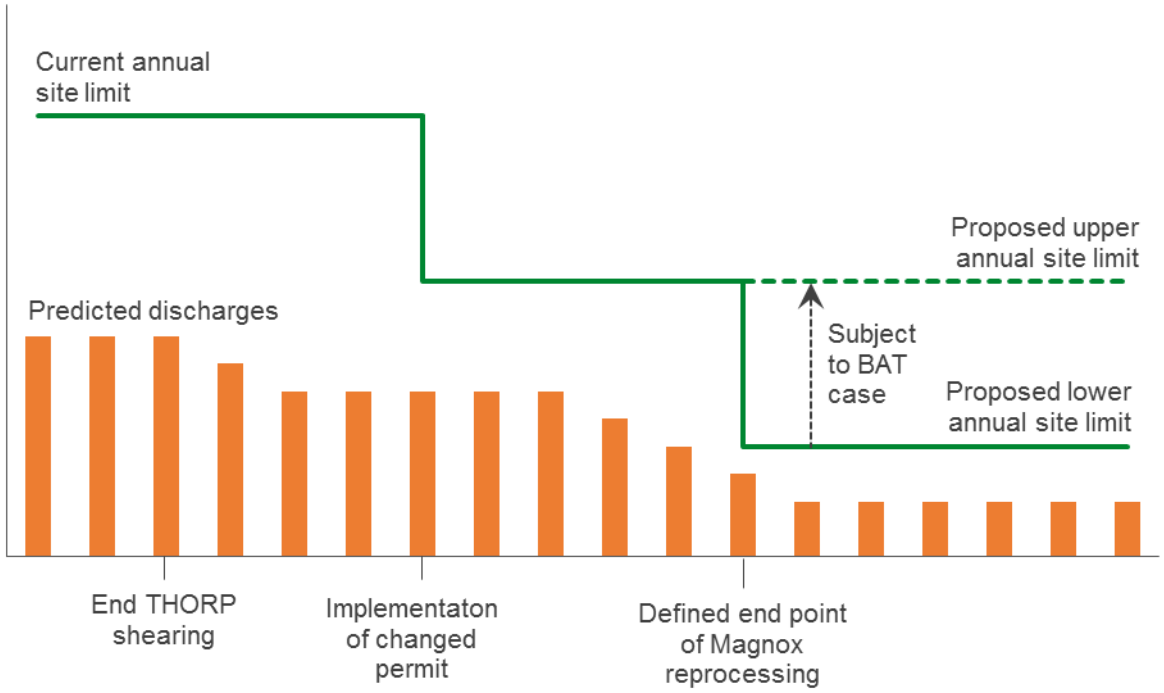
- Significantly reducing site discharge limits and introducing a 2-tier (upper and lower) site discharge limit structure
- Removing some site discharge limits where discharges have fallen below significant levels and they do not meet our criteria for setting limits

- Replacing plant discharge limits with plant notification levels so that Sellafield Ltd can make most effective use of the available discharge routes and treatment plants
- Removing discharge limits related to the rate of fuel reprocessing (throughput) to reflect the end of reprocessing operations
- Introducing a specific tritium limit for solid waste disposals at the on-site landfill known as the Calder Landfill Extension Segregated Area (CLESA)

The decision document also considers Sellafield Ltd's arrangements for using best available techniques to prevent or minimise discharges of radioactive waste, identifying improvements and requests for more information, as necessary.

In assessing the permit change request, we have taken into account relevant statutory requirements, and government guidance and policy. All of the relevant proposed aqueous limits (tritium, technetium-99, total alpha and total beta) are broadly consistent with the 2020 expected outcomes in the UK Strategy for radioactive discharges, taking into account that headroom is required between expected discharges and limits.

We have decided to change (vary) the permit to include the upper and lower site discharge limits at the values in Sellafield Ltd's revised proposal. We have also agreed to remove site discharge limits where discharges have fallen below significant levels and do not meet our criteria for setting a limit. All remaining site limits are significantly reduced, apart from 3 upper tier limits. Around half of the upper tier limits will come into effect when the permit change (variation) is issued and last until the relevant important milestone has been achieved. This will be either the end of Magnox reprocessing or the commissioning of the retrievals ventilation system incorporating high efficiency particulate air (HEPA) filtration in the Magnox Swarf Storage Silos (MSSS) ventilation stack. Once the lower site limit is in force, the upper site limit will only apply where we have agreed that Sellafield Ltd has submitted an acceptable BAT case to move to the upper limit for a certain time so that it can complete certain tasks. The upper and lower site limits and requirement for BAT cases is illustrated below:



The table below sets out the revised site limits at both upper and lower tier values and compares them with the existing limits. It also shows which limits we are removing and whether the upper or lower tier limit will be in force when the permit becomes effective.

We have decided that quarterly notification levels (QNLs) will be set at 25% of the site limit in force (upper or lower tier). These mean that Sellafield Ltd has to inform us if the trend in site discharges indicate it is likely that they could exceed an annual limit. We would then scrutinise operations more closely.

We have decided to replace annual plant limits with annual plant notification levels (APNL), and to remove fuel throughput limits as these related to rates of reprocessing activities that are no longer possible. The vast majority of APNL are set at much lower levels than the previous plant limits apart from in a few cases where they are set at the same level as the existing limit. The levels are generally based on the monthly trigger levels that Sellafield Ltd uses to monitor plant discharge performance and so reflect its use of best available techniques to minimise discharges of radioactive waste. Sellafield Ltd must notify us if an APNL is exceeded. This will prompt us to examine closely if it is applying BAT at individual plants. Sellafield Ltd would not be in breach of its permit if it exceeded either a QNL or APNL, but it would have to notify us about the circumstances leading to the levels being exceeded, and why it believes that it has continued to use BAT.

We have also decided to ask Sellafield Ltd to submit a quarterly report that shows any internal monthly triggers that have been exceeded. Again, this can lead us to question whether BAT is being applied at individual plants before the APNL is exceeded.

Overall, we believe that this new structure of limits and controls (site upper and lower limits, QNLs and APNLs, and monthly triggers) provides a high level control of discharges by the operator and regulator while also allowing the flexibility to achieve the Sellafield mission. The revised structure of limits and controls also meets with our limit setting guidance and so reflects the current approach to regulating radioactive waste disposals.

We have decided that we could permit an increase in the tritium limit for disposals in CLESA landfill to an average consignment limit of 12,000Bq/g, whilst ensuring that the environment and people are protected. This increase would mean decommissioning could progress more quickly. We plan to implement the changes to the limits and conditions Sellafield Ltd proposed to allow greater flexibility in the disposal of waste containing tritium at CLESA once Sellafield Ltd has received confirmation that it is not required to make a Euratom Article 37 submission, or, if it is, that the Department for Business Energy and Industrial Strategy (BEIS) and Sellafield Ltd have received a positive opinion that the discharges will not affect Member States from the EC on an Article 37 submission.

Overall, we are satisfied that, subject to a number of improvements and providing additional information, Sellafield Ltd has demonstrated that it has adequate arrangements in place to use BAT and to effectively manage radioactive waste with regard to meeting relevant statutory requirements and government guidance and policy. The requirements for improvements and information can be found in the permit and its associated Compilation of Environment Agency Requirements, Approvals and Specifications (CEAR) document. The conditions of the permit are legally binding on Sellafield Ltd. The CEAR is used to specify the detailed requirements of the permit conditions so that they are fully complied with. The CEAR is not legally binding in itself and we are not formally consulting on the details that it contains. We refer to the CEAR in the decision document where we think this is helpful and have highlighted key proposed changes to it in appendix 5. We will work closely with Sellafield Ltd to ensure that the CEAR is fully implemented, once our final decision on the application is made. Key improvements in the permit and the CEAR include:

- developing and maintaining a waste management plan (WMP) and a site wide environmental safety case (SWESC)
- progress reports relating to improvements in Sellafield Ltd's asset management arrangements generally and, in particular, managing ventilation ducting
- an assessment of future aqueous discharges of cobalt-60 from legacy waste
- maintaining and reviewing the CLESA closure and aftercare management plan
- progress reports on higher activity waste (HAW) records restoration work
- some changes to, remove and consolidate existing requirements relating to approved gaseous waste discharge outlets, discharge and waste reporting, discharge check monitoring and providing other information

We have also updated the permit to reflect wider developments in our regulation of nuclear sites along with some changes to implement the Basic Safety Standards Directive 2013/59/Euratom and other minor updates.

We are satisfied that the radiation doses to the public and dose rates to non-human species (wildlife) associated with permitted discharges from the Sellafield site will be well below the UK national dose limit of 1,000 microsieverts per year (µSv/y), the source (300µSv/y) and site (500µSv/y) dose constraints and below the guideline level for non-human species of 40microgray per hour. We have assessed the total doses to a representative (most exposed) person as 108 and 59µSv/y for discharges of radioactive waste at the upper and lower site limits respectively. Both values are considerably lower than the total dose at the existing permit site limits of 203µSv/y.

We have assessed the application, considered the responses we received and have made a draft decision to grant the application subject to the conditions in the draft varied permit that accompanies this document. We now wish to consult further on our draft decision and draft environmental permit. The aim of this consultation is to seek your views on our draft decision and draft permit to help us come to a final decision.

We believe that our decision and permit conditions are consistent with the relevant legislation, guidance on the regulation of radioactive discharges into the environment, and relevant government policy. We have also considered relevant wider social-economic duties, including contributing to sustainable development. This also promotes growth amongst legitimate operators because the standards applied to the operator are consistent across businesses in this sector and have been set to achieve the required legislative standards.

We will not make any final decisions about this application until we have considered the responses to this public consultation.

Consultation questions

1. Do you understand the proposed structure of discharge limits and levels, and how it is intended to control discharges at the site? Does the new structure (site upper and lower limits, quarterly notification levels, annual plant notification levels and monthly triggers) raise any concerns for you? If so, what are those concerns?
2. Do the values of the proposed site (upper and lower limits), quarterly notification levels and annual plant notification levels raise any concerns for you? If so, what are those concerns?
3. Are you satisfied that the varied Sellafield permit aligns with government policy and guidance, in particular the UK strategy for radioactive discharges? If not, what are your concerns?
4. Does the proposed tritium limit for disposals in CLESA raise any concerns for you? If so, what are these concerns?
5. Is there anything that is inaccurate or missing in the draft decision document? If so, please provide details.
6. Has any relevant information become available since we consulted on the application, or was any information missed last time that we have not provided as part of this consultation? If so, please provide details.
7. Any other comments on the proposed permit change (variation)?

Table: Existing and revised site limits - note the limit to be in force when the permit change (variation) becomes effective is shown in bold.

All quantities are given in scientific notation, for example 3.0E+06, which means 3000000.

Radionuclide or radionuclide group	Current (MBq)	New upper & lower (MBq)	% of current limit	Current (GBq)	New upper & lower (GBq)	% of current limit
	Gaseous discharges: Site limits			Aqueous discharges: Site limits		
H-3	1.1E+09	**3.7E+08(1)** 1.7E+08	34 15	1.8E+07	**3.0E+06(1)** 7.0E+05	17 4
C-14	3.3E+06	**2.3E+06(1)** 3.6E+05	70 12	2.1E+04	**1.3E+04(1)** 5.1E+03	63 24
Co-60	-	3.8E+05	-	3.6E+03	3.6E+03 **2.5E+03**	**100** **69**
Kr-85	4.4E+11	**7.0E+10(2)**	16	-	-	-
Sr-90	7.1E+02	**5.0E+02(3)** 7.4E+01	70 10	4.5E+04	3.2E+04 **1.4E+04**	**70** **31**
Zr-95/Nb-95	-	-	-	2.8E+03	Removed	-
Tc-99	-	-	-	1.0E+04	**7.5E+03(1)** 4.5E+03	75 45
Ru-106	2.3E+04	1.8E+04 **2.8E+03**	**78** **12**	5.1E+04	1.0E+04 **3.1E+03**	**20** **6**
Sb-125	3.0E+04	**3.0E+04(2)**	100	-	-	-
I-129	7.0E+04	**4.2E+04(1)** 1.3E+04	60 18	2.0E+03	8.0E+02 **3.2E+02**	**40** **16**
I-131	3.7E+04	Removed	-	-	-	-
Cs-134	-	-	-	1.6E+03	Removed	-
Cs-137	5.8E+03	**4.8E+03(3)** 4.1E+02	83 7	3.4E+04	2.4E+04 **1.7E+04**	**71** **50**
Ce-144	-	-	-	4.0E+03	Removed	-
Np-237	-	-	-	7.3E+02	Removed	-
Pu-alpha	1.9E+02	**1.3E+02(3)** 7.2E+01	70 38	7.0E+02	5.0E+02 **2.9E+02**	**71** **41**
Pu-241	3.0E+03	Removed	-	2.5E+04	1.8E+04 **6.0E+03**	**72** **24**
Am-241	-	-	-	3.0E+02	2.2E+02 **1.4E+02**	**72** **47**
Am-241 + Cm-242	1.2E+02	**8.4E+01(3)** 5.0E+01	70 42	-	-	-
Cm-243+Cm-244	-	-	-	5.0E+01	Removed	-
Alpha	8.8E+02	**6.6E+02(3)** 3.2E+02	75 36	9.0E+02	6.0E+02 **3.4E+02**	**65** **38**
Beta	4.2E+04	**3.2E+04(3)** 5.1E+03	75 12	1.8E+05	1.2E+05 **6.3E+04**	**67** **35**
Uranium	-	-	-	2000kg (70GBq)	7.0E+01 **2.0E+01**	100 29

(1) Will move to lower limit after the end of Magnox reprocessing, by written agreement in the CEAR

(2) Limit removed after the end of Magnox reprocessing, as notified by Sellafield Ltd

(3) Will move to lower limit when MSSS HEPA filters have been installed and commissioned, by written agreement in the CEAR

Draft decision document: application by Sellafield Ltd under the Environmental Permitting (England and Wales) Regulations 2016 to carry out radioactive substances activities at:

Sellafield site
Seascale,
Cumbria
CA20 1PG

Contents

1. About this document

1. This is a draft decision document that accompanies a draft permit. It explains how we have considered Sellafield Ltd's application and why we have included the specific conditions in the draft permit we are proposing to issue. It is our record of our decision-making process, to show how we have taken into account all relevant factors in reaching our decision. Unless the document explains otherwise, we have accepted Sellafield Ltd's proposals.
2. The document is in draft at this stage because we have yet to make a final decision. Before we make this decision we want to explain our thinking to the public and other interested parties, to give them a chance to understand that thinking and, if they wish, to make relevant representations to us. We will make our final decision only after carefully taking into account any relevant matter raised in the responses we receive. Our mind remains open at this stage, although we believe we have covered all the relevant issues and reached a reasonable conclusion, our ultimate decision could yet be affected by any information that is relevant to the issues we have to consider. However, unless we receive information that leads us to change the conditions in the draft permit, or to reject the application altogether, we will issue the permit in its current form.
3. In this document, we frequently use phrases like 'we have decided', 'the permit', 'the limits', and so on. That gives the impression that our mind is already made up, but, as we have explained above, we have not yet done so. The language we use enables this document to become, in due course, the final decision document, with no more re-drafting than is absolutely necessary.
4. This document includes:
   - a description of how we process and determine applications
   - a summary of the application and brief details of our consultation on the application
   - a description of our assessment
   - a statement of our draft decision
   - a summary of responses to our consultation at the application stage
5. The final version of this document will include a summary of responses to our consultation on our draft decision.
6. The accompanying draft variation notice and draft consolidated permit have text highlighted in pink where changes are required in the final version for example signing of the permit.

2. How we process and determine applications

Introduction

7. The Environment Agency is responsible, under the Environmental Permitting (England and Wales) Regulations 2016 (EPR 16) (GB Parliament, 2016a), for regulating certain radioactive substances activities (RSA) on nuclear sites in England, namely:

- receiving radioactive waste to dispose of that waste
- disposing of radioactive waste on or from the premises
- where the operator is not the nuclear site licensee, keeping or using radioactive material
- keeping or using mobile radioactive apparatus

We do this by issuing, and monitoring performance against, a permit that sets conditions under which activities must be carried out, and limits on disposals. 'Disposals' of radioactive waste include discharges into the air, the sea, rivers, drains or groundwater, disposals to land, and by transfer to another site. A 'nuclear site' is one that has a nuclear site licence under the Nuclear Installations Act 1965 (NIA 65) (GB Parliament, 1965).

8. We regulate these sites to protect members of the public from harm from the discharge and disposal of radioactive waste and to protect the wider environment. We regulate within a framework of extensive government policy, strategy and guidance on the management and disposal of radioactive waste. This framework is summarised in the government guidance on radioactive substances regulation (GB Parliament, 2011). The guidance sets out the government's position on how radioactive substances regulation (RSR) should be applied and implemented and how we as the regulator and operators should interpret particular terms. In summary, we require operators to protect people and the environment by:

- minimising the amount of radioactive waste generated
- minimising the amount of radioactive waste that has to be discharged into the environment
- discharging that waste in ways that minimise the radiological impact on the public and protect the wider environment
- using the best way (optimal route) to dispose of solid waste

Our process

9. Operators can apply to the Environment Agency for a new permit or to change (vary) an existing permit at any time. The process we follow in assessing applications is described in the government's EPR core guidance (GB Parliament, 2013) and in our guidance on the regulation of radioactive substances activities on nuclear licensed sites (Environment Agency, 2012a). The process for nuclear sites is outlined below.

1. **Pre-application** - We encourage applicants to discuss applications with us before they submit them.
2. **Receive application and consult on the application** - The applicant makes an application, providing the information as set out in the application form and supporting guidance. We advertise and consult on all applications for new permits. We may also advertise and consult on some variations depending on the nature of the proposals and the likely degree of public interest.
3. **Assess application and make a draft decision** - We carefully assess the application and any responses we receive from our consultation and come to a draft decision on whether to grant the application and, if so, the appropriate permit conditions.

4. **Consultation on draft decision** - We may choose to consult further on our draft decision and draft permit depending on the nature of the proposals and the likely degree of public interest. We do this by using a document that sets out our draft decision.
5. **Review, approval and issue of decision** - Where we consult on our draft decision, we carefully consider all relevant information we receive during and after consultation, together with existing information. We make a decision whether to issue a new or varied permit and, if so, what its conditions should be. We publish a document that provides the reasons for our decisions.

Public participation

10. We advertised and consulted on this application in accordance with our public participation statement and associated working together arrangements (see Working together: your role in our environmental permitting (Environment Agency, 2010a)). In view of the nature of the application and the degree of public interest, we decided to consult further on our draft decision and draft permit.

Legal, policy and regulatory considerations

11. We have made our decision taking into account all relevant legal, policy and regulatory matters. The legal requirements and government policy relating to managing the generation and disposal of radioactive waste are set out in the government guidance on radioactive substances regulation (GB Parliament, 2011). The government has also issued 'Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment' (GB Parliament, 2009a). This states that we should base our decision on the principles set out in the 'UK Strategy for radioactive discharges' (UKSRD) (GB Parliament, 2009b), namely:
    - regulatory justification of practices by the government
    - providing the best (optimising) protection on the basis that radiological doses and risks to workers and members of the public from a source of exposure should be kept as low as reasonably achievable (the ALARA principle)
    - applying limits and conditions to control discharges from justified activities
    - sustainable development
    - using best available techniques (BAT)
    - the precautionary principle
    - the polluter pays principle
    - the preferred use of 'concentrate and contain' in managing radioactive waste over 'dilute and disperse', in cases where there would be a definite benefit in reducing environmental pollution, provided that BAT is being applied and worker dose is taken into account
12. Our RSR environmental principles (Environment Agency, 2010b) (REPs) set out a consistent and standardised framework for the technical assessments and judgments that we make when regulating radioactive substances.
13. Our assessment of the application is set out in chapters 4 to 8, in a structure that reflects the layout and questions in the application form. Table 2.1 shows this layout, identifying the main issues we need to consider when making decisions on the disposal of radioactive waste. It also refers to the relevant reference documents and guidance (most of these documents can be accessed from our nuclear regulation page on gov.uk: https://www.gov.uk/government/collections/radioactive-substances-regulation-for-nuclear-sites). In chapters 4 to 8 we explain how we have reached our decision against these and any other relevant considerations.

Table 2.1: Main considerations

Considerations	Documentation
General	Government guidance on radioactive substances regulation (GB Parliament, 2011) The regulation of radioactive substances activities on nuclear licensed sites (Environment Agency, 2012a) RSR environmental principles (Environment Agency, 2010b) RSR: Management arrangements at nuclear sites (Environment Agency, 2010c) Legal operator and competence requirements: environmental permits (Environment Agency, 2016b)
Justification	Appendix 2 of Government policy - radioactive & nuclear substances (GB Parliament, 2015a)
Euratom article 37	Commission recommendation 2010/635/Euratom (EU, 2010)
Disposal of radioactive waste	Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment (GB Parliament, 2009a) Scope of and exemptions from the radioactive Substances regulation in the UK (GB Parliament, 2018c) RSR: Principles of optimisation (Environment Agency, 2010d) Criteria for setting limits on the discharge of radioactive waste from nuclear sites (Environment Agency, 2012b)
Disposal routes and monitoring	RMTGN1 - Standardised reporting of radioactive discharges from nuclear sites (Environment Agency & SEPA, 2010) RMTGN2 - Environmental radiological monitoring (Environment Agency and others, 2010)
Radiological assessments	Principles for the assessment of prospective public doses (Environment Agency and others, 2012) Initial radiological assessment methodology (Environment Agency, 2006)
Other statutory requirements	See chapters 7 and 8

14. Although we will normally determine an application, the Secretary of State can require any application to be referred to him/her for determination (regulation 63 of EPR 16). As noted in the EPR core guidance (GB Parliament, 2013), this would be an exceptional step and likely to be taken only if the application involved issues of more than local importance, for example, if the application:

- was of substantial regional or national significance
- was of substantial regional or national controversy
- may involve issues of national security or of foreign governments

The core guidance also says that any decision for the Secretary of State to determine the application would be made solely on those grounds, with no consideration of the substantive merits of the application itself.

15. The Secretary of State has not 'called in' this application.

How we set discharge limits

16. The permit contains site discharge limits, quarterly notifcation levels and annual plant notification levels. Site limits cover the total discharge of that radionuclide from the site in aqueous or gaseous discharges and set on a rolling 12-month basis. Exceeding a permit limit means not complying with condition 3.1.2, that is 'The limits on disposals given in schedule 3 shall not be exceeded.' Exceeding a notification level however, does not mean breaching a permit. Quarterly notification levels (QNL) are set as an early warning for the site limit. They apply on a rolling quarterly basis. Annual plant notification levels (APNL) are set as a prompt that discharges from an individual plant should be investigated, to understand whether BAT continues to be applied.

17. We have established guidance on how we set limits on radioactive discharges from nuclear sites (Environment Agency, 2012b). Specifically, we have considered the following points when determining which radionuclides need site limits, identifying those that:

    (a) are significant in terms of radiological impact on people – that is, the dose to the most exposed group at the proposed limit exceeds 1microsievert per year (μSv/y)

    (b) are significant in terms of radiological impact on non-human species (wildlife) – this only needs to be considered where the impact on reference organisms from the discharges of all radionuclides at the proposed limits exceeds 40microgray per hour (μGy/h)

    (c) are significant in terms of the quantity of radioactivity discharged – that is, the discharge of a radionuclide exceeds 1TBq per year

    (d) may contribute significantly to collective dose – this only needs to be considered where the collective dose, for up to 500 years (known scientifically as truncated at 500 years), from the discharges of all radionuclides at the proposed limits exceeds 1man-Sievert per year (manSv/y) to any of the UK, European or world populations

    (e) are constrained under national or international agreements or are of concern internationally

    (f) are indicators of plant performance, if not otherwise limited on the above criteria

    (g) are appropriate generic categories from the RSR pollution inventory (for example, 'alpha particulate' and 'beta/gamma particulate' for discharges to air) that limit any radionuclides not otherwise covered by the limits set on the above criteria

18. The approach for setting limits outlined above applies to site limits. We also took the same criteria into account in setting existing plant limits and annual plant notification levels. We set plant limits or annual plant notification levels for individual sites to make sure that BAT is used to control discharges where, and to the extent that, the site limits do not do so.

19. The conditions in the permit relating to notification levels require the operator to provide a written submission containing the following information when a notification level is exceeded:

    - details of what happened
    - a description of the techniques used to minimise the activity of radioactive waste discharged
    - a review of those techniques having regard to permit conditions covering the use of best available techniques to:
        - minimise the activity of waste produced
        - minimise the activity of gaseous and aqueous radioactive waste
        - minimise the volume of radioactive waste disposed of by transfer to other premises
        - dispose of radioactive waste in a form and manner so as to minimise the radiological effects on the environment and members of the public
        - exclude all entrained solids, gases and non-aqueous liquids from radioactive aqueous waste prior to discharge
        - characterise, sort and segregate solid and liquid radioactive wastes to facilitate their optimal disposal routes

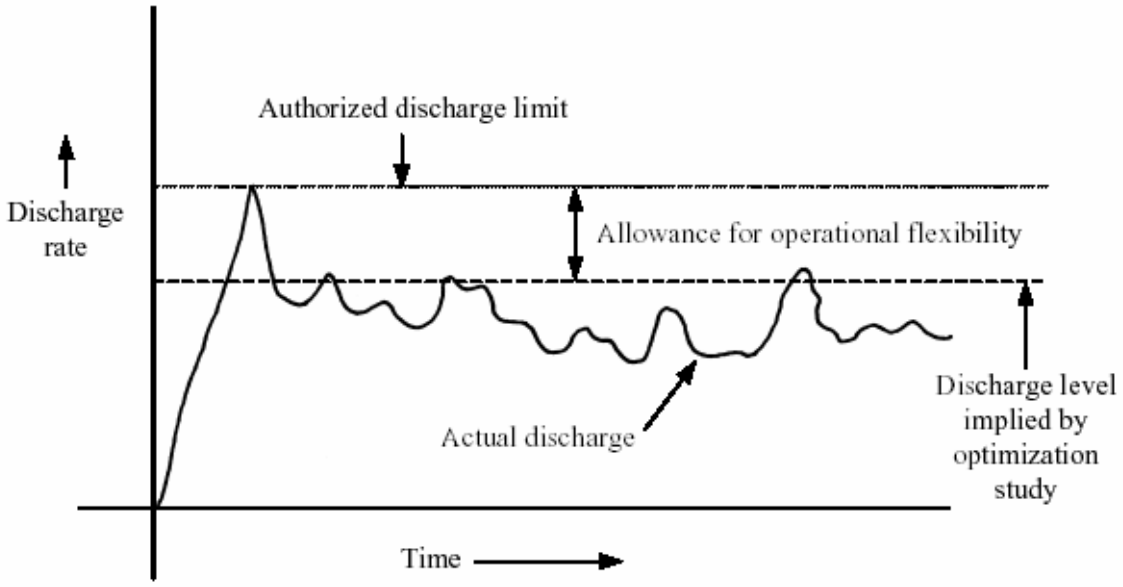
20. When we receive this information we will consider whether we need to take any action, for example if it appears that Sellafield Ltd has failed to apply best available techniques to minimise

radioactive releases. We will then consider if it has failed to comply with other permit conditions and, if so, take appropriate action.

21. In line with statutory guidance (GB Parliament, 2009a), we will set limits based on using BAT to make sure that operators control discharges within the 'normal operation' of the facility. This covers the 'operational fluctuations, trends and events that are expected to occur over the lifetime of the facility', such as start-up and shut down, maintenance, plant wash out and other expected changes. This does not include increased discharges resulting from other events where it appears, BAT has not been used, such as accidents, inadequate maintenance, inadequate operation, including inadequate training and supervision.

22. The following chart (Figure 2.1) (IAEA, 2010) shows this approach. The 'allowance for operational flexibility' is sometimes referred to as 'headroom'. Additional flexibility may be needed for decommissioning tasks to make sure that clean-up is not constrained.

Figure 2.1: Setting of discharge limits



3. The application and our consultation on the application

Introduction

23. Sellafield Ltd has applied to change (vary) the conditions of an environmental pemit to carry out radioactive substances activities at Sellafield. The application consists of the relevant RSA environmental permit application forms (parts A, B5, C3 & F) and a submission of information to provide the required detailed technical information, as listed in appendix 3.

24. The further information provided during our assessment of the application (see Further information section below) also forms part of the application.

Description of the facility

25. The applicant has provided a description of the proposed changes to the facility in the variation application (Sellafield Ltd, 2018a) (see chapter 5 regarding permit changes and appendix 5 covering CEAR changes).

26. Sellafield Ltd has reprocessed spent nuclear fuel in its Thermal Oxide Reprocessing Plant (THORP) and its Magnox reprocessing plant for many years. However, fuel reprocessing ended at THORP in November 2018 and is expected to end at the Magnox reprocessing plant in 2020. Consequently, the site will see a significant reduction in radioactive discharges to the environment. Given these reductions, Sellafield Ltd will need to change its environmental permit to better reflect these lower discharge levels. Following the end of fuel reprocessing, Sellafield Ltd's mission will focus on decommissioning and the safe and secure environmental clean-up (remediation) of the Sellafield site. This change is a good opportunity to make sure that the permit allows this work to continue, including post operational clean out (POCO) and the clean-up of the high hazard legacy facilities to reduce the risk to people and the environment. This is often referred to as high hazard risk reduction (HHRR).

Site location

27. The Sellafield site occupies an area of approximately 4 square kilometres on the coast of west Cumbria, north of the village of Seascale and south of the major population centres of Whitehaven and Workington. The coast is mainly used for leisure and recreation. The coastal plain areas outside population centres are dominated by improved grassland for animal grazing. Adjacent to the site is the Cumbria Coast Marine Conservation Zone (MCZ). Drigg Coast (4km to the south) is a Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and part of the Morecambe and Duddon Estuary Special Protection Area (SPA). Other nearby SSSI include St Bees Head (9km to the north) and Pillar and Ennerdale Fells (13km to the north east). Wast Water (12km east) is also a SAC.

Consultation

28. We advertised and consulted on the application from 26 October 2018 to 21 December 2018, in accordance with our public participation statement and working together agreements. We placed the responses on the public register held at the Environment Agency offices identified in appendix 2, except where the person making the response asked us not to do so.

29. We publicised the consultation by discussing it with the West Cumbria Sites Stakeholder Group, issuing press releases, displaying posters in local libraries, supermarkets and sports centres, posting on social media, and directly contacting a number of organisations and individuals inviting them to participate.

30. See appendix 2 for further details of our consultation on the application.

31. The comments we received in response to our consultation are referred to in chapters 4 to 8, where they have affected our approach or our decision. Otherwise, they are addressed in appendix 2.

Further information

32. Although we considered that the application was in the correct form and contained enough information for us to begin our assessment, we needed more information to complete it. We issued an information notice as detailed below (table 3.1). We placed a copy of the information notice and the responses we received on our public register.

Table 3.1: Further information notice

Further information requested	Response received
Notice dated 26 April 2019	Received 31 July 2019: • Revised site gaseous and aqueous site limit proposals.

33. We needed this extra information because our determination process raised a number of questions, mainly concerning the site limits. Specifically, these were consistency with other published information, changes in the sources of discharges, and the required margin between expected discharges and limits (headroom). To simplify our request for further information, we produced 7 general points be addressed (table 3.2 and 3.3). We asked Sellafield Ltd to:

(a) explain or resolve differences between the proposed future site limits and the current effective site limits (i.e. the existing fuel throughput-related permit limits that would apply on the cessation of THORP and on cessation or at low rates of Magnox reprocessing)

(b) explain or resolve differences in expected and projected discharge information in the variation application with the published discharge information in the UKSRD review, 2018 (GB Parliament, 2018a)

(c) demonstrate due consideration of the UKSRD and its expected outcomes (GB Parliament, 2009b; GB Parliament, 2018a)

(d) demonstrate that knowledge from past discharges is taken into account i.e. using historic discharge figures as a benchmark

(e) explain or resolve significant sources of discharges post reprocessing

(f) explain or resolve the basis of, and differences between, future 'expected discharges', 'projected discharges' (from the Sellafield effluent strategy model) and proposed site limits

(g) ensure consistency between phase 1 and phase 2 upper limits when predicted future discharges are the same

Table 3.2: Further information areas requested for gaseous site discharge limits where a, b, c, etc. refer to the above points to be addressed

Radionuclide or radionuclide group	Proposed phase 1 limit	Proposed phase 2 upper limit	Proposed phase 2 lower limit
H-3	a, b, d, e, f	a, b, d, e, f	a, b, d, e, f
C-14	d, e, f	d, e, f	d, e, f
Kr-85	a, d, f	-	-
Sr-90	e, f	e, f	e, f
Ru-106	d, f	-	-
Sb-125	-	-	-
I-129	d, e, f	d, e, f	d, e, f
Cs-137	e, f	e, f	e, f
Pu-alpha	d, e, f	d, e, f	d, e, f
Am-241 + Cm-242	d, e, f	d, e, f	d, e, f

Radionuclide or radionuclide group	Proposed phase 1 limit	Proposed phase 2 upper limit	Proposed phase 2 lower limit
Alpha	b, d, e, f	b, d, e, f	b, d, e, f
Beta	b, d, e, f	b, d, e, f	b, d, e, f

Table 3.3: Further information areas requested for aqueous site limits, where a, b, c etc. refer to the above points to be addressed

Radionuclide or radionuclide group	Proposed phase 1 limit	Proposed phase 2 upper limit	Proposed phase 2 lower limit
H-3	a, b, d, f	b, c, d, e, f	b, c, d, e, f
C-14	-	a, d, e, f	d, e, f
Co-60	d, e, f	d, e, f	d, e, f
Sr-90	d, f, g	d, f, g	d, f
Tc-99	b, d, f	b, c, d, e, f	b, c, d, e, f
Ru-106	d, e, f	d, e, f	d, e, f
I-129	a, d, e, f	-	-
Cs-137	f, g	-	-
Pu-alpha	d, f	d, f	d, f
Pu-241	d, f	-	-
Am-241	d, f	d, f	-
Alpha	b, d, f	b, c, d, f	b, c, d, f
Beta	b, d, f	b, c, d, f	b, c, d, f
Uranium	F	f	f

34. We also requested further information on minor issues by email and telephone. This information was helpful and addressed those minor issues. Appendix 4 provides a summary of these information requests.

Sellafield Ltd's current RSA permit

35. Sellafield Ltd's current permit is based around its reprocessing operations and includes site limits, quarterly notification levels, plant limits, throughput related limits and some additional components, required for certain situations. The current permit includes site limits for a wide range of radionuclides, which were appropriate when both THORP and Magnox reprocessing were operational. The QNLs are set at 25% of the relevant site limit. A QNL provides us with early information of an elevated discharge(s) which, if continued, may lead to a site limit being breached. In these circumstances, we scrutinise operations more closely to determine whether the operator has used BAT to minimise discharges.

36. Plant limits are included in the current permit. These cover a wide range of radionuclides, a wide range of plants discharging gaseous radioactive waste, and all of the main liquid effluent facilities and aqueous discharge points. Exceeding a plant limit is a breach of the permit and so may result in us taking enforcement action.

37. The current permit includes limits for some radionuclides related to the throughput rate of fuel in THORP and Magnox reprocessing plants. Additional components are included if a large quantity of Magnox fuel is processed in evaporator C or in the event of the Site Ion Exchange Plant (SIXEP) malfunctioning.

Application for variation

38. Sellafield Ltd provided a description of the proposed changes to the production and disposal of radioactive waste in its variation application (Sellafield Ltd, 2018a). The main changes are summarised below. Our detailed assessment of the proposals is contained in chapters 4 to 8.

Overview

39. The proposed changes are driven by the change in status of the Sellafield site, from an operational reprocessing site to a decommissioning site. In summary, Sellafield Ltd's proposed changes were:

- some significantly reduced site limits
- removing some site limits where discharges have fallen below significant levels
- a 2-phased change to site limits to take account of the end of fuel reprocessing in the THORP plant in 2018 (phase 1) and Magnox in 2020 (phase 2)
- introducing a 2-tier site limit structure (upper and lower site limits) in phase 2, after the end of Magnox reprocessing (see paragraphs 42 and 43 for explanation of 2-tier site limit structure). Lower limits being applied to routine operations but allowing temporary higher upper limits to apply to essential time limited decommissioning and waste treatment activities. Moving from lower to upper limits would mean we had to agree that Sellafield Ltd has made an acceptable BAT case
- replacing plant limits with annual plant notification levels, so that Sellafield Ltd can make the most effective use of the available discharge routes and treatment plants
- remove fuel throughput related limits to reflect the end of reprocessing operations
- introduce a specific tritium limit for solid waste disposals at the on-site landfill known as the Calder Landfill Extension Segregated Area (CLESA)

40. Sellafield Ltd's original application for changes to the gaseous site limits are shown in table 3.4:

Table 3.4: Original application for changes to the gaseous site limits

Radionuclide or radionuclide group	Current limit (MBq)	Sellafield Ltd original proposed phase 1 limit (MBq)	% of current site limit	Sellafield Ltd original proposed phase 2 upper limit (MBq)	% of current site limit (MBq)	Sellafield Ltd original proposed phase 2 lower limit (MBq)	% of current site limit (MBq)
H-3	1.1E+09	7.2E+08	65%	5.5E+08	50%	2.2E+08	20%
C-14	3.3E+06	2.5E+06	75%	2.3E+06	70%	1.7E+06	50%
Kr-85	4.4E+11	1.8E+11	40%	-	-	-	-
Sr-90	7.1E+02	5.7E+02	80%	5.0E+02	70%	5.0E+02	70%
Ru-106	2.3E+04	2.0E+04	85%	2.0E+04	85%	2.0E+04	85%
Sb-125	3.0E+04	3.0E+04	100%	-	-	-	-
I-129	7.0E+04	4.9E+04	70%	4.2E+04	60%	2.8E+04	40%
I-131	3.7E+04	-	-	-	-	-	-
Cs-137	5.8E+03	4.8E+03	83%	4.8E+03	83%	4.8E+03	83%
Pu-alpha	1.9E+02	1.5E+02	80%	1.3E+02	70%	1.3E+02	70%
Pu-241	3.0E+03	-	-	-	-	-	-
Am-241 + Cm-242	1.2E+02	8.4E+01	70%	8.4E+01	70%	8.4E+01	70%
Alpha particulate	8.8E+02	6.6E+02	75%	6.6E+02	75%	4.4E+02	50%
Beta particulate	4.2E+04	3.2E+04	75%	3.2E+04	75%	2.1E+04	50%

41. Sellafield Ltd's original application for changes to the aqueous site limits are shown in table 3.5.

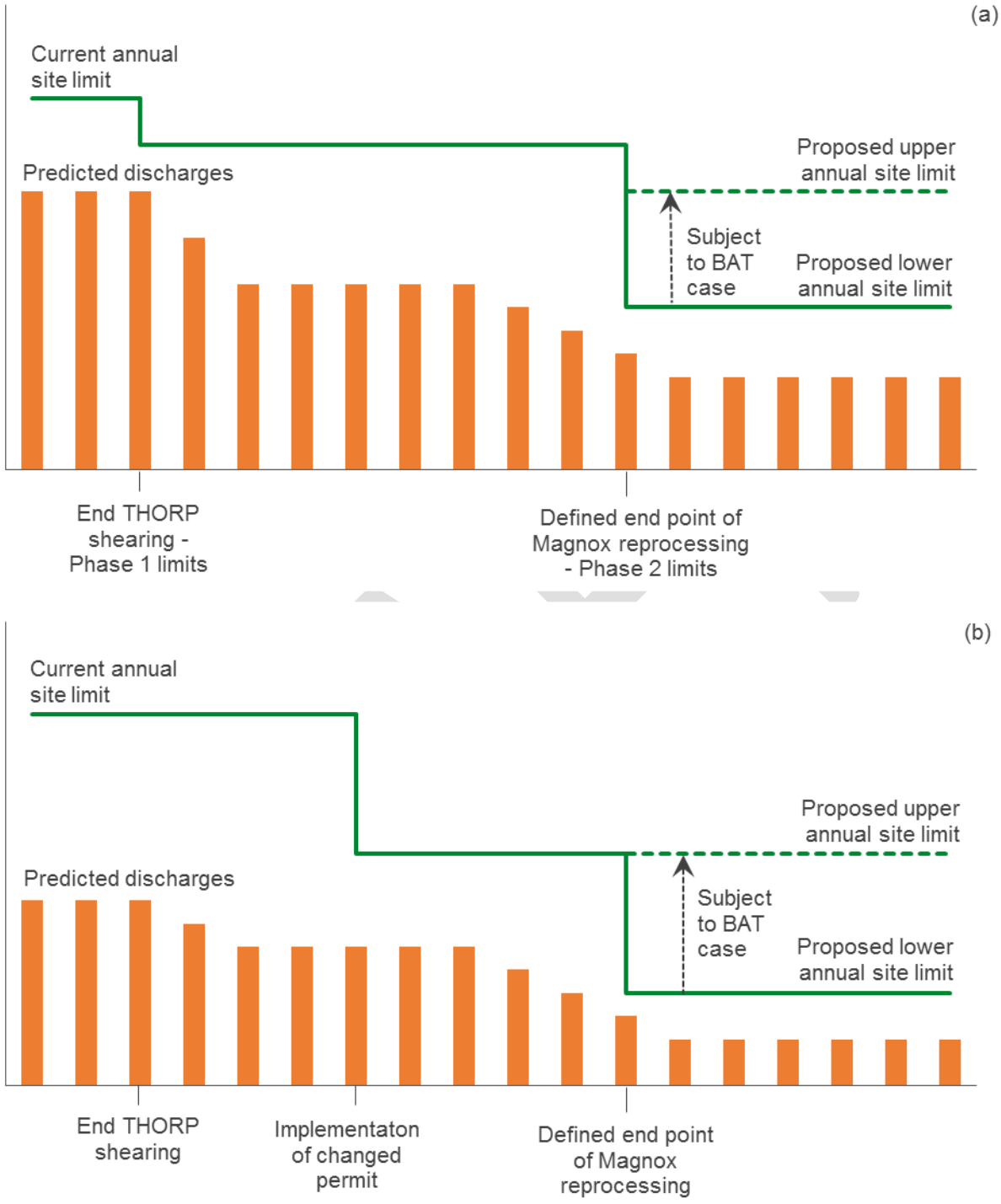
Table 3.5: Original application for changes to the aqueous site limits

Radionuclide or radionuclide group	Current limit (GBq)	Sellafield Ltd original proposed phase 1 limit (GBq)	% of current site limit)	Sellafield Ltd original proposed phase 2 upper limit (GBq)	% of current site limit	Sellafield Ltd original proposed phase 2 lower limit (GBq)	% of current site limit
H-3	1.8E+07	1.1E+07	60%	7.2E+06	40%	1.4E+06	8%
C-14	2.1E+04	1.8E+04	85%	1.1E+04	50%	8.4E+03	40%
Co-60	3.6E+03	3.6E+03	100%	3.6E+03	100%	3.6E+03	100%
Sr-90	4.5E+04	3.6E+04	80%	3.2E+04	70%	2.3E+04	50%
Zr-95 + Nb-95	2.8E+03	-	-	-	-	-	-
Tc-99	1.0E+04	9.0E+03	90%	8.0E+03	80%	6.0E+03	60%
Ru-106	5.1E+04	3.6E+04	70%	1.5E+04	30%	1.0E+04	20%
I-129	2.0E+03	1.6E+03	80%	8.0E+02	40%	4.0E+02	20%
Cs-134	1.6E+03	-	-	-	-	-	-
Cs-137	3.4E+04	2.7E+04	80%	2.4E+04	70%	1.7E+04	50%
Ce-144	4.0E+03	-	-	-	-	-	-
Np-237	7.3E+02	-	-	-	-	-	-
Pu-alpha	7.0E+02	7.0E+02	100%	6.3E+02	90%	4.2E+02	60%
Pu-241	2.5E+04	2.0E+04	80%	1.8E+04	70%	7.5E+03	30%
Am-241	3.0E+02	2.7E+02	90%	2.4E+02	80%	1.5E+02	50%
Cm-243+244	5.0E+01	-	-	-	-	-	-
Alpha	9.0E+02	8.1E+02	90%	7.2E+02	80%	4.5E+02	50%
Beta	1.8E+05	1.4E+05	80%	1.3E+05	70%	8.1E+04	45%
Uranium (kg)	1.8E+05	-	-	-	-	-	-

42. Following our request for further information, Sellafield Ltd revised its application in relation to site limits (Sellafield Ltd, 2019a, b, c, d, e, f). It removed the phased change to limits and proposed a 2-tier limit structure consisting of upper and lower limits. This approach became possible due to THORP closing in November 2018, the progress being made towards closing the Magnox reprocessing plant, and by assessing predicted future discharges further. This 2-tiered approach provides a simpler process for managing discharges, where moving from a routine lower limit to an upper limit requires the operator to provide a suitable BAT case rather than an application to vary the permit. Sellafield Ltd states that this tiered approach has allowed it to propose much lower levels for lower tier limits than would be the case if only single limit values were proposed. The aim of this approach is to protect the environment, while allowing high hazard and risk reduction activities to continue without significant delays invariably caused by repeated permit changes.

43. Figure 3.1 illustrates broadly how Sellafield Ltd's latest proposed site limits (blue line) appear in the context of the current limits and the approach in its original application (black line). Predictions of actual discharges are also shown (red line). Sellafield Ltd's latest proposed site limits are generally lower than those in its orginal application.

Figure 3.1: Illustration of proposed revision to annual site limits: (a) Sellafield Ltd's initial application; (b) revised application following our information request

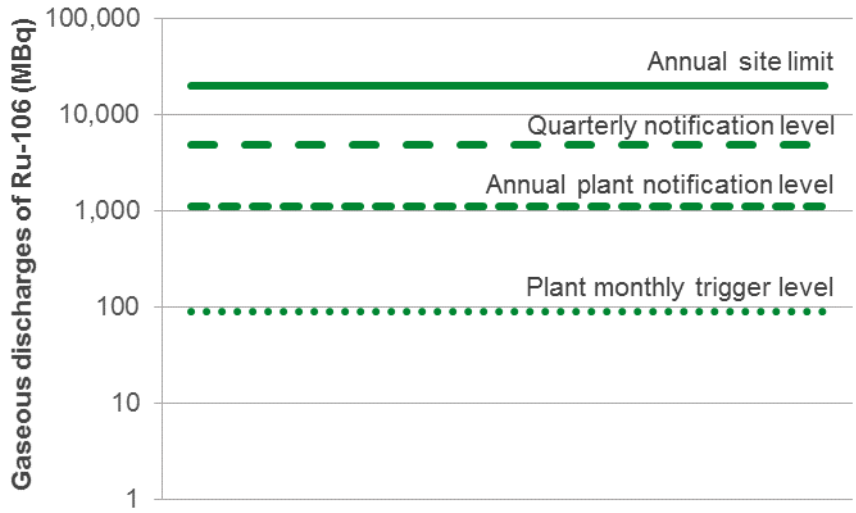


44. Throughout the rest of this document, we only discuss in detail Sellafield Ltd's latest proposed site limits, provided in response to our request for further information, and so there is no further reference to the 2-phased approach in its original application.

How discharges are controlled

45. Overall, Sellafield Ltd has proposed an approach to managing future discharges that consists of site limits, quarterly notification levels, annual plant notification levels and plant monthly triggers (figure 3.2 and paragraph 48). This structure of discharge controls makes sure that there are several levels at which we could intervene should discharges increase.

Figure 3.2: Proposed approach to control site discharges (Ru-206)



46. The Sellafield Ltd application seeks a permit that is fit for the future, when its activities will be focused on decommissioning and clean-up. The proposals include significant reductions in most of the annual site limits, and recognition that some radionuclide discharges will be sufficiently low that limits are no longer needed. The proposals include replacing plant limits with annual plant notification levels set at lower levels of discharge, which are aligned to monthly plant trigger levels. The proposal for upper and lower tier annual site discharge limits would allow Sellafield Ltd to carry out work, for example to decommission legacy facilities, that may result in discharges above the lower tier limit but below the upper tier limit, provided that an adequate BAT case is made that we agree with.

47. As noted above, the proposal is for annual site limits and quarterly and annual plant notification levels to be set in the permit regarding Sellafield Ltd's aqueous and gaseous discharges. It should be noted that Sellafield Ltd also uses even lower trigger levels to monitor discharges at a plant level on a monthly basis. The gaseous monthly trigger levels form the basis of Sellafield Ltd's proposed gaseous annual plant notification levels.

48. Figure 3.2 illustrates the structure of discharge controls for Ru-106 gaseous discharges (note that the y-axis is a logarithmic scale). In this example, Sellafield Ltd will report to us, on a quarterly basis, if gaseous monthly discharges of Ru-106 exceed 90MBq. This report will act as an early warning regarding any annual plant notification levels that might be threatened, for gaseous discharges of Ru-106 that is 1,100MBq. The annual plant notification levels are set lower than the quarterly notification levels, which for gaseous discharges of Ru-106 the upper QNL is 4,500MBq. The QNL provides an early warning regarding site limits that might be threatened. The upper site limit for gaseous discharges of Ru-106 is 18,400MBq. For comparison, the annual discharge that would result in a dose of 1µSv/y is 3,920,000MBq.

49. In chapter 6, we consider this structure of discharge controls, and how we can take action appropriately and promptly if there are any increases in discharges.

Annual site limits

50. Normally, for an operating facility, we would expect to review past discharges when setting new site limits. However, given the fundamental change in operations at Sellafield, this is not entirely appropriate.

51. Sellafield Ltd has proposed revised site limits based on the Sellafield Effluent Management Strategy (SEMS), which uses the Overall Effluent Strategy Model (OESM) to predict discharges from work taking place on site. Comparing OESM predicted discharges and actual discharges from 2010 and 2011 to 2015 shows that OESM predicts discharges within 15% on average for well understood operations (Sellafield Ltd, 2019 b). It is likely that this 'model uncertainty' will increase as Sellafield Ltd carries out new and non-routine tasks such as POCO, HHRR and decommissioning.

52. The OESM has provided 2 different results, 'expected discharges' and 'projected discharges'.

53. ‘Expected discharges’ are the maximum value of best estimates of future annual discharges after THORP and Magnox reprocessing plants have closed. Comparing OESM expected discharge predictions with actual past discharges shows on average 15% discrepancy (that is 15% model uncertainty).

54. The ‘projected discharges’ that form the basis for Sellafield Ltd's proposals for upper and lower tier annual site limits include considering:

- ‘expected discharge’ (as noted above)
- maximum historic discharge (2006 to 2016) from non-reprocessing related activities
- higher and lower uncertainties that can relate to plant performance, schedule or challenge
- model uncertainty (~15% see above)

55. The uncertainties accounted for in OESM outputs can only be those that are quantified. There are some further uncertainties (for example, regarding exact characteristics of waste to be retrieved from legacy facilities) that are not yet quantified. It is because of these further uncertainties that some limits are proposed at values higher than the projected discharge predicted by OESM.

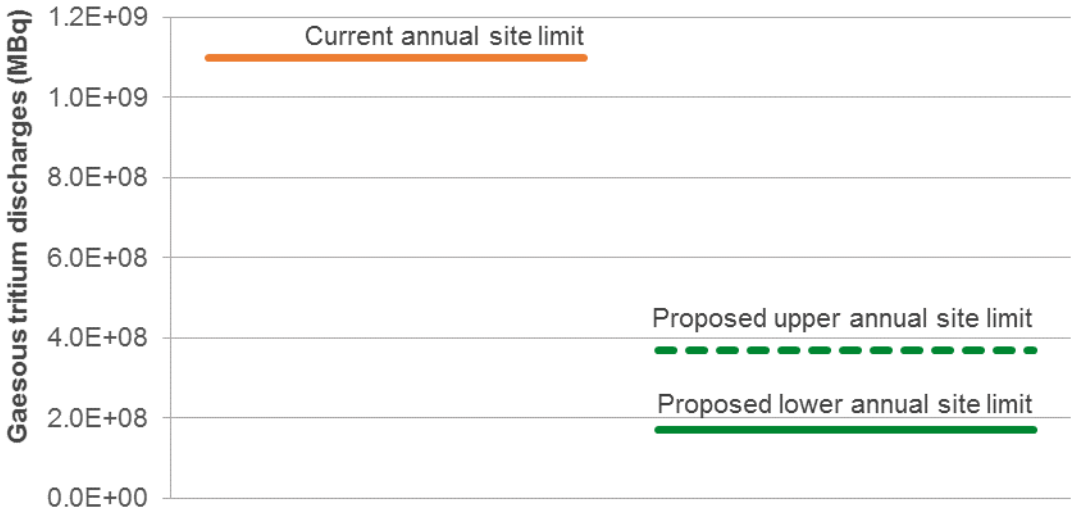
56. Proposed lower tier site limits generally align with OESM lower uncertainty projected discharges plus 15% to account for model uncertainty.

57. Proposed upper tier site limits are generally based on the OESM higher uncertainty projections plus 15% to account for model uncertainty. In some cases, more headroom is proposed between the OESM prediction and the site limit. Generally, this is because of unquantified uncertainties. For example, Sellafield Ltd states that for some of the planned retrieval activities, particularly taking waste out of the legacy ponds and silos, the exact characteristics of the waste will only be determined as the retrievals progress. There are, therefore, unquantified uncertainties in the future discharges. Also, the plans for POCO are still developing. It may be that these use new techniques, so there is also unquantified uncertainty regarding those discharges.

58. Our assessment, in chapter 6, reviews these unquantified uncertainties and assesses whether we consider them reasonable as the basis for site limits. In doing so, we are aware that Sellafield Ltd has proposed introducing annual plant notification levels that will mean it has to report any increases in plant discharges at levels much lower than the site limits.

59. Figure 3.3 illustrates, using gaseous tritium (H-3) discharges, how site limits will generally decrease from current to upper and lower limits. The majority, but not all, radionuclide limits follow this trend.

Figure 3.3: Illustration of the proposed changes to site limits (tritium)



Site limit proposals

60. Sellafield Ltd's revised application for changes to the gaseous site limits are shown in table 3.6.

Table 3.6: Revised application for changes to the gaseous site limits

Radionuclide or radionuclide group	Current limit (MBq)	Sellafield Ltd revised proposed upper limit (MBq)	% of current site limit (MBq)	Sellafield Ltd revised proposed lower limit (MBq)	% of current site limit (MBq)
H-3	1.1E+09	3.7E+08	34%	1.7E+08	15%
C-14	3.3E+06	2.3E+06	70%	3.8E+05	12%
Kr-85	4.4E+11	7.0E+10	16%	-	-
Sr-90	7.1E+02	5.0E+02	70%	7.4E+01	10%
Ru-106	2.3E+04	1.8E+04	78%	2.8E+03	12%
Sb-125	3.0E+04	3.0E+04	100%	-	-
I-129	7.0E+04	4.2E+04	60%	1.3E+04	18%
I-131	3.7E+04	-	-	-	-
Cs-137	5.8E+03	4.8E+03	83%	4.1E+02	7%
Pu-alpha	1.9E+02	1.3E+02	70%	7.2E+01	38%
Pu-241	3.0E+03	-	-	-	-
Am-241 + Cm-242	1.2E+02	8.4E+01	70%	5.0E+01	42%
Alpha particulate	8.8E+02	6.6E+02	75%	3.2E+02	36%
Beta particulate	4.2E+04	3.2E+04	75%	5.1E+03	12%

61. Sellafield Ltd's revised application for changes to the aqueous site limits are shown in table 3.7.

Table 3.7: Revised application for changes to the aqueous site limits

Radionuclide or radionuclide group	Current limit (GBq)	Sellafield Ltd revised proposed upper limit (GBq)	% of current site limit (GBq)	Sellafield Ltd revised proposed lower limit (GBq)	% of current site limit (GBq)
H-3	1.8E+07	3.0E+06	17%	7.0E+05	4%
C-14	2.1E+04	1.3E+04	63%	5.1E+03	24%
Co-60	3.6E+03	3.6E+03	100%	2.5E+03	69%
Sr-90	4.5E+04	3.2E+04	71%	1.4E+04	31%
Zr-95 + Nb-95	2.8E+03	-	-	-	-
Tc-99	1.0E+04	7.5E+03	75%	4.5E+03	45%
Ru-106	5.1E+04	1.0E+04	20%	3.1E+03	6%
I-129	2.0E+03	8.0E+02	40%	3.2E+02	16%
Cs-134	1.6E+03	-	-	-	-
Cs-137	3.4E+04	2.4E+04	71%	1.7E+04	49%
Ce-144	4.0E+03	-	-	-	-
Np-237	7.3E+02	-	-	-	-
Pu-alpha	7.0E+02	5.0E+02	71%	2.9E+02	41%
Pu-241	2.5E+04	1.8E+04	72%	6.0E+03	24%
Am-241	3.0E+02	2.2E+02	72%	1.4E+02	47%
Cm-243+244	5.0E+01	-	-	-	-
Alpha	9.0E+02	6.0E+02	67%	3.4E+02	38%
Beta	1.8E+05	1.2E+05	65%	6.3E+04	35%
Uranium (kg)	(2000kg)	7.0E+01 (2000kg)	100%	2.0E+01 (600kg)	30%

Site limit removals

62. Discharges of some radionuclides have already reduced, or are predicted to reduce to levels such that we would not ordinarily impose site limits based on our criteria for setting limits. Sellafield Ltd

has applied to remove site limits for some radionuclides where discharges arise from reprocessing related activities, and where the discharges are projected to fall below the level at which limits would be required. Our assessment in chapter 6 considers the case for removing these limits.

Site quarterly notification levels

63. Under site QNLs the operator must provide us with information if discharges exceed a level set in the permit. Exceeding a notification level is not a breach of the permit, but could act as a trigger for us to intervene, for example to find out if best available techniques are being applied to minimise discharges. Sellafield Ltd has not proposed QNLs and so we have detailed how we determined these in our assessment in chapter 6.

Annual plant notification levels

64. Sellafield Ltd has proposed introducing new annual plant notification levels. These would be in addition to the quarterly notification levels in place for site discharges and would replace current plant limits.

65. As with quarterly notification levels, exceeding an annual plant notification level would not be a breach of the permit. We highlight that Sellafield Ltd has proposed annual plant notification levels that are much lower than the previous annual plant limits. A number of the annual plant notification levels are included because they are indicators of plant performance rather than because of dose consequence of discharge to the public. These stringent annual plant notification levels would allow discharges at a plant level to be closely regulated, as notification of a level being reached could allow us to intervene to determine if BAT is being applied to minimise discharges.

Throughput related limits

66. Throughput related limits were set regarding THORP and Magnox reprocessing. THORP is no longer operating. The throughput of Magnox reprocessing is accounted for in the annual plant notification level calculations for the Separation Area Ventilation (SAV) stack, and so Sellafield Ltd has proposed to remove these from the permit. In chapter 6, we have considered the previous throughput-related limits in our assessment of Sellafield Ltd's proposals.

Additional components to limits

67. The change from plant limits to annual plant notification levels removes the need for additional components. In the existing permit, these allowed for higher limits in specific reported cases, for example, processing through evaporator C or a reported malfunction of SIXEP. The proposed approach is that if Sellafield Ltd exceeds an annual plant notification level, it will have to provide a written submission explaining what happened and why it considers that it has continued to use BAT. For waste vitrification plants (WVP) and SIXEP, it is possible that such a notification may relate to the issues requiring the previous additional components. We would assess these in the same way as other APNL notifications in relation to demonstrating BAT.

CLESA tritium limit

68. Sellafield Ltd applied to include a nuclide-specific concentration limit for tritium (H-3) of 1.0E+05Bq/g taken as an average across each consignment load. This was supported by a number of documents. However, following detailed discussion on these documents and informal feedback on this proposal, Sellafield Ltd revised its application to change the concentration limit for tritium (H-3) to 4.0E+04Bq/g and subsequently 1.2 E+04Bq/g. This increase would enable decommissioning to progress more quickly.

CEAR changes

69. Sellafield Ltd has proposed amendments to the CEAR as follows:

- 3.2.5(a) - sample type, frequency, volume and analysis required by Environment Agency
- 4.2.2 part 2 paragraph 1 Waste disposal information
- 4.2.2 part 2 paragraph 3 Results of the environmental monitoring programme
- 4.2.2 part 2 paragraph 4 Monitoring exceedances
- 4.2.2 part 2 paragraphs 8, 26, 27, 28 Merging of these notification requirements
- 4.2.2 part 2 paragraph 9 CLESA report

- 4.2.2 part 2 paragraph 10 Hydrogeological risk assessment review
- 4.2.2 part 2 paragraphs 15, 16, 17, 18 Reviews of best practice, means to assess activity and research and development
- 4.2.2 part 2 paragraph 23 SIXEP and related plants operation and management report
- 4.2.2 part 2 paragraph 25 Review and update of BAT assessments for low level waste and very low level waste disposals

70. Our review and decisions concerning these changes is set out in appendix 5 and referred to in chapters 5 and 6, where appropriate.

4. Our assessment - part 1: General

Introduction to our assessment

71. In chapters 4 to 8, we set out our decision based on our assessment of the application and consideration of the responses to our consultation. There are a number of matters we need to consider before deciding whether to grant the application and, if so, what conditions we should apply to the permit. We address these in the following sections. These are mainly set out in the same order as in the application form.
72. In this chapter, we consider justification and Article 37 of the Euratom treaty.
73. In chapter 5, we consider how the operator proposes to use BAT for the disposal of waste so as to reduce the radiological impact to members of the public to a level that is as low as reasonably achievable and to protect the environment. That chapter explains how we have addressed relevant statutory requirements and government policy and guidance in relation to how the disposal of radioactive waste is to be carried out.
74. In chapter 6, we consider disposal routes and limits, receipt of waste, and monitoring of waste disposals and the environment.
75. In chapter 7, we consider the radiological impact on members of the public and the environment from the proposed discharges of radioactive waste. We also consider whether, in permitting those discharges, we would fulfil our duties across a range of environmental legislation.
76. In chapter 8, we consider a number of wider social-economic duties, including contributing to sustainable development.
77. In reaching our decision, we have addressed the relevant legislation, government policy and guidance, our own guidance and the responses to our consultation. Table 2.1 in chapter 2 lists the main documentation that describes these requirements. Our consideration of responses to the consultation that have affected our approach or our decision is set out in the relevant parts of chapters 4 to 8. Our consideration of other responses is set out in appendix 2.
78. A number of issues were raised that are outside our remit and that we have not considered in reaching our decision. We have identified these issues in appendix 2.

Justification (RSR Part A, Q11)

79. 'The Justification of Practices Involving Ionising Radiation Regulations 2004' (GB Parliament, 2004) are not part of the environmental permitting regime. But, if an application for an environmental permit relates to a practice, as defined in the 'Basic Safety Standards Directive' (BSSD) (EU, 2013), we can only grant a permit if the practice is justified (see appendix 2 of Government policy - radioactive & nuclear substances (GB Parliament, 2015a) for further details).
80. The practices that are justified are production of nuclear fuel, generation of electricity by nuclear reactors, and recovery of usable products from spent nuclear fuel (GB Parliament, 2018b). The justified practice, for example generation of electricity, includes the decommissioning of relevant facilities and the associated waste management.

Euratom Treaty, Article 37

81. Under Article 37 of the Euratom Treaty, member states must provide information to the European Commission relating to any plan for the disposal of radioactive waste. A submission is required, among other things, for a new nuclear facility or for a change to an existing nuclear facility that results in less restrictive authorised disposal limits. The information provided to the Commission has to be sufficient to determine whether these plans could lead to radioactive contamination of the water, soil or airspace of another member state. The Commission provides its opinion within 6 months, after consulting the group of experts referred to in Article 31 of the Treaty. Until an operator receives a positive opinion, we cannot grant an environmental permit to allow it to proceed with new plans to dispose of radioactive waste or to operate a new facility.

82. An Article 37 submission was not required for this application, because the permit variation is not due to a change in Sellafield Ltd's plan, and it does not include less restrictive permitted discharge limits. Rather, it is an administrative change to provide Sellafield Ltd with a permit that is fit for purpose with respect to its mission to focus on decommissioning and environmental clean-up (remediation) of the Sellafield site.

83. As noted in paragraph 395, Sellafield Ltd is awaiting confirmation that it does not need a Euratom Article 37 submission regarding changes to the permitted disposals in CLESA. Or, if it does, that the Department for Business, Energy and Industrial Strategy (BEIS) and Sellafield Ltd have received a positive opinion that the discharges will not affect Member States from the Commission on an Article 37 submission. These changes are highlighted in pink in the draft permit to denote that these cannot be made until this opinion has been received.

5. Our assessment - part 2: BAT for the management and disposal of radioactive waste

Introduction

84. Under EPR 16, we must carry out our work to make sure that the levels of ionising radiation resulting from the disposal of radioactive waste that any member of the public and the population as a whole are exposed to are kept as low as reasonably achievable, taking into account economic and social factors.

85. We do this by requiring the operator to use best available techniques in the operation of the facility to:

- prevent and minimise (in terms of radioactivity) the creation of radioactive waste
- minimise (in terms of radioactivity) discharges of gaseous and aqueous radioactive waste
- minimise the impact of those discharges on people, and adequately protect other species (wildlife)
- minimise (in terms of mass and volume) solid and non-aqueous liquid radioactive waste

By 'operation' we mean how the facility has been designed, built, maintained, operated and dismantled. We also require the operator to dispose of solid and non-aqueous liquid waste by using the most effective (optimised) routes (taking account of the waste hierarchy and the proximity principle).

86. BAT is, therefore, applied to aspects such as minimising waste created (for example, by avoiding contamination of materials, and taking opportunities to reuse or recycle materials that might otherwise be disposed of as waste). BAT is also applied to reducing discharges (abatement), and monitoring plant, discharges and the environment. It takes account of factors such as the availability and cost of relevant measures, operator safety, and the benefits of reduced discharges and disposals. If the operator is using BAT, radiation risks to members of the public will be as low as reasonably achievable, and the environment will be adequately protected.

87. Sellafield Ltd must also demonstrate, for any waste created for which there is no currently available disposal route, that is, intermediate level waste (ILW) and high level waste (HLW):

- how suitable it is to be disposed of
- how it will be managed, in the interim, so as not to bias its disposal

88. In considering Sellafield Ltd's proposals, we have considered the 'Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment' (GB Parliament, 2009a), and and other relevant government policy and strategies (for example, GB Parliament, 2007; GB Parliament, 2016b, GB Parliament 2018a).

89. This variation application gave us the opportunity to review progress against our site environmental review (SER) objectives that are taken from our nuclear delivery plan (NDP). We have also used lessons learned from our Sellafield site regulation findings. The permit is the main way we meet our SER objectives. The permit limits and conditions make sure that we fulfill our statutory responsibilities. In some cases, the SER objectives stretch into our wider responsibility to support sustainable development (see chapter 8). The belief is that a high-performing permit holder will encourage the necessary environmental culture to make sure that actions are taken to protect the environment. We work with Sellafield Ltd to meet our SER objectives and to make sure that we regulate fairly by not specifying our expectations in the permit if these can be achieved voluntarily. This review gave us the opportunity to reflect whether this approach is working in all cases and whether the balance between specification and voluntary action is effective and efficient. We have, therefore, proposed changes as detailed below.

90. This chapter provides our review of Sellafield Ltd's application of BAT. It summarises the main changes to the permit and CEAR and on-going requirements that will help to ensure that best available techniques continue to be applied at Sellafield, and that our longer term SER objectives for the site are met. The final section of this chapter summarises all of our revisions to the permit and CEAR, which are discussed in more detail in chapters 5 to 8 and appendix 5.

How Sellafield Ltd assesses BAT

91. This section provides an overview of Sellafield Ltd's arrangements supporting BAT. Sellafield Ltd will need to include new arrangements for producing BAT submissions, as noted above, to support a move to an upper tier site limit for a specific programme of work.

92. Sellafield Ltd has described its framework of arrangements for demonstrating BAT (Sellafield Ltd, 2018d). Sellafield Ltd has a management system (SLMS) that provides guidance regarding compliance obligations using Sellafield Ltd practices (SLP) and Sellafield Ltd supporting practices (SLSP). The SLMS also includes the charters for governance groups, detailing their purpose and membership. Sellafield Ltd uses a 'gated' process for projects (where there are decisions, or gates, that are required to pass to the next phase of the process) including outline programme approval, initiating project delivery and detail design 'gates'. The BAT framework includes site strategy evaluation, programme planning, project studies, project concept, design engineering, operations, decommissioning and termination. Each stage of the BAT framework has goals that need to consider BAT and that are reviewed through the governance arrangements. Sellafield Ltd has a management of change process that includes assessing significant changes to people, plant and processes. We have decided to retain the CEAR requirement for Sellafield Ltd to notify us in writing of plant modification proposals that have actual or potential significant environmental implications, before it implements them.

93. Sellafield Ltd has an environmental management manual that describes how it achieves effective environmental management. The manual defines the main environmental management principles and practices which, when applied, make sure that Sellafield Ltd provides effective environmental management in the context of regulatory, legislative and business requirements and in support of its vision and mission. This manual notes that operational BAT is achieved mainly by following the environment case process. Sellafield Ltd has environment cases covering all facilities on site and these:

- identify significant environmental impacts, which need controlling
- identify controls needed for environmental protection and compliance, which demonstrate that BAT has been applied. These controls can be in the form of equipment (environmental equipment) or procedural controls (environmental procedural controls)
- identify environmental equipment (EE) or environmental procedural controls (EPC) that carry out the necessary control function
- track the completion of improvement recommendations

94. Sellafield Ltd is developing a corporate environment case. This comprises a number of documents covering principles, strategic level BAT and governance. These documents will be important in demonstrating that BAT has been used at a site level.

95. Our regulatory team is regularly involved in checking whether Sellafield Ltd has demonstrated and implemented BAT. We do this by inspecting the site, assessing facility environment cases, assessing project BAT assessments, and reviewing discharges and environmental monitoring. While there have been a number of non-compliances regarding using BAT in recent years, these represent a small number compared to the number of BAT assessments that are carried out and the wide range and diverse nature of activities carried out on the Sellafield site.

96. We also require Sellafield Ltd to produce an annual report reviewing its environmental performance. To improve the value of this reporting, we have decided to introduce a CEAR requirement to evaluate environmental performance reporting options, supported by consultation with interested groups, setting out Sellafield Ltd's preferred option. This may help to consolidate and integrate environmental reporting requirements to meet our needs and those of other interested groups (appendix 5).

97. Working with the Scottish Environment Protection Agency (SEPA) and Natural Resources Wales, we have introduced a new management condition (1.1.3) to specify our expectations for lifetime radioactive waste management, using the waste management plan and site wide environmental safety case introduced by Guidance on Requirements for Release from Radioactive Substances Regulation (GRR) (Environment Agency, SEPA and Natural Resources Wales, 2018) as the tools to demonstrate that the main requirements are met. We have added a new improvement requirement to table S1.2 to require the first version of the WMP and SWESC to be prepared at each site and allow condition 1.1.3 to be fully applied. Condition 4.3.6 makes sure that we are notified of significant changes to the WMP and SWESC during the lifetime of the permit. We believe that this should build on and complement work carried out to develop and maintain an integrated waste strategy.

98. Consequently, we have decided to remove the CEAR requirement for Sellafield Ltd to develop and maintain an integrated waste strategy and associated plan to avoid duplication. We have added a new CEAR requirement for Sellafield Ltd to submit an outline plan, with important milestones, for developing the waste management plan and site wide environmental safety case (see appendix 5).

99. We are confident that Sellafield Ltd's arrangements for assessing BAT are sound and that the future developments outlined above should ensure this continues.

BAT to prevent and minimise the creation of radioactive waste

100. The waste hierarchy is a framework used to inform strategic thinking, highlighting the order in which options for dealing with waste should be considered. This hierarchy is applied throughout industry, and is not just limited to the nuclear sector. Sellafield Ltd has its own version of the waste hierarchy that it believes better suits the needs and challenges it faces. The main difference is it has added a 'safety and risk reduction' element. As with the conventional waste hierarchy, the options prevention and minimisation of waste need considering most and provide the greatest benefit. As you progress further down the hierarchy, the options for waste management become less favourable.

101. Where possible, waste is minimised or avoided, for example, removing excess packaging before materials enter the separation area, and re-using pallets. The volume of waste destined for disposal is also minimised through treatment options such as compaction or size reduction, using on-site facilities or off-site incineration facilities for some types of process waste. Decontamination techniques are also used so that waste can be reused, recycled or managed as a lower category of waste. In addition, waste is also segregated, which is important in allowing it to be disposed of in the best way (by optimal routes). Applying the waste hierarchy means balancing priorities, including protecting health, safety, security and the environment, value for money, affordability and maturity of the technology. Sellafield Ltd considers that it applies the waste hierarchy to managing all waste.

102. However, Sellafield Ltd recognises that there is still significant scope for improvement to prevent and minimise waste. It has a site-wide integrated waste management (IWM) programme that is focused on making improvements and developing new capability and innovation to waste management.

103. We recognise that Sellafield Ltd applies the waste hierarchy to prevent and minimise waste, but we agree that there is significant room for improvement by developing new capability and innovation to waste management. This will be achieved by improving waste characterisation, which has been a theme of a nuclear sector (including Sellafield) themed inspection (Environment Agency, 2016a), We have supported related work at both the UK (NDA, in prep) and international level (NEA, 2017). We continue to work with the Office for Nuclear Regulation (ONR) and Sellafield Ltd to make sure these developments are successful.

BAT to minimise the discharges of gaseous and aqueous radioactive waste

104. Radioactive gaseous discharges arise from ventilation air from process plants during operations associated with receiving, storing, reprocessing and managing spent nuclear fuels, together with ventilation air from waste management processes and decommissioning projects.

105. Gaseous discharges are minimised by using BAT in the following areas:

- by using conditioning of building air supplies to minimise particulates
- reducing humidity and excluding corrosive ions (for example, the salt in seaspray)
- process and equipment designed to minimise arisings to gaseous streams
- high efficiency particulate air (HEPA) filtration to minimise radioactive discharges associated with particulate matter
- wet scrubbers (both water and caustic type) on streams where significant gaseous activity is present, to capture activity from the gaseous stream into the aqueous stream
- other abatement equipment such as electrostatic precipitators (ESPs), condensers and pre-heaters to prevent condensation, which affects performance of the filters. Through an annual CEAR requirement, Sellafield Ltd reports HEPA filtration performance to us, and we have decided that this requirement should remain in place

106. A major recent development has been the construction, commissioning and operation since 2016 of the Separation Area Ventilation (SAV) plant, which diverts gaseous discharges from the Magnox reprocessing plant and other facilities to a new discharge stack with additional HEPA filtration abatement plant. This has allowed the decommissioning and demolition of pile 1 and the redundant reprocessing plant stacks to begin. A significant future development is the installation of HEPA filtration at the Magnox Swarf Storage Silos (MSSS) plant.

107. In 2018, we became aware of defects (holes) in the ducting serving the Analytical Services and Special Nuclear Materials (North) Facilities. These defects were due to failures in asset care and maintenance. We assessed that the likely impact was minor, but noted it could be more significant if faults lined up, for example loss of HEPA filtration or ventilation motive force. As these events had happened before at the Sellafield site, and given that the potential impact of these defects is now greater, we decided to serve an enforcement notice (Environment Agency, 2018a) on Sellafield Ltd. Under this notice, Sellafield Ltd had to repair the defects, improve maintenance and develop a programme of inspection and repair of the remaining ducting (see also appendix 1). Sellafield Ltd has complied with this enforcement notice.

108. Due to concerns that there may be similar issues across the Sellafield site, and the history of wider non-compliances associated with ventilation systems, we sought assurance that Sellafield Ltd will act and learn from these events, so that it understands the remaining threat and addresses it across the entire site. Responding to these concerns, Sellafield Ltd is carrying out a major asset inspection programme covering the external ventilation ducting associated with the nuclear facilities across the Sellafield site. In addition, it has agreed to commission an independent review of its ventilation asset management arrangements. To make sure that this work is completed and any deficiencies in ventilation ducting and ventilation asset management arrangements addressed, we have decided to make this a permit improvement condition requirement. We will require Sellafield Ltd to submit regular progress reports until this programme of work is complete.

109. We also have a concern that there is a backlog of redundant ventilation ducting that is yet to be decommissioned. Consequently, we have decided to introduce a CEAR requirement for Sellafield Ltd to provide a written annual report containing a register of all redundant radiological ventilation ducting at Sellafield, including a description of the redundant systems, ownership and asset condition, plans to decommission ducting, and a summary of the work carried out in the previous 12 months to decommission redundant radiological ventilation ducting (appendix 5).

110. Radioactive aqueous discharges arise from process plants during operations associated with receiving, storing, reprocessing and managing spent nuclear fuels, from waste management processes and decommissioning projects. Some local measures are in places at plants to prevent, minimise, reuse, recycle and abate aqueous waste, for example reusing water in fuel ponds and local effluent treatment plants.

111. The major aqueous waste treatment plants operating on the site are:

- high active liquor evaporation and storage (HALES) plant, which evaporates highly active effluents before vitrification in the WVP

- salt evaporator, which conditions and concentrates waste streams for interim decay storage before treatment in the Enhanced Actinide Removal Plant (EARP)
- the Site Ion Exchange Plant (SIXEP), which reduces radioactive discharges of effluents containing beta-emitting radionuclides by using ion-exchange and sand bed filtration
- EARP, whose main purpose is to reduce the levels of plutonium and other actinides in aqueous discharges using flocculation and ultra-filtration
- segregated effluent treatment plant (SETP), which treats low activity effluent streams that are not directed to EARP (treatment comprises neutralising acidic effluent streams before mixing with alkaline effluent streams to ensure volatile species are discharged to the marine environment rather than air. This reduces dose and removes high specific gravity particulates using a hydrocyclone
- solvent treatment plant (STP), which removes radioactivity from the medium active solvent streams via a solvent wash process with the aqueous waste directed to EARP for further treatment. Aqueous discharges continue to arise from the laundry and lagoon, the factory sewer and the THORP receipt and storage (THORP R&S) fuel pond. Aqueous discharges from the THORP Dissolver Offgas System (THORP DOG) have declined significantly since THORP closed

112. When reprocessing ends, Sellafield Ltd aims to maximise the use of existing treatment facilities, such as diverting effluent streams from the SETP to EARP to improve abatement levels before they are discharged into the sea. In addition, a new effluent treatment plant, the SIXEP Continuity Plant (SCP) is currently being designed and is planned to replace part of SIXEP in the next decade. In order to monitor these developments, we have decided that Sellafield Ltd must provide regular reports describing its ongoing programme of work to make sure the SIXEP and EARP effluent treatment plants continue to operate effectively. These documents will help us better understand the aqueous discharges from SIXEP and EARP, and the variation of discharges from SIXEP and EARP donor plant operations. They will also provide an insight into activities aimed at further minimising the radioactive aqueous discharges from SIXEP and EARP and their donor plants by using best available techniques. This extends a previous requirement that just related to SIXEP.

113. Through an annual CEAR requirement, Sellafield Ltd provides us with a written report of its annual work programme and testing of sea pipelines that are in use or intended to be used. We have decided that it should continue to do this. We also intend to retain the CEAR notification requirements that relate to the routing of aqueous waste down the sea pipelines and lagoon/factory sewer during exceptional conditions. We will also retain the CEAR requirement for an annual overall effluent strategy (OES) report. This contains a summary of estimates of current and future site gaseous and aqueous waste discharges by main activities and the associated radiological impact. The report also includes a summary of the approach used to produce these estimates. Sellafield Ltd provides this report to a number of interested parties, including government, so that Sellafield Ltd's contribution to meeting the aims and expected outcomes of the UKSRD is clear.

114. Our assessment of a factory sewer (FS) BAT report, including additional information Sellafield Ltd provided, concluded that it has complied with the permit improvement condition (requirement S1.2.4). We can, therefore, remove it from the permit. We believe that Sellafield Ltd has adequately demonstrated how it has, and will continue to, use BAT to make sure that it understands the impacts of contaminated groundwater on the FS, and to minimise the radioactivity and associated impact of the discharges on members of the public and the environment. However, we note that it appeared that abstraction of contaminated groundwater from a borehole located in contaminated ground close to the HALES facility had not been operational for about a year before the increase in Sr-90 discharges from the FS. This suggests that there may be a link, and that HALES borehole abstraction may represent a BAT control with respect to minimising FS radioactive discharges. We have highlighted to Sellafield Ltd that it should monitor this groundwater abstraction operation and consider it in the context of making sure BAT is used to minimise radioactive discharges via the FS.

115. The Ground Environmental Review Meeting, which began in February 2018, has been set up to oversee the Magnox Swarf Storage Silo (MSSS) facility and land quality management,

containment assurance tactics and techniques that demonstrate compliance. This meeting has to provide an annual update on leak management technologies that could be used at MSSS and the First Generation Magnox Storage Pond (FGMSP) and surrounding areas. This requirement stemmed from a recommendation in a regulatory assessment of Sellafield Ltd's proposals for leak detection and mitigation, as part of an ongoing BAT demonstration (Environment Agency, 2015a). To date, this annual update has not been provided to the meeting. We, therefore, consider it is appropriate to include a new CEAR requirement to make sure that this review is carried out in future.

116. With THORP closing, site discharges of some radionuclides, in particular volatile radionuclides (H-3, C-14, Kr-85 and I-129) have already declined. In 2018, BEIS published a review: UKSRD: 2018 Review of the 2009 Strategy, (GB Parliament, 2018a). This looked at performance against the 2009 strategy and updated operator forecasts up to 2030, taking into account planned operating changes such as the closure of THORP in 2018 and completion of Magnox reprocessing in 2020. The review concluded that there is clear evidence that the UK is making progress in meeting the outcomes of the strategy and contributing towards the objectives of the OSPAR Radioactive Substances Strategy (OSPAR, 2010).

117. Government policy on radioactive discharges states that unnecessarily introducing radioactivity into the environment is undesirable, even at levels where doses to humans and other species are low and, on the basis of current knowledge, are unlikely to cause harm. For Sellafield Ltd, this is being achieved through long-term strategic planning. In order to encourage and support this longer-term strategic planning, and in support of government policy, we have decided that Sellafield Ltd should evaluate strategic options for ceasing sea pipeline discharges (and pipeline remediation) and for the lagoon drainage system to become purely a surface water drainage system (appendix 5). We believe that considering these long-term objectives early will help to guide shorter term decisions on effluent management. We recognise that Sellafield Ltd has already given some consideration to these matters.

118. Overall, we consider that Sellafield Ltd applies BAT to minimise gaseous and aqueous waste discharges and it continues to make good progress towards achieving the 2020 and 2030 expected outcomes of the UKSRD. However, we continue to see a small but persistent number of events associated with managing gaseous and aqueous waste, which leads to us taking enforcement action to prevent repeat events. Some events are associated with ageing infrastructure, and we have recently carried out a nuclear sector (including Sellafield) inspection covering the wider theme of asset management arrangements (Environment Agency, 2018d). To make sure these inspection findings are addressed, we have decided that Sellafield Ltd must provide regular asset management progress update reports, including the status of each area of development, progress against planned timescales and availability of resources through the CEAR document (appendix 5). In the longer term, new infrastructure, for example SCP, decommissioning and a lower dependency on the ageing effluent infrastructure, should also help to make sure that Sellafield Ltd continues to apply BAT to minimise discharge of gaseous and aqueous radioactive waste.

BAT to minimise the impact of discharges

119. Sellafield Ltd minimises the impact of its gaseous discharges by making sure that significant discharges are made via engineered stacks, which are specified in the permit and allow significant dispersion and dilution before impacting on people or the environment. Gaseous discharges also occur from fuel ponds that are open to the atmosphere. A range of measures are taken to minimise the radioactivity concentration of pondwater and to deter wildlife from coming into contact with pondwater to minimise the impact on people or the environment. Minor discharges are made through other approved outlets, which require regulatory approval, and are specified in the CEAR document.

120. We have decided to downgrade 2 stacks to 'other approved outlets' in this review. This is because the main radioactive inventory has been removed from the decontamination centre and the ventilation switched off. Discharges from the SIXEP stack have been very low for some time, and despite the future increased challenge to SIXEP, are not expected to increase. More detail on

these changes is provided in chapter 6. We have also made minor amendments to the list of 'other approved outlets' in the CEAR document (appendix 5).

121. Sellafield Ltd minimises the impact of its aqueous discharges by making sure that all discharges are made via the sea pipelines, factory sewer and the Calder interceptor sewer. Aqueous waste is segregated, with the more radioactive discharges being discharged to sea, 2km offshore via the sea pipelines. This means that all but a very small fraction of radioactive waste discharged to sea is subject to significant dispersion and dilution before impacting on people and the environment. Batch discharges are made via the sea pipelines at times, in a form and in a way that minimises the radiological effects on the environment and members of the public, mainly by considering tides. No other 'outlets' are approved for the discharge of aqueous radioactive waste.

122. In the future, Sellafield Ltd might wish to engineer new routes for other aqueous effluents via the factory sewer or Calder interceptor sewer. To make sure that these plans are appropriate, we will include a new pre-operational measure:

    The Operator shall submit proposals for any new engineered routing of effluent via the Calder Interceptor Sewer or Factory Sewer, including a report which demonstrates how best available techniques (BAT) will be used to minimise the activity of discharges of aqueous radioactive waste to the environment and to minimise its radiological effects on the environment and members of the public. These proposals will require approval in writing from the Environment Agency prior to such disposals being made.

123. Overall, we consider that Sellafield Ltd applies BAT to minimise the impact of gaseous and aqueous waste discharges. However, as noted above, we continue to see a small but persistent number of events associated with gaseous and aqueous waste management, some of which have led to minor discharges of gaseous and aqueous waste from the effluent infrastructure rather than the engineered outlet. This has led to us taking enforcement action (Environment Agency, 2018a), to prevent repeat events. We have also placed requirements on Sellafield Ltd to routinely report on some asset management aspects of the effluent infrastructure (see above).

BAT to minimise the quantity of other radioactive waste and selecting optimal disposal routes

124. Sellafield Ltd's arrangements supporting the assessment of BAT are detailed above. The approach uses the waste hierarchy and evaluates disposal options to identify BAT. The approach also recognises that generally the radiation dose per unit disposal is higher for discharges to air than to sea than to land.

125. In order to monitor the selection of solid radioactive waste disposal routes, we have decided that Sellafield Ltd must regularly review its BAT assessments for disposing of low level waste (LLW) and very low level waste (VLLW). It should specify the current BAT assessment in a summary document that it submits to us when it is updated. We have also decided to retain the pre-operational requirement that Sellafield Ltd must make sure that adequate arrangements are place before transferring VLLW and LLW for subsequent treatment, disposal, incineration, metals recovery or final disposal. We believe that these measures will provide greater clarity and allow us to oversee whether the best routes for disposing of solid radioactive waste are being chosen.

126. Sellafield Ltd is permitted to dispose of solid radioactive waste to an onsite landfill (CLESA). We have decided to retain CEAR requirements for Sellafield Ltd to provide an annual report on the performance of the Calder Floodplain Landfill Extension – Segregated Area (CLESA), to regularly, review the hydrogeological risk assessment for CLESA, and maintain a closure and aftercare management plan for CLESA through regular review. Furthermore, we will retain a CEAR requirement to make sure that no landfill infrastructure, for example engineered cap, leachate and gas management systems can be built until Sellafield Ltd has submitted relevant construction proposals that we can accept (appendix 5). We believe that these controls will make sure that the management and development of onsite landfills at Sellafield is regulated appropriately in line with waste management requirements.

127. Overall, we consider that Sellafield Ltd applies BAT to minimise the quantity of other radioactive waste and in choosing the best ways to dispose of the waste (disposal route). However, as noted above, we continue to see a small number of events associated with waste consignment at

Sellafield Ltd and more widely across the nuclear sector. We recognise that this may relate to a strategic approach to characterise boundary ILW/LLW and dispose of it as LLW, where appropriate, and a strong desire to progress HHRR and wider decommissioning. Furthermore, there have also been changes in the waste acceptance criteria (WAC) and more ways to dispose of waste now available, making the choice of waste disposal route more complex. Consequently, this area has been (Environment Agency, 2018b, and 2018c) and continues to be a particular area that we are monitoring closely.

Managing and disposing of radioactive waste for which there is currently no disposal route available

128. To help implement the NDA's 2016 strategy (NDA, 2016), a Problematic Waste Integrated Project Team (PW IPT) was established in May 2016. Its objective is to develop a co-ordinated and improved approach to managing problematic radioactive waste industry-wide. Problematic waste (PW) includes low level waste (LLW) and higher activity waste. It is defined as waste for which there is no disposal route currently available or planned, or where existing solutions are not appropriate or suitable. LLW Repository Ltd and Radioactive Waste Management Ltd (RWM) on behalf of the NDA is leading the IPT, which liaises with a range of interested groups. A group of interested professionals, called a community of practice, has been developed, which includes Sellafield Ltd and the regulators, and a problematic waste tool kit has been developed. Based on different waste types and treatment techniques, the toolkit provides information in the form of technical datasheets, facility datasheets, an overview, case studies, strategy and optioneering studies, research reports, and disposability.

129. According to government policy (GB Parliament, 2015a), HAW in England should be managed in the long-term through geological disposal, alongside safe and secure interim storage until a geological disposal facility (GDF) is available. Radioactive Waste Management Limited (RWM) is a subsidiary of the Nuclear Decommissioning Authority (NDA) and has been established to develop and implement a GDF and provide waste management solutions. HAW means high-level radioactive waste (HLW), ILW and LLW that cannot be disposed of at present.

130. As part of ongoing work on nuclear sites to reduce hazards and allow decommissioning and clean-up of redundant facilities, HAW is being conditioned and packaged and placed in interim storage. To provide confidence that these HAW packages will be suitable for disposal in the GDF when it is available, RWM carries out formal assessments of submissions from HAW producers for specific HAW conditioning proposals, as part of its disposability assessment process.

131. Some HAW at Sellafield, in particular current operational waste, has been been the subject of formal disposability assessments and has been issued with final letters of compliance. This indicates that the conditioned waste is suitable to be disposed of at the GDF. However, some operational waste and significant quantities of legacy waste at Sellafield have not been issued with final letters of compliance and remain unconditioned. In some cases, waste is still to be retrieved from the legacy facility, and in other cases, waste has been retrieved and is now in modern standards containment, but stored in an unconditioned form. Working with ONR, we have accepted that legacy HAW may be stored unconditioned in modern standards facilities, in order to progress HHRR, subject to work being done to understand how to manage the waste for final disposal.

132. A joint regulatory inspection (Environment Agency and Office for Nuclear Regulation, 2012) at Sellafield highlighted issues about the vulnerability of paper records and the slow rate of converting to other media such as digital and microform to comply with regulatory requirements and managing them in the long term. Disposing of HAW to a geological disposal facility will require good quality, accessible waste package records that meet the waste acceptance criteria for the GDF. It is essential that waste producers improve the quality and resilience of records for their existing and future waste packages. We note that Sellafield Ltd has recognised the importance of improving waste package records, but we also acknowledge that progress has been slower than expected due to the scale, condition and complexity of the existing records. Through a new CEAR requirement, we will require Sellafield Ltd to provide us with an annual report on progress with its programme to restore legacy records for higher activity waste packages and to meet the RWM standards on waste package records for new packages. This will help to reduce risks in permitting disposals of this waste.

133. Overall, we are satisfied that Sellafield Ltd has demonstrated that some waste for which there is no disposal route (ILW and HLW) currently available is suitable to be disposed of. It has also demonstrated that meanwhile it will manage this waste in a way that will not affect how it is finally disposed of. However, we continue to work with Sellafield Ltd, ONR and RWM to establish approriate ways of addressing the unconditioned waste, and to make sure that appropriate improvements to waste package records are made.

Other Environment Agency initiated changes

134. There has been a number of changes to the permit template since the Sellafield Ltd permit was last varied. These template changes introduce conditions into the permit that require an operator to develop and maintain a waste management plan and a site-wide environmental safety case in line with the joint environment agencies' guidance document 'Management of radioactive waste from the decommissioning of nuclear sites: guidance on the requirements for release from radioactive substances regulation' (known as the GRR). The consolidated permit also includes changes arising from the Environmental Permitting (England and Wales) (Amendment) (No. 2) Regulations (for implementation of the Basic Safety Standards Directive 2013/59/Euratom) and other minor updates.

135. We intend to initiate the following changes to the permit (table 5.1), to implement recent permit template changes and changes identified by our review (this table does not include all of the changes required regarding upper and lower site limits).

Table 5.1: Environment Agency-initiated changes to the permit

Permit section	Detail
Introductory Note	Update to reflect current operations at Sellafield and summarise changes introduced.
Section 1.1	New condition 1.1.4 inserted into all permits After completion of requirement [1.2.7] specified in Schedule 1 table S1.2, the operator shall maintain a waste management plan and a site-wide environmental safety case, which together demonstrate throughout the lifecycle of the regulated facility; (a) how the production and disposal of radioactive waste is managed to protect the environment and to optimise the protection of people; (b) how the disposability of radioactive waste that will require disposal on or from the premises is assured; (c) how members of the public and the environment are protected from the non-radiological hazards of disposals of radioactive waste; and (d) how the premises will be brought to a condition at which it can be released from regulation under this permit.
Section 1.1	Amendment of current condition 1.1.5 and re-number as 1.1.6 The operator shall manage and operate the activities in consultation with a suitable Radioactive Waste Adviser for the purpose of advising the operator as to compliance with this permit.
Section 2.3	Amended wording of condition 2.3.5 The operator shall check, at an appropriate frequency, the effectiveness and maintenance of systems, equipment and procedures provided to meet the requirements of conditions 2.3.1, 2.3.2 and 2.3.3.
Section 2.3	Amended wording of condition 2.3.6 The operator shall have and comply with appropriate criteria for the acceptance into service of adequate systems, equipment and procedures for:

Permit section	Detail
	(a) carrying out any monitoring and measurements necessary to determine compliance with the conditions of this permit; (b) measuring and assessing exposure of members of the public and radioactive contamination of the environment.
Section 2.3	New condition 2.3.7 Subject to condition 2.3.2, the operator shall carry on the activities in a manner so as to minimise the risk of pollution from any non-radioactive substances used in, or any non-radiological properties of, the radioactive waste, except to the extent the risk is addressed in a separate environmental permit.
Section 3.1	Amended wording of condition 3.1.2 To enable use of upper and lower site limits
Section 3.2	Amended wording of condition 3.2.6 The operator shall carry out: (a) regular calibration, at an appropriate frequency, of measuring instruments and other systems and equipment provided for: (i) carrying out any monitoring and measurements necessary to determine compliance with the conditions of this permit; (ii) measuring and assessing exposure of members of the public and radioactive contamination of the environment. (b) regular checking, at an appropriate frequency, that such measuring instruments and other systems and equipment are serviceable and correctly used
Section 4.3	Amended wording of condition 4.3.5 Where the operator proposes to make a change in the management system or resources, which might have, or might reasonably be seen to have, a significant impact on how compliance with the conditions of this permit is achieved, the operator shall: (a) notify the Environment Agency at least 28 days before making that change, or where that is not possible, without delay; and (b) include in the notification a description of the proposed changes.
Section 4.3	New condition 4.3.7 inserted in to all permits Where the operator proposes to make a change to the waste management plan, to the site-wide environmental safety case or, where applicable, to the facility-specific environmental safety case, including a change to the waste acceptance criteria, which might have, or might reasonably be seen to have, a significant impact on the quantity or nature of radioactive wastes disposed or planned to be disposed of on the site, or result in a significant change to the nature, place or environmental impact of such disposals, the operator shall: (a) notify the Environment Agency at least 28 days before making that change, including in the notification a description of the proposed changes; and (b) where the Environment Agency so notifies the operator, not implement the proposed changes until the Environment Agency has given its agreement in writing.
Section 4.3	New notification condition 4.3.9 The operator shall notify the Environment Agency in writing of the completion of Magnox reprocessing within one month of the date of completion.
Section 4.3	New notification condition 4.3.10

Permit section	Detail
	The operator shall notify the Environment Agency in writing of the completion of active commissioning of HEPA filtration for the MSSS ventilation stack
Section 4.3	New notification condition 4.3.11 The operator shall notify the Environment Agency in writing of the start and end of operations associated with the removal of fuel, isotopes or graphite from Piles 1 and 2
Table S1.2	Removal of completed improvement programme requirements.
Table S1.2	Revision of the date for improvement condition S1.2.5
Table S1.2	New improvement condition 1.2.7 Prepare a suitable waste management plan and a site-wide environmental safety case to meet the requirements of condition 1.1.3 of this permit, and have these available for inspection by the Environment Agency. Date: 31/3/23
Table S1.2	New improvement condition 1.2.8 The operator shall provide summary progress reports covering the prioritised programme of work to demonstrate all radioactive gaseous waste is contained within radiological ventilation systems external to active facilities such that discharge is via an authorised outlet. Reports should cover progress with: the programme of plant inspection; the independent review of Sellafield Ltd's ventilation asset management arrangements; and work to address identified deficiencies in the physical ventilation assets and the asset management arrangements. Date: 1/8/20 and 6-monthly thereafter until the progress of work is complete
Table S1.2	New improvement condition 1.2.9 The operator shall undertake an assessment of future aqueous discharges of cobalt-60 from legacy waste. A report containing the output from this assessment and substantiated proposals for revised cobalt-60 site aqueous discharge limits shall be submitted to the Environment Agency in writing. Date: 1/10/23
Table S1.3B	Correction of typographical errors.
Table S1.3B	New improvement condition S1.3B.5 The Operator shall submit proposals for any new engineered routing of effluent via the Calder Interceptor Sewer or Factory Sewer, including a report which demonstrates how best available techniques (BAT) will be used to minimise the activity of discharges of aqueous radioactive waste to the environment and to minimise its radiological effects on the environment and members of the public. These proposals will require approval in writing from the Environment Agency prior to such disposals being made.
Table S3.3A	Amendments to table: Amendment to VLLW row, column 2: The holder of an environmental permit for the receipt and disposal of VLLW (at..) (this will apply where the operator cannot comply with the exemption conditions). Amendment to LLW row, column 2: The holder of an environmental permit for the receipt and disposal of LLW (at..)

Permit section	Detail
	Amendment to rows 4 and 5, column 1: Units for liquid waste equivalent to LLW/ILW amended from GBq/m3 to GBq/t. Amendment to row for liquid waste equivalent to LLW, column 2: The holder of an environmental permit for the receipt and disposal of liquid waste (at ..) or a person operating under a relevant radioactive substances exemption Amendment to row for transfrontier shipments, columns 1 and 2: Radioactive Waste as defined in the Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008
Schedule 6	New interpretations added to Schedule 6 "active commissioning of HEPA filtration in MSSS" means the active commissioning of HEPA filtration in the new MSSS ventilation stack "disposability" means capable of being conditioned, packaged and disposed of in a way that meets the standards and specifications for final disposal using the identified disposal route, and where the conditioned waste will maintain its integrity such that safe and efficient storage, handling, transport and disposal is achieved. "Magnox reprocessing" means the feed of fuel into the Magnox reprocessing dissolver. "optimise" means the outcome of the process of optimisation, in which all exposures to ionising radiation of any member of the public and of the population as a whole resulting from the disposal of radioactive waste are kept as low as reasonably achievable, taking into account economic and social factors. "site-wide environmental safety case" means a documented set of claims made by the operator, and substantiated by a structured collection of arguments and evidence, to demonstrate achievement by the site as a whole of the required standard of environmental safety. Where relevant it includes the facility-specific environmental safety case for any on-site disposal facility. "waste management plan" means a documented plan, prepared by the operator, which provides a comprehensive description of the current intent for dealing with all radioactive waste on or adjacent to the site and demonstrates how waste management has been optimised.
Schedule 6	Amended definitions in Schedule 6 "National Arrangements for Incidents Involving Radioactivity" means the arrangements co-ordinated by Public Health England to protect the public from hazards arising from the use and transport of radioactive materials and in situations where no formal contingency plans exist. "Radioactive Waste Adviser" means an individual, or group of individuals, with the knowledge, training and experience needed to give radioactive waste management and environmental radiation protection advice in relation to radioactive waste to ensure the effective protection of members of the public whose competence is recognised by the Environment Agency.
Schedule 7	Updating of the site map to include indicative pipelines and CLESA boundary

136. We have decided to make the following changes to the CEAR, initiated by us, to implement recent permit template changes and changes identified by our review:

- Table 1 revisions to reflect changes to the CEAR

- CEAR requirement 3.1.1 revision covering changes to other approved outlets
- CEAR requirement 3.1.2 (b) new requirement relating to agreement of which upper and lower site limits are effective
- CEAR requirement 3.2.5(a) revision to the independent check monitoring programme
- CEAR requirement 3.2.5(b) minor revisions to avoid potential CEAR cross referencing issues
- CEAR requirement 4.2.1 revision to provide our contact details
- Revised CEAR requirement 4.2.2 part 1 revision relating to online pollution inventory reporting
- CEAR 4.2.2 part 2 paragraph 1 new requirements relating to reporting of monthly discharge trigger exceedances and removal of out of date reporting proformas
- CEAR 4.2.2 part 2 paragraphs 3 and 7 revision regarding Council Directive 96/29/Euratom
- CEAR 4.2.2 part 2 paragraph 6 new requirements relating to reporting on the asset management improvement programme and work associated with redundant ventilation ducting
- CEAR 4.2.2 part 2 paragraph 14 new requirements relating to notification level reviews, waste management plan, site wide environmental safety case and strategic options assessments relating to aqueous waste discharges
- CEAR 4.2.2 part 2 paragraphs 15, 16 and 17 consolidation of BAT reviews into a single requirement
- CEAR 4.2.2 part 2 paragraph 18 revision relating to provision of R&D developments on request
- CEAR 4.2.2 part 2 paragraph 23 revision to require regular review of SIXEP and EARP operating plans
- CEAR 4.2.2 part 2 paragraph 24 revision to require SL to assess options for future reporting of environmental performance
- CEAR 4.2.2 part 2 paragraph 26 removal of requirement as this is no longer relevant, following removal of the additional component regarding processing of Magnox raffinate in evaporator C
- CEAR 4.2.2 part 2 new paragraph requiring the maintenance and review of CLESA closure and aftercare management plan
- CEAR 4.2.2 part 2 new requirement requiring progress reporting on HAW records restoration
- CEAR 4.2.2 part 2 new requirement requiring an annual update report on the research and development into leak detection and mitigation technologies, during retrieval operations from high hazard high risk (HHHR) legacy facilities

137. Our review and decisions concerning these changes is set out in appendix 5 and is referred to in this chapter and chapter 6, where appropriate.

Conclusion

138. We are satisfied that, subject to making the improvements and providing the information identified in the sections above, Sellafield Ltd has demonstrated that it uses best available techniques to prevent or minimise discharges of radioactive waste and is effectively managing radioactive waste, taking into account relevant statutory requirements and government guidance and policy.

6. Our assessment - part 3: Limits and notification levels

Introduction

139. This chapter sets out our assessment of Sellafield Ltd's application proposals for changes to the permit limits on the disposals of radioactive waste. This is reviewed in sections covering our approach to setting limits, including site limits, removing site limits, upper and lower site limits, quarterly notification levels and annual plant notification levels. We also look at our assessment of gaseous limits/levels, aqueous limits/levels, CLESA disposal limits and changes to the monitoring of discharges and disposals of radioactive waste and the environment. This structure enables a clear link between the changes Sellafield Ltd requested and our decisions.

140. In the 'Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment' (GB Parliament, 2009a), the government provides guidance on how we should try to meet these objectives: by applying the environmental principles in the UKSRD, as listed in chapter 2 of this document. The statutory guidance also requires us to take account of other government objectives, such as the safe and timely decommissioning of redundant facilities, clean-up of the historic legacy of radioactive waste, security of energy supply, and maintaining defence nuclear capabilities.

141. We have set limits on disposals in accordance with our document 'Criteria for setting limits on the discharge of radioactive waste from nuclear sites' (Environment Agency, 2012b). That is, we have set limits based on operators using BAT to minimise disposals to the environment, allowing for 'normal operation' of the facility. 'Normal operation' takes account of operational fluctuations, trends and events that are expected to occur over the likely lifetime of the facility. Our guidance takes account of the 'Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment' (GB Parliament, 2009a).

Setting site limits

142. Sellafield Ltd has proposed new values for site limits. The majority of these represent a large reduction from those in the current permit.

143. The site limits are based on future projections of discharges from Sellafield Ltd's Overall Effluent Strategy Model. We have reviewed these projections, together with the recognised uncertainties in future discharges and our understanding of forthcoming changes as Sellafield Ltd ceases reprocessing and becomes a decommissioning site.

144. We will normally set annual site limits for each radionuclide, or group of radionuclides, that, for normal operation:

(a) are significant in terms of radiological impact on people – that is, the dose to the most exposed group at the proposed limit exceeds 1μSv/y

(b) are significant in terms of radiological impact on non-human species – this only needs to be considered where the impact on reference organisms from the discharges of all radionuclides at the proposed limits exceeds 40μGy/h

(c) are significant in terms of the quantity of radioactivity discharged – that is, the discharge of a radionuclide exceeds 1TBq/y

(d) may contribute significantly to collective dose – this only needs to be considered where the collective dose, up to 500 years, from the discharges of all radionuclides at the proposed limits exceeds 1manSv/y to any of the UK, European or world populations

(e) are constrained under national or international agreements or are of concern internationally

(f) are indicators of plant performance, if not otherwise limited on the above criteria

(g) include appropriate generic categories from the RSR pollution inventory, for example ‘alpha particulate’ and ‘beta/gamma particulate’ for discharges to air, to limit any radionuclides not otherwise covered by the limits set on the above criteria

145. We also recognise that it is imperative that HHRR work at Sellafield is carried out in a timely way. While we want to make sure that BAT is used to protect people and the environment, we do not want to stop or delay that work. We are mindful of not constraining clean-up, and recognise this in our limit setting guidance (Environment Agency, 2012b): ‘Flexibility in setting discharge limits may also be necessary in those cases where other important government objectives need to be met, for example the safe and timely decommissioning of redundant facilities, and clean-up of the historic legacy of radioactive waste’. In summary, we want to make sure HHRR continues by setting limits that take account of the uncertainties associated with this work, while still protecting people and the environment.

146. We have mainly considered the following criteria to review the suitability of Sellafield Ltd's proposed site limits:

(a) Alignment with previous throughput-related limits for low rates of Magnox reprocessing

(b) Alignment with published UKSRD expected outcomes

(c) Comparison with past discharges, noting that past discharges resulting from the operation of two reprocessing plants should be larger than future discharges

(d) Alignment with Overall Effluent Strategy Model projections

(e) Any 'headroom' above OESM projections is adequately justified

147. Following our review of Sellafield Ltd's initial site limit proposals, we wrote to request further information (see chapter 3). In response, Sellafield Ltd provided a revised set of site limit proposals consisting of upper tier limits and lower tier limits. Sellafield Ltd determined its revised site limits using 'projected discharge' outputs from the OESM.

148. The OESM has provided 2 different outputs: 'expected discharges' and 'projected discharges'.

149. ‘Expected discharges’ are the maximum value of best estimates of future annual discharges after the THORP and Magnox reprocessing plants have closed. Comparing OESM 'expected discharge' predictions with actual past discharges shows on average a 15% discrepancy (15% model uncertainty).

150. The ‘projected discharges’ that form the basis for Sellafield Ltd's proposals for upper and lower site limits include consideration of:

- ‘expected discharge’ (as noted above)
- maximum historic discharge (2006 to 2016) from non-reprocessing related activities
- higher and lower uncertainties that can relate to plant performance, schedule or challenge
- model uncertainty (~15% see above)

151. The uncertainties accounted for in OESM outputs can only be those that are quantified. There are some further uncertainties, for example regarding exact characteristics of waste to be retrieved from legacy facilities, which are not yet quantified. It is because of these further uncertainties that some limits are proposed to be at values higher than the projected discharge predicted by OESM.

152. Proposed lower tier site limits generally align with OESM lower uncertainty projected discharges plus 15% to account for model uncertainty.

153. Proposed upper tier site limits are generally based on the OESM higher uncertainty projections plus 15% to account for model uncertainty. In some cases, more headroom is proposed between the OESM prediction and the site limit. Generally, this is because of unquantified uncertainties.

154. Sellafield Ltd's report (Sellafield Ltd, 2019b) has also listed the further uncertainties associated with the discharge predictions for each radionuclide in both aqueous and gaseous discharges. Not all of these uncertainties have been quantified. Sellafield Ltd has a programme of work to assess all of them, but this is not complete. Many of these assessments relate to future legacy ponds and silos retrievals projects. These further uncertainties affect the amount of headroom Sellafield Ltd has proposed above projected discharge levels, particularly for upper tier limits. For example, Sellafield Ltd states that for some of the planned retrieval activities, particularly taking waste out of

the legacy ponds and silos, the exact characteristics of the waste will only be determined as the retrievals progress. There are, therefore, unquantified uncertainties in the future discharges. Also, the plans for POCO are still developing. It may be that these use new techniques, so there is also unquantified uncertainty regarding those discharges. There may be future clean-up (remediation) options that would result in a task being completed more quickly, so that the total discharge was reduced, but the discharge rate was increased. Sellafield Ltd has not proposed any upper site limits that it considers could constrain planned future work in that way.

155. It should be noted that the OESM predictions are not identical to the predictions Sellafield Ltd provided as the basis for the UKSRD expected outcomes. This is due to differences in both the scenarios modelled and updates to OESM since those predictions were provided.

156. An external review of OESM by the Universities of Lancaster and Warwick (Management School, University of Lancaster and Warwick Business School, University of Warwick, 2006) noted: "there is no similar model being used by another organisation" and "It is…appropriate for providing a holistic view of the effluent system across Sellafield." This review gives us further confidence that it is appropriate to use OESM as a tool to predict discharges and as a basis for limit setting. Furthermore, we have been working with Sellafield Ltd for over a decade on developing OESM.

157. Due to the accuracy of its predictions, we consider that using OESM demonstrates BAT for setting future gaseous and aqueous site limits. Consequently, where Sellafield Ltd has proposed site limits at the OESM projected discharges, including quantified input and model uncertainties, we have decided that site limits should be set at these values. This is the case for most of the lower site limits and some of the upper site limits.

158. We have considered any headroom that Sellafield Ltd has added to the OESM predictions to give the proposed limit. In considering what headroom is acceptable, we took account of the following points:

- We will be tracking discharges at much lower levels, as previously discussed in relation to monthly trigger level exceedance reporting, annual plant notification levels and quarterly notification levels (see below for detail on these)
- It is reasonable that there are a number of uncertainties that are yet to be determined, for example in understanding characteristics of legacy waste during retrievals and in developing plans for POCO
- We also do not want to restrict high hazard and risk reduction work at Sellafield Ltd due to constraining site limits

159. We give our decision on the setting of site limit values in later sections of this chapter. We have paid particular attention to considering Sellafield Ltd's proposed limits with headroom in excess of the OESM predictions. We accept Sellafield Ltd's proposal as to which site limit (upper or lower) will be in force when the permit comes into effect and the trigger for moving from upper to lower limits.

Removing site limits

160. Sellafield Ltd proposed removal of some site limits where no limit setting criteria apply with respect to future discharges.

161. When considering whether it is appropriate to remove a site limit, we have taken account of discharge quantity (less than 1TBq/y), the radiological impact (less than 1μSv/y), the collective dose (less than 1manSv/y, for up to 500 years), constraints under national or international agreements and whether the radionuclide is an indicator of plant performance. More detail is provided in the later sections within this chapter.

Upper and lower site limits

162. Reprocessing is planned to end shortly at Sellafield, which will result in reduced aqueous and gaseous discharges. THORP shearing of fuel has already ended and the upper site limits take account of that. The lower site limits take account of the end of Magnox reprocessing. Once all reprocessing is complete, while generally discharges are predicted to reduce significantly, there is greater uncertainty regarding the discharge predictions. There may be decommissioning tasks that

result in higher discharges while they are taking place. Taking account of these issues, along with our guidance noted above regarding other important government objectives, we have decided that a 2-tier system for discharge limits is appropriate. The benefits of this 2-tier approach is illustrated in figure 3.1. In summary, it ensures stringent regulation of discharges, while providing the flexibility to accommodate the Sellafield decommisioning and clean-up programme.

163. The upper and lower site limits will be specified in the permit. The limits in force at any time (upper or lower) will be specified in the CEAR.

164. Gaseous discharges of krypton-85 and antimony-125 will only be produced while Magnox reprocessing is operating. Therefore, only upper limits are required, and removing these upper limits will reviewed further at the appropriate time.

165. Most of the gaseous and some of the aqueous site limits will have the upper site limits in force when the permit comes into effect. When Magnox reprocessing is completed, that is when the last batch of fuel is fed to the dissolver, Sellafield Ltd will report this to us. This will be the trigger for some of the gaseous and aqueous site limits to move to the lower limit, unless Sellafield Ltd can establish a BAT case for retaining upper limits for some radionuclides. The lower limits will come into force, but will only apply 12 months after notification of the completion of Magnox reprocessing, as they cover 12 consecutive months of discharge data.

166. Some of the gaseous limits are affected by MSSS retrievals. These retrievals will begin as soon as practicable, which is appropriate in order to remove hazard and reduce risk from this legacy facility. However, the initial retrievals will occur before improvements have been made to the gaseous abatement system, that is the installation of HEPA filters. When HEPA filtration has been installed and commissioned, Sellafield Ltd will report that to us. This will be the trigger for some gaseous limits to move to the lower limit.

167. Once the lower site limit is in force, the upper site limit will only be in force in cases where we agree with Sellafield Ltd's BAT case submitted to us regarding the need to move to the upper limit, for a specified period to carry out certain tasks. We will respond to this BAT case by letter, agreeing to move to the upper site limit, or not. If we agree to move to the upper site limit, then CEAR requirement 3.1.2 (c) will be modified accordingly. This approach will allow specific work to take place, for example where hazards are higher than normal or where there is significant uncertainty over radioactive waste produced. It will also make sure that we can monitor activity closely, and that people and the environment are protected.

168. We give our more detailed consideration of whether upper or lower site limits should be in force when the permit change comes into effect in later sections within this chapter.

Quarterly notification levels

169. Sellafield Ltd has made no proposals about quarterly notification levels (QNLs), but we have considered these when assessing the permit application.

170. The QNLs do not necessarily need to be one quarter of the site limits, recognising that site limits may include significant headroom in some cases. Our guidance (Environment Agency 2012b) is to 'set QNLs based on the expected level of discharges associated with the use of BAT'. In determining the QNL, expert judgement is required as some discharges result from batch processing. The QNL should not be set such that a batch process cannot operate normally without continuously exceeding the notification level. The purpose of the QNL is to identify abnormal operations and prompt the operator to investigate.

171. We have considered different methods for setting site QNLs and the advantages and disadvantages of these methods. In the current permit, QNLs are set at 25% of site limits. This provides us with early information of an elevated discharge which, if continued, may lead to a limit being breached or otherwise indicate abnormal operations. In these circumstances, it is appropriate for us to monitor operations closely to determine whether the operator is continuing to use best available techniques to minimise discharges. We have determined that this continues to be the best method for setting site QNLs and, therefore, will set all site QNLs at 25% of the site limits.

Annual plant notification levels

172. Sellafield Ltd has proposed that plant limits are replaced with annual plant notification levels that are generally set at a much lower level of discharge.

173. We agree with Sellafield Ltd's proposals to change from plant limits to annual plant notification levels. At the principle level, this aligns with the government's ambition as noted in the better regulation framework, 'to continue to bear down on the costs to business of regulation while maintaining important regulatory protections.' While the analytical and reporting costs of complying with an annual plant notification level are identical to those for complying with a limit, the cost to business of the steps taken to avoid or justify exceeding a plant limit are greater than those required of a notification level, and, therefore, do not add an appropriate increase in value. We have taken this decision by considering the structure of discharge controls that will be in place to regulate discharges as illustrated in figure 3.2 in chapter 3. This includes site limits, quarterly notification levels, annual plant notification levels and monthly triggers, making sure that there are several levels of control where regulatory action could be taken should discharges increase.

174. Annual plant notification levels are generally based on historic discharge data, using accepted statistical methods for determining the values. This is the same approach that Sellafield Ltd applies in setting its internal monthly trigger levels for aqueous and gaseous discharges. Sellafield Ltd uses the internal trigger values to highlight any instances where internal checks should be made on the discharges. These act as an early warning system in relation to permit limits and notification levels. Sellafield Ltd has used these monthly trigger levels as the basis for its proposed annual plant notification levels. We have audited the annual plant notification levels Sellafield Ltd proposed. Where our check calculations, based on data we hold about Sellafield Ltd's discharges, are within ± 20% of Sellafield Ltd's proposals, we have accepted them. Where our check calculations are outside of that range, we have proposed different levels, unless there is good reason for the difference, for example a forthcoming change in the plant operations.

175. In the future, there will be changes to operations in existing facilities and new facilities will be built to allow POCO, HHRR and decommissioning at the Sellafield site. Sellafield Ltd will need to consider whether these changes mean that annual plant notification levels will need to change or whether new annual plant notification levels will be required. We expect that Sellafield Ltd will review the annual plant notification levels annually, and propose changes (up or down) where necessary. This may result in the permit needing changing on a regular basis. This is no different from the recent past, where the permit has been varied approximately every 18 months. To make sure that Sellafield Ltd carries out this review, we have decided to formalise this process through a revised version of CEAR requirement 4.2.2 part 2 paragraph 14:

    'The operator shall submit annual permit review reports that review the existing permit conditions, limitations and notification levels in the context of the site's waste management plans and its supporting strategies. The reports shall identify and justify situations, if any, where changes to the existing conditions, limitations and notification levels are appropriate and should cover situations both where the headroom is restrictive or excessive. The reviews should be underpinned by a comprehensive waste stream characterisation following major changes to the source term and/or effluent management at Sellafield (e.g. covering HHRR and POCO/decommissioning transitions for major plants; diversion of major effluent streams; use of new major effluent treatment plants). The permit review reports shall also include a high level review of the discharge data for all 'open fuel storage ponds and other approved outlets', to understand and highlight the reasons for any significant changes in discharges and to summarise any changes required to 'other approved outlets'.

176. This requirement will ensure that Sellafield Ltd continues to review discharge limits and levels, taking account of changes within Sellafield facilities and operations.

177. As reprocessing operations come to an end and Sellafield Ltd focuses on POCO, HHRR and decommissioning, the future discharges are expected to be more uncertain than in the past. It is possible that some of these uncertainties may be realised in the future, resulting in an annual plant notification level being exceeded. In that case, we expect Sellafield Ltd will highlight the need for a change in the relevant annual plant notification level following its next annual review. Together with Sellafield Ltd, we will review the annual plant notification levels from time to time, and adjust the levels if required.

Plant monthly triggers

178. Sellafield Ltd proposes to continue monitoring discharge performance at an individual plant level against a set of monthly trigger levels. These are set at lower levels than annual plant notification levels as shown in figure 3.2 in chapter 3.

179. We have decided that according to a new requirement in the CEAR (4.2.2 part 2 paragraph 1 part c), Sellafield Ltd will be required to provide us with a report each quarter detailing monthly trigger exceedances.

180. Overall, we have decided that these controls (site upper and lower limits, QNLs, annual plant notification levels and monthly triggers) should be implemented, as they provide the operator and regulator with a high level of control of discharges, while still giving the flexibility needed for the HHRR, POCO and decommissioning programmes at Sellafield to go ahead.

How the changes will work in practice

181. When the permit variation comes into effect, the upper/lower site limits and the annual plant notification levels in the permit will be in force. These site limits and annual plant notification levels will remain in force until Sellafield Ltd notifies us that the relevant milestone (end of Magnox reprocessing or installation and commissioning of MSSS HEPA filtration) has been reached. Condition 4.3.9 requires Sellafield Ltd to notify us within one month of the completion of Magnox reprocessing (this is defined in the permit as the last feed of Magnox fuel to the dissolver) and condition 4.3.10 requires Sellafield Ltd to notify us within one month of installing and commissioning HEPA filtration at MSSS.

182. Condition 3.1.2 (b) sets out the requirements for any application by Sellafield Ltd to move from lower to upper limits. Sellafield Ltd will be able to apply for a change to the upper site limit for a specified radionuclide(s) for a certain time period to carry out a specified task or programme of work. If we agree that the application is supported by an adequate demonstration that the work uses best available techniques, we will agree to move to the upper limit and quarterly notification level detailed in the CEAR under 3.1.2 (b) part ii. We will not make any changes to the permit.

183. If Sellafield Ltd wishes to move to upper tier limits or to remain at these after the Magnox reprocessing has ended or when HEPA filtration at MSSS is commissioned, it will need to submit specific cases to us to agree. This application could form part of an annual permit review report under paragraph 14 of condition 4.2.2 part 2 in the CEAR, or as a separate submission under condition 3.1.2 (b) as detailed in the CEAR.

184. The site limits and annual plant notification levels apply on a 12-month rolling basis. The 12-month discharges will be reset to zero when the permit variation comes into effect, so the new site limits and annual plant notification levels will only apply to 12 months of discharges one year after this date. Similarly, the quarterly notification levels will apply to 3 months' discharges only 3 months after the date of the permit variation. This approach is taken as the revised limits and levels cannot be applied retrospectively to discharges made under the previous permit limits.

185. From the date when a site limit moves from an upper to a lower limit, the cumulative discharges accounted for against the site limit and associated quarterly notification level will be reset to zero. This is because Sellafield Ltd should not be found non-compliant for exceeding a lower limit as a result of past discharges that were authorised by an upper limit at the time they were made. If, following acceptance of a suitable BAT case, a site limit moves from a lower to an upper limit, the cumulative discharge will not be reset to zero as all past discharges were required to be below the lower limit and so also the upper limit.

186. As noted above, Sellafield Ltd will have to regularly review the annual plant notification levels and provide a submission to us detailing the outcome of this review. We expect some of these reviews to propose revisions to the annual plant notification levels. We will consider those proposals as part of the annual permit review and vary the permit according to our assessment (consulting the public if the permit change is significant). Therefore, the values of annual plant notification levels in the permit may change in future, including at the end of Magnox reprocessing.

187. Sellafield Ltd's submission may note that an annual plant notification level is expected to be exceeded as a result of a specific task for which we have agreed the upper site limit tier limits can

be in force. If the task is expected to continue for more than one year, we may vary the annual plant notification level in the permit. For shorter durations, we may accept that the annual plant notification level can be exceeded for a short time. Exceeding a notification level is not a breach of the permit.

188. Where there is a reduction in an annual plant notification level, there will be no resetting of discharges. If discharges exceed the new annual plant notification level as a result of past discharges made prior to the new notification level coming into force, Sellafield Ltd will need to explain this in the response required for exceeding a notification level. Again it should be noted that exceeding a notification level is not a breach of the permit but will result in increased regulatory scrutiny of discharges.

Gaseous discharges to the environment

189. The site limits on disposals of gaseous radioactive waste are shown in schedule 3 to the draft permit. This section summarises our assessment and conclusions for each radionuclide, firstly for those where Sellafield Ltd applied to remove the site limits, and secondly for those with changes to the site limits.

190. As explained above, we will be including a revised CEAR requirement 4.2.2 part 2 paragraph 14. This requirement will ensure that Sellafield Ltd continues to review discharge limits and levels, taking account of changes within Sellafield facilities and operations.

Proposed limits for gaseous discharges

191. As noted in chapter 3, we made a formal request to Sellafield Ltd during the determination process, which asked questions about the proposed site limits in the original application. In response to that request, Sellafield Ltd revised its proposals for site limits. Table 6.1 provides a summary of Sellafield Ltd's revised proposed site limits and our decision on site limits.

Table 6.1: Summary of Sellafield Ltd revised proposals, and our decision on site limits covering gaseous waste discharges

Radionuclide or radionuclide group	Current limit (MBq)	Sellafield Ltd proposed upper limit (MBq)	Environment Agency draft upper limit (MBq)	Sellafield Ltd proposed lower limit (MBq)	Environment Agency draft lower limit (MBq)
H-3	1.1E+09	3.7E+08	3.7E+08	1.7E+08	1.7E+08
C-14	3.3E+06	2.3E+06	2.3E+06	3.8E+05	3.8E+05
Kr-85	4.4E+11	7.0E+10	7.0E+10	-	-
Sr-90	7.1E+02	5.0E+02	5.0E+02	7.4E+01	7.4E+01
Ru-106	2.3E+04	1.8E+04	1.8E+04	2.8E+03	2.8E+03
Sb-125	3.0E+04	3.0E+04	3.0E+04	-	-
I-129	7.0E+04	4.2E+04	4.2E+04	1.3E+04	1.3E+04
I-131	3.7E+04	-	-	-	-
Cs-137	5.8E+03	4.8E+03	4.8E+03	4.1E+02	4.1E+02
Pu-alpha	1.9E+02	1.3E+02	1.3E+02	7.2E+01	7.2E+01
Pu-241	3.0E+03	-	-	-	-
Am-241 + Cm-242	1.2E+02	8.4E+01	8.4E+01	5.0E+01	5.0E+01
Alpha particulate	8.8E+02	6.6E+02	6.6E+02	3.2E+02	3.2E+02
Beta particulate	4.2E+04	3.2E+04	3.2E+04	5.1E+03	5.1E+03

192. Table 6.2 shows our decision on QNLs.

Table 6.2: Summary of our decision on QNLs covering site gaseous waste discharges

Radionuclide or radionuclide group	Environment Agency draft upper QNL (MBq)	Environment Agency draft lower QNL (MBq)
H-3	9.3E+07	4.3E+07
C-14	5.8E+05	9.5E+04
Kr-85	1.8E+10	-
Sr-90	1.3E+02	1.9E+01
Ru-106	4.5E+03	7.0E+02
Sb-125	7.5E+03	-
I-129	1.1E+04	3.3E+03
Cs-137	1.2E+03	1.0E+02
Pu-alpha	3.3E+01	1.8E+01
Am-241 + Cm-242	2.1E+01	1.3E+01
Alpha particulate	1.7E+02	8.0E+01
Beta particulate	8.0E+03	1.3E+03

193. Table 6.3 shows which gaseous site limits (upper or lower) will be in force when the permit comes into effect and what is expected to trigger a move from upper to lower site limits.

Table 6.3: Summary of our decision on which upper or lower gaseous waste discharge site limits will be in force on the permit variation effective date

Radionuclide or radionuclide group	Upper/lower	Trigger for move to lower
H-3	Upper	End of Magnox reprocessing
C-14	Upper	End of Magnox reprocessing
Kr-85	Upper	Limit removed after the end of Magnox reprocessing
Sr-90	Upper	HEPA filters installed and commissioned for MSSS
Ru-106	Lower	None
Sb-125	Upper	Limit removed after the end of Magnox reprocessing
I-129	Upper	End of Magnox reprocessing
Cs-137	Upper	HEPA filters installed and commissioned for MSSS
Pu-alpha	Upper	HEPA filters installed and commissioned for MSSS
Am-241 + Cm-242	Upper	HEPA filters installed and commissioned for MSSS
Alpha particulate	Upper	HEPA filters installed and commissioned for MSSS
Beta particulate	Upper	HEPA filters installed and commissioned for MSSS

Removing gaseous site limits

194. Sellafield Ltd has proposed that the site limits for iodine-131 (I-131) and plutonium-241 (Pu-241) should be removed from the date the variation comes into effect and that limits for krypton-85 (Kr-85) and antimony-125 (Sb-125) should be removed following the end of Magnox reprocessing. We have reviewed Sellafield Ltd's application and information regarding future discharge predictions for these radionuclides and our conclusions are summarised in the sections below.

Removing iodine-131 (I-131) and plutonium-241 (Pu-241) gaseous site limits

195. I-131 is a gas produced during reactor operations that becomes trapped in the spent fuel. It can then be released during reprocessing operations. It has a short half-life of 8 days, decaying by the release of beta radiation. Its short half-life means it is of particular importance if short cooled fuel is to be reprocessed. No short cooled fuel remains for reprocessing and so the source for any release is very small compared with past operations. Following release into the environment, the main sources of exposure (pathways) are inhaling the I-131 gas or drinking milk containing I-131.

Where the I-131 has landed on plants, it can be consumed by livestock and then transferred into milk.

196. Pu-241 is formed in reactor operations and remains within the spent fuel. Pu-241 is recovered through reprocessing but a very small fraction is discharged into the air during the recovery process. It has a half-life of 14 years. It will be discharged into the environment as a particulate and animals and people may inhale or ingest Pu-241.

197. Expected discharges for I-131 and Pu-241 after reprocessing has ended are significantly less than 1TBq (less than 700MBq) and recent discharges do not show an increasing trend. Between January 2013 and December 2017, all discharges gave rise to a dose less than 0.5µSv/y. The dose from expected discharges is less than 0.01µSv/y for I-131 and less than 0.000005µSv/y for Pu-241, respectively. The public dose limit is 1,000µSv/y.

198. Given the lack of short cooled fuel remaining for reprocessing, there is no reason to consider that I-131 discharges will increase in the future. Unexpected increases in discharges would still be highlighted to us by the review of monitoring data Sellafield Ltd has to carry out (CEAR requirement 4.2.2 part 2 paragraph 14) as well as by our own review of discharge data.

199. Permit limits and levels will be set for gaseous I-129, which is similar in behaviour to I-131 except it has a much longer half-life. This makes it a more suitable isotope for monitoring at a plant level and in the environment. Monitoring and limits applied to these discharges will indicate if there are any issues regarding the performance of iodine abatement equipment.

200. Sellafield Ltd will continue to have permit limits and levels regarding total beta particulate, so it will carry out sampling and analysis to report these discharges. If there is a higher than normal result for beta particulate, Sellafield Ltd can carry out further analyses to determine discharges of specific radionuclides including Pu-241.

201. As none of the limit setting criteria are met by projected discharges of I-131 or Pu-241, we accept that there is no requirement for a site limit nor any plant or quarterly notification levels for these radionuclides.

Removing krypton-85 (Kr-85) and antimony-125 (Sb-125) gaseous site limits

202. Kr-85 is a gas produced during the operation of a nuclear reactor. It is trapped within the spent fuel and then released during fuel shearing/decanning, which is the first stage in reprocessing, and subsequently during fuel dissolution. It is an unreactive gas with a half-life of almost 11 years.

203. Sb-125 is a metal produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in most of the Sb-125 being directed into solid radioactive waste, but a small fraction is discharged into the air, particularly during Magnox fuel decanning operations. Sb-125 has a half-life of just under 3 years. Following discharge into the air, Sb-125 may concentrate in certain plants, which can then be eaten by animals and people.

204. Sellafield Ltd proposes to remove both site limits following the end of Magnox reprocessing. Expected discharges of Kr-85 are already significantly reduced due to THORP fuel shearing and dissolution ending, but discharges will continue for the duration of Magnox fuel dissolution as part of reprocessing operations. After the end of reprocessing operations, there will be no source for continued Kr-85 discharges at a level that would meet the limit setting criteria.

205. Sb-125 discharges are dominated by Magnox fuel decanning operations associated with reprocessing. Sellafield Ltd proposes to remove the site limit at the end of Magnox reprocessing as fuel decanning operations will have ended, and so there will be no significant source for continued Sb-125 discharges at a level that would meet the limit setting criteria.

206. We agree in principle with the proposal to remove these limits at the end of Magnox reprocessing. However, we will require Sellafield Ltd to provide further evidence that discharges have declined as expected before we remove these limits. We expect Sellafield Ltd to provide that information as part of a submission regarding CEAR requirement 4.2.2 part 2 paragraph 14.

Revised gaseous site limits and quarterly notification levels

207. The following sections describe our determination of new site limits for gaseous discharges and associated quarterly notification levels.

Revised tritium (H-3) gaseous site limit and quarterly notification level

208. Tritium gas is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in some tritium being directed into solid radioactive waste, but a fraction is released into the air. It has a half-life of about 12 years. In the environment, water is the most important hydrogen-containing compound.

209. Sellafield Ltd has proposed significant reductions in the site limits. Discharges are dominated by Magnox reprocessing, so will decline after this ends. The main discharges after Magnox reprocessing ends will be due to downstream treatment of effluents from Magnox reprocessing, POCO and fuel storage ponds. There is uncertainty in the discharges associated with POCO and pile 1 and 2 decommissioning. The lower limit is acceptable as it aligns with the OESM projected discharges. The upper limit allows Magnox reprocessing to be completed, and includes some headroom above the OESM projected discharge to take account of uncertainty regarding the potential long-term storage of unreprocessed fuel in uncemented bit bins.

210. We agree with Sellafield Ltd's proposed upper and lower tier limits (table 6.1) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect, with a lower limit then expected to be applied after Magnox reprocessing ends. We have agreed quarterly notification levels based on 25% of these site limits (table 6.2).

Revised carbon-14 (C-14) gaseous site limit and quarterly notification level

211. C-14 gas is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in most of the C-14 being directed into solid radioactive waste but some is released into the air. It has a half-life of almost 6,000 years. Plants take in carbon from the atmosphere and soil, and these can then be eaten by animals and people.

212. Sellafield Ltd has proposed significant reductions in the site limits. Discharges are dominated by Magnox reprocessing, so will decline after this ends. The main discharges after Magnox reprocessing ends will be due to downstream treatment of Magnox effluents and POCO. There is uncertainty in the discharges after Magnox reprocessing ends. This is associated with crossover of ventilation from HALES evaporators C and D to WVP, POCO (particularly of the THORP DOG) and pile 1 and 2 decommissioning. There are solids within the THORP DOG plant, and these solids need to be removed during POCO. Sellafield Ltd will try to remove these solids by washing with water, but if that is not successful, then it will use acid. If it does use acid, that will result in C-14 being released. The lower limit is acceptable as it closely aligns with the OESM projected discharge levels and accounts for uncertainty in POCO discharges by providing reasonable headroom to allow for projected discharges after Magnox reprocessing ends. The upper limit allows Magnox reprocessing to be completed and includes acceptable headroom above the OESM projected discharge to take account of discharges from THORP DOG POCO. It also accounts for uncertainty with possible crossover ventilation from HALES evaporators C and D to WVP when managing remaining Magnox liquors.

213. We agree with Sellafield Ltd's proposed upper and lower tier limits (table 6.1) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect, with a lower limit then expected to be applied after Magnox reprocessing ends. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.2).

Revised krypton-85 (Kr-85) gaseous site limit and quarterly notification level

214. Kr-85 is one of the larger contributors to the radiation dose people receive from Sellafield Ltd's gaseous discharges. Sellafield Ltd has proposed a significant reduction in the site limit. There will be no significant discharges after Magnox reprocessing ends, so no lower limit has been proposed or will apply. We will remove the site limit when we receive acceptable evidence submission regarding CEAR requirement 4.2.2 part 2 paragraph 14. We accept Sellafield Ltd's proposed upper site limit as it is below recent maximum discharges (with THORP operating), it represents a significant reduction from the current site limit, it provides headroom above the OESM projected discharges to allow Magnox reprocessing to be completed, and we do not believe that there is merit in constraining discharges further.

215. We agree with Sellafield Ltd's proposed upper site limit to apply until the end of Magnox reprocessing (table 6.1) and have confirmed that one or more of our limit setting criteria is met. We have determined the quarterly notification level based on 25% of this limit (table 6.2). When Magnox reprocessing ends, and once we have established that there are no significant discharges of Kr-85, we will remove the site limit.

Revised strontium-90 (Sr-90) gaseous site limit and quarterly notification level

216. Sr-90 is a metal produced during reactor operations that becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in most of the Sr-90 being directed into solid radioactive waste, but a small fraction is released into the air. It is discharged as a particulate aerosol in gaseous discharges. It has a half-life of 29 years. Plants may take in strontium from the atmosphere and soil, and these can then be eaten by animals and people.

217. Discharges are mainly from the Fuel Handling Plant (FHP), Analytical Services and Plutonium Finishing and Storage stack (AS and PF&S) and Magnox Swarf Storage Silo. Discharges from MSSS are expected to increase when work begins to remove the waste from that facility. The impact of MSSS retrievals on discharges is uncertain, so MSSS has retained a high annual plant notification level. A new discharge stack with HEPA filtration will be installed on MSSS. Once this filtration is in use, discharges are expected to reduce significantly.

218. Sellafield Ltd has proposed significant reductions in site limits, particularly the lower limit. There is uncertainty in discharges associated with MSSS retrievals and the risk of dislodging post filter accumulations during decommissioning of AS and PF&S. The proposed upper site limit provides significant headroom above the OESM projected discharges, but we accept this given the need to clean up legacy facilities, the uncertainties associated with these discharges, and the low radiation dose to people from Sr-90 discharges. The lower limit is a significant reduction, aligns with the OESM projected discharges and provides reasonable headroom to allow for discharges when Magnox reprocessing ends.

219. We agree with Sellafield Ltd’s proposed upper and lower site limits (table 6.1) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect, with a lower limit then expected to be applied after active commissioning of MSSS HEPA filtration. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.2).

Revised ruthenium-106 (Ru-106) gaseous site limit and quarterly notification level

220. Ru-106 is a metal produced during reactor operations that becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in most of the Ru-106 being directed into solid radioactive waste, but a small fraction is released into the air. It is normally discharged as a particulate aerosol in gaseous discharges, although volatile Ru-106 discharges can also occur. It has a half-life of about 1 year. Vegetation may take in ruthenium from the atmosphere and soil, and this can then eaten by animals and people.

221. Discharges of Ru-106 are produced mainly by the waste vitrification plants, which convert highly active liquor (HAL) into a solid glass product form. This is important for reducing the risk at Sellafield. The WVP process is prone to blocking with solid glass, so Sellafield Ltd has been looking for ways to prevent blockages, including using an unblocking tool to remove any solids which, if left, could completely block the plant. If a blockage does occur, the same unblocking tool is used repeatedly and with greater force. Each time the unblocking tool is used and removed, there is the potential for calcine to be withdrawn and deposited on the outer surfaces of the melter. When this melter is subsequently heated, there is the potential for volatile Ru-106 to be discharged through the cell ventilation system.

222. Sellafield Ltd proposed significant reductions in the site limits, particularly the lower limit. There is uncertainty regarding discharges associated with unblocking operations and those resulting from small amounts of calcine deposited on the outside of the melter. Both the upper and lower limits align with the OESM projected discharges.

223. Sellafield Ltd's proposed upper limit is acceptable given the reduction compared to the existing limit, the low radiation dose to people from Ru-106 discharges, the need to allow risks to continue to be reduced through the vitrification of HAL, and the uncertainties associated with these discharges due to preventing unblocking and recovery operations. The lower limit is acceptable as

it provides reasonable headroom to allow for projected discharges after Magnox reprocessing ends (table 6.1).

224. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.1) and have confirmed that one or more of our limit setting criteria is met. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.2). The lower limit will apply from the date the permit comes into effect.

225. We have accepted Sellafield Ltd's BAT case (Sellafield Ltd, 2019c) supporting the need for upper limits for WVP unblocking operations. Therefore, if Sellafield Ltd proposes to carry out unblocking operations that may challenge the lower limit, as detailed in the BAT case, then we only require it to notify us of those operations, and we will change the CEAR to record that the upper limit is in force. However, Sellafield Ltd is continually seeking to improve vitrification operations, so there may be a circumstance in the future where an unblocking operation is planned that does not fit with the current BAT case. If that happens, Sellafield Ltd will need to provide an updated BAT case, which we will assess to decide whether to change the CEAR to record that the upper limit is in force.

Revised antimony-125 (Sb-125) gaseous site limit and quarterly notification level

226. The main source of Sb-125 discharges into the air is from Magnox fuel decanning operations. Consequently, Sellafield Ltd has not proposed a reduction in an upper site limit compared to the current limit, but has proposed that the limit is removed once Magnox reprocessing is complete.

227. Although there is significant headroom above the OESM projected discharges, Sellafield Ltd's proposed upper site limit is acceptable given the low radiation dose to people from Sb-125 discharges and because we do not wish to constrain the timely completion of Magnox reprocessing. There will be no significant discharges after Magnox reprocessing ends, so Sellafield Ltd has not proposed any lower limit and none will apply. We will remove the site limit once we receive acceptable evidence regarding CEAR requirement 4.2.2 part 2 paragraph 14.

228. We agree that Sellafield Ltd's proposed upper site limit will apply until the end of Magnox reprocessing (table 6.1) and have confirmed that one or more of our limit setting criteria is met. We have agreed the quarterly notification level based on 25% of this limit (table 6.2). When Magnox reprocessing ends, and once we have established that there are no significant discharges of Sb-125, we will remove the site limit.

Revised iodine-129 (I-129) gaseous site limit and quarterly notification level

229. I-129 is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in some of the I-129 being directed into solid radioactive waste, but a fraction is discharged into the air. It has a half-life of about 15,700,000 years. Following discharge into the air, the main sources of exposure are inhaling I-129 gas or drinking milk containing I-129. Where the I-129 has landed on plants, it can be consumed by livestock and then transferred into milk.

230. Sellafield Ltd has proposed significant reductions in the site limits. Discharges are mainly due to Magnox reprocessing, so will decline after this ends. The main discharges after Magnox reprocessing ends will be due to downstream treatment of Magnox effluents and POCO. There is uncertainty in the discharges after Magnox reprocessing ends associated with POCO (particularly of THORP DOG). There are solids within the THORP DOG plant and these solids need to be removed during POCO. Sellafield Ltd will try to remove these solids by washing with water, but if that is not successful, it will use acid. If it does use acid, that will result in I-129 being released and discharged into the air. The proposed upper limit is acceptable as it will allow Magnox reprocessing to be completed and includes some headroom above the OESM projected discharges to take account of discharges from THORP DOG POCO. The lower limit is acceptable as it closely aligns with the OESM projected discharge levels and provides reasonable headroom to allow for projected discharges after Magnox reprocessing ends.

231. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.1) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect, with a lower limit then expected to be applied after the end of Magnox reprocessing. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.2).

Revised caesium-137 (Cs-137) gaseous site limit and quarterly notification level

232. Cs-137 is a metal produced during reactor operations that becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in most of the Cs-137 being directed into solid radioactive waste, but a small fraction is released into the air. It is discharged as a particulate aerosol in gaseous discharges. It has a half-life of 30 years. Plants may take in caesium from the atmosphere and soil and these can then be eaten by animals and people.

233. Discharges are mainly from the Fuel Handling Plant and Magnox Swarf Storage Silo. Discharges from MSSS are expected to increase when work begins to remove the waste from that facility. The impact of MSSS retrievals on discharges is uncertain, so MSSS has retained a high annual plant notification level. A new discharge stack with HEPA filtration will be installed on MSSS. Once this filtration is in use, discharges are expected to reduce significantly.

234. Sellafield Ltd has proposed significant reductions in site limits, particularly the lower limit. There are uncertainties regarding future discharges associated with MSSS retrievals and the risk of dislodging post filter accumulations during decommissioning of AS and PF&S. The upper limit provides significant headroom above the OESM projected discharges, but this is acceptable given the need to clean up legacy facilities, the uncertainties associated with these discharges, and the low radiation dose to people from Cs-137 discharges. The lower limit is a significant reduction, aligns with the OESM projected discharges and provides reasonable headroom to allow for discharges after Magnox reprocessing ends.

235. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.1) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect, with a lower limit then expected to be applied after active commissioning of MSSS HEPA filtration. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.2).

Revised plutonium – alpha (Pu-alpha) americium-241 + curium-242 (Am-241 + Cm-242) and alpha emitting radionuclides associated with particulate matter gaseous site limits and quarterly notification levels

236. Pu-alpha, Am-241 and Cm-242 are metals produced during reactor operations that become trapped in the spent fuel. Pu-alpha covers the main alpha emitting plutonium radionuclides (Pu-238, Pu-239 and Pu-240). Pu-alpha is recovered through reprocessing, but a very small fraction is discharged into the air during the recovery process. Reprocessing and associated waste treatment operations result in most of the Am-241 and Cm-242 being directed into solid radioactive waste, but a very small fraction is released into the air. All are discharged as particulate aerosols in gaseous discharges. Pu-238 has a half-life of about 88 years, Pu-239 24,000 years and Pu-240 6,500 years. Am-241 has a half-life of 432 years and Cm-242 has a half-life of 163 days. Animals and people may inhale or ingest these radionuclides.

237. Alpha emitting radionuclides associated with particulate matter is a term used to group particulate alpha emitters, generally actinides. The source and characteristics of the main radionuclides in this group have been discussed above in sections on the individual radionuclides, for example, plutonium, americium and curium.

238. Sellafield Ltd has proposed significant reductions in all of these site limits. The main source of discharges is expected to be unfiltered discharges. Discharges from Analytical Services are a significant source. This is an old facility with historic contamination, so there is potential for future discharges if post-filter contamination is dislodged. It is expected that discharges from MSSS will increase as a result of retrievals. There is currently gaseous scrubbing equipment in place, but a new discharge system with HEPA filtration will be installed on MSSS. Once this filtration is in use, discharges are expected to reduce significantly, allowing Sellafield Ltd to propose a lower limit. There is uncertainty in future discharges associated with MSSS retrievals and risk of dislodging post filter accumulations during decommissioning of AS and PF&S. The upper limits for Pu-alpha and Am-241+Cm-242 result in a low radiation dose for people, with the alpha emitting radionuclides associated with particulate matter limit resulting in a higher dose. All of the upper limits provide significant headroom above OESM projected discharges, but are acceptable given the need to clean up legacy facilities and the uncertainties associated with these discharges. The lower limits are acceptable as they are significantly lower than current limits, align with the OESM

projected discharge levels and provide reasonable headroom to allow for projected discharges after Magnox reprocessing ends.

239. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.1) and have confirmed that one or more of our limit setting criteria is met. The upper limits will apply from the date the permit comes into effect, with lower limits then expected to be applied after active commissioning of MSSS HEPA filtration. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.2).

Revised beta particulate gaseous site limit and quarterly notification level

240. Beta emitting radionuclides associated with particulate matter is a term used used to group particulate beta emitters. The source and characteristics of the main radionuclides in this group have been discussed above in sections on the individual radionuclides, for example, strontium, ruthenium, antimony and caesium.

241. Sellafield Ltd has proposed significant reduction in limits. The main source of discharges is expected to be unfiltered discharges. Discharges from Analytical Services are a significant source. This is an old facility with historic contamination, so there is potential for future discharges if post-filter contamination is dislodged. It is expected that discharges from MSSS will increase as a result of retrievals. There is currently gaseous scrubbing equipment in place, but a new discharge system with HEPA filtration will be installed on MSSS. Once this filtration is in use, discharges are expected to reduce significantly, allowing Sellafield Ltd to propose a lower limit. There is uncertainty in future discharges associated with MSSS retrievals and risk of dislodging post filter accumulations during decommissioning. The lower limit is expected to be applied after active commissioning of MSSS HEPA filtration. Note the lower limit is much less than the total individual plant contributions as operations that will produce increased discharges are not expected to occur at the same time. The upper limit provides significant headroom above OESM projected discharges, but this is acceptable given the need to clean up legacy facilities and the uncertainties associated with these discharges. The lower limit is acceptable as it aligns with the OESM projected discharge levels and provides reasonable headroom to allow for projected discharges after Magnox reprocessing ends.

242. We agree with Sellafield Ltd's proposed upper and lower site limits (see table 6.1) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect, with a lower limit then expected to be applied after active commissioning of MSSS HEPA filtration. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.2).

Gaseous annual plant notification levels

243. As noted in chapter 3, we raised a number of questions with Sellafield Ltd when assessing its application. As a result, Sellafield Ltd revised some of its proposed annual plant notification levels. Table 6.4 below shows Sellafield Ltd's final proposed annual plant notification levels ('*' denotes where these are different from the original application) and our decision for annual plant notification levels compared with current plant limits. In some circumstances, our decision to put in place or not specify annual plant notification levels does not align with Sellafield Ltd's orginal application.

Table 6.4: Summary of Sellafield Ltd revised proposals, and our decision for annual plant notification levels covering gaseous waste site discharges

Plant	Radionuclide or radionuclide group	Current plant limit (MBq)	Sellafield Ltd proposed annual plant notification level (MBq)	% of current plant limit	Environment Agency draft annual plant notification level (MBq)	% of current plant limit
FGMSP	Caesium-137	7.5E+01	-	-	7.3E-01	1.0%
	Alpha	4.6E+00	-	-	8.0E-01	17.0%
	Beta	7.3E+01	-	-	2.6E+00	4.0%

Plant	Radionuclide or radionuclide group	Current plant limit (MBq)	Sellafield Ltd proposed annual plant notification level (MBq)	% of current plant limit	Environment Agency draft annual plant notification level (MBq)	% of current plant limit
Original, 1st and 2nd extensions MSSS stack	Strontium-90	3.7E+02	3.7E+02	100.0%	3.7E+02	100.0%
	Caesium-137	1.6E+03	1.6E+03	100.0%	1.6E+03	100.0%
	Alpha	2.8E+00	2.8E+00	100.0%	2.8E+00	100.0%
	Beta	2.7E+03	2.7E+03	100.0%	2.7E+03	100.0%
3rd extension MSSS stack	Strontium-90	4.4E+02	4.4E+02	100.0%	4.4E+02	100.0%
	Caesium-137	4.8E+03	4.8E+03	100.0%	4.8E+03	100.0%
	Alpha	1.5E+00	1.5E+00	100.0%	1.5E+00	100.0%
	Beta	3.5E+03	3.5E+03	100.0%	3.5E+03	100.0%
FHP	Strontium-90	2.0E+01	4.8E+00	24.0%	4.8E+00	24.0%
	Antimony-125	3.0E+04	2.4E+04	80.4%	2.4E+04	80.4%
	Caesium-137	3.0E+02	3.6E+01	12.0%	3.6E+01	12.0%
	Alpha	1.6E+00	1.3E+00	82.5%	1.3E+00	82.5%
	Beta	3.0E+02	1.3E+02	42.0%	1.3E+02	42.0%
WVP	Carbon-14	1.3E+06	2.2E+05	17.0%	2.2E+05	17.0%
	Ruthenium-106	1.9E+04	1.1E+03	5.7%	1.1E+03	5.7%
	Iodine-129	1.4E+03	2.9E+02	20.5%	2.3E+02	16.1%
	Iodine-131	4.8E+03	-	-	-	-
	Alpha	7.5E+00	2.4E-01	3.2%	2.4E-01	3.2%
	Beta	6.0E+03	1.1E+01	0.2%	1.1E+01	0.2%
Thorp	Tritium H-3	4.3E+07	3.6E+07	83.7%	3.6E+07	83.7%
	Carbon–14	7.6E+05	1.5E+05	19.7%	1.5E+05	19.7%
	Krypton–85	4.4E+11	-	-	-	-
	Iodine–129	3.8E+04	7.4E+03	19.5%	7.4E+03	19.5%
	Iodine–131	4.2E+03	-	-	-	-
	Alpha	6.0E+01	8.0E+00	13.4%	8.0E+00	13.4%
	Beta	1.2E+03	4.5E+01	3.7%	4.5E+01	3.7%
STP	Carbon–14	7.6E+05	4.2E+04	5.5%	2.8E+05	37.1%
	Iodine–129	2.1E+04	1.0E+03	4.9%	1.0E+03	4.9%
	Iodine–131	3.4E+03	-	-	-	-
	Alpha	3.7E-01	1.7E-01	46.1%	1.7E-01	46.1%
	Beta	3.9E+02	1.0E+00	0.3%	1.0E+00	0.3%
AS and PF&S	Caesium–137	1.7E+02	6.9E+01	40.4%	6.9E+01	40.4%
	Plutonium–alpha	1.9E+02	5.4E+01	28.4%	5.4E+01	28.4%
	Americium–241 & Curium–242 in total	1.2E+02	3.6E+01	30.0%	3.6E+01	30.0%
	Alpha	3.7E+02	8.6E+01	23.4%	8.6E+01	23.4%
	Beta	6.1E+02	2.3E+02	37.0%	2.3E+02	37.0%

Plant	Radionuclide or radionuclide group	Current plant limit (MBq)	Sellafield Ltd proposed annual plant notification level (MBq)	% of current plant limit	Environment Agency draft annual plant notification level (MBq)	% of current plant limit
WEP	Carbon-14	1.3E+05	1.1E+04	8.6%	1.1E+04	8.6%
	Iodine-129	4.8E+02	1.7E+02	35.5%	1.7E+02	35.5%
	Alpha	6.4E+00	5.3E-01	8.2%	5.3E-01	8.2%
	Beta	3.9E+02	3.9E+00	1.0%	3.9E+00	1.0%
NNL*	Alpha	4.8E+01	2.9E-01*	0.6%	2.9E-01	0.6%
	Beta	2.7E+03	1.4E+00	0.1%	1.4E+00	0.1%
Decontamination Centre Stack	Alpha	2.9E+00	3.4E-01	11.7%	-	-
	Beta	3.1E+02	2.6E+00	0.8%	-	-
SAV*	Tritium H-3	1.1E+09	1.8E+08*	16.4%	1.8E+08	16.4%
	Carbon–14	1.3E+06	1.0E+05*	7.7%	1.0E+05	7.7%
	Krypton–85	1.2E+11	2.1E+10*	17.5%	2.1E+10	17.5%
	Iodine–129	1.3E+04	4.4E+03	33.7%	4.4E+03	33.7%
	Iodine–131	3.0E+04	-	-	-	-
	Plutonium–alpha	5.2E+01	-	-	-	-
	Plutonium-241	2.4E+03	-	-	-	-
	Alpha	3.4E+02	1.8E+00	0.5%	1.8E+00	0.5%
	Beta	6.7E+02	1.2E+01	1.8%	1.2E+01	1.8%
Open Fuel Storage Ponds and other approved outlets	Tritium H-3	2.3E+06	2.3E+06	100%	2.3E+06	100.0%
	Carbon–14	8.4E+04	8.4E+04	100%	8.4E+04	100.0%
	Alpha	5.0E+02	5.0E+02	100%	9.0E+01	18.0%
	Beta	1.3E+04	1.3E+04	100%	1.2E+03	9.2%

Review of proposal for First Generation Magnox Storage Pond (FGMSP) stack downgrade to 'approved outlet' (disposal outlet reference A1)

244. The trend in FGMSP gaseous discharges of alpha and beta emitting radionuclides associated with particulate matter shows a significant decrease since 2011. In 2017, the removal of stack efficiency factors (SEFs), which had been derived in 1988 to compensate for potential under-sampling, reduced the reported discharges further, noting that the previous use of SEFs may have caused past discharges to be over reported. The case for removal of SEFs in 2017 was based on consideration of extensive modifcation of the ventilation and sampling systems since 2012, including the installation of both primary and secondary HEPA filter banks and improvements to sampling eqiupment and pipework. Since 2017, the majority of measurements of alpha emitting radionuclides associated with particulate matter discharges have been reported at limits of detection.

245. Retrievals of sludge from D Bay began in November 2018 and are expected to continue for a number of years. Retrievals will also include removing solid waste and may result in an increase in gaseous discharges. At the time of our assessment, discharge data was available for 10 D Bay sludge transfers only. While this did not indicate any rise in discharges, the data set is not considered to be large enough to adequately represent future D Bay retrievals.

246. Based on the information currently available, we have decided that the FGMSP stack should not be downgraded to an ‘approved outlet’, and that the current gaseous discharge plant limits should

be replaced by the annual plant notification levels (table 6.4). Downgrading the FGMSP stack to an 'approved outlet' can be considered at a future date once Sellafield Ltd has determined that it has a sufficiently representative discharge dataset to understand the future impact on discharges from D Bay retrieval operations.

Magnox Swarf Storage Silo – Original building, 1st, 2nd and 3rd extension extract ventilation system stacks (disposal outlet references A2 & A12)

247. In Sellafield Ltd's original application there was limited evidence and some apparent inconsistency in the information and statements it provided to support the proposed MSSS annual plant notification levels. Consequently, we asked it to provide more information to substantiate the proposed annual plant notification levels. The additional information it provided answered our questions and allowed us to conclude that the proposed annual plant notification levels for MSSS 2nd and 3rd extension stacks are appropriate. This is because they allow for the significant uncertainty in future discharges, enable HHRR work at the MSSS plant to proceed, and provide contingency, currently discharges are only made via the 2nd extension stack, and the 3rd extension stack is isolated but is being retained as a contingency measure. We have decided to set annual plant notification levels for the 3rd extension stack, so that this contingency could be used without delaying HHRR. In summary, the proposed annual plant notification levels are substantially higher than the current levels of discharge. This is because waste retrieval operations will begin in the near future and there is considerable uncertainty regarding what impact this will have on discharges. In the future, all MSSS gaseous discharges are expected to be made via a new discharge stack, which incorporates new HEPA filtration and uses existing gaseous scrubbing equipment. This is currently being installed at the MSSS plant but is not expected to be operational until after waste retrieval operations begin.

248. We agree with Sellafield Ltd's proposal that the existing MSSS plant limits should be replaced by annual plant notification levels set at the same values (table 6.4). This is because we accept that there is a high level of uncertainty associated with future gaseous discharges as the waste retrievals programme is implemented. Reviewing the annual plant notification levels from time to time will make sure that they remain appropriate in the context of HHRR. We expect that future information provided as part of submissions regarding CEAR requirement 4.2.2 part 2 paragraph 14 will inform this process. As noted above, it is expected that in due course all MSSS gaseous discharges will be made via a new stack with enhanced HEPA filtration, and that appropriate new annual plant notification levels will need to be agreed.

Review of proposal for Fuel Handling Plant (FHP) stack downgrade to 'approved outlet' at phase 2 (disposal outlet reference A3)

249. In the original application, Sellafield Ltd proposed replacing plant limits with annual plant notification levels at phase 1 of the permit limit changes and to redesignate the FHP stack as an 'approved outlet' at phase 2 of the permit limit changes (after Magnox reprocessing ends).

250. We have reviewed the calculations Sellafield Ltd provided comparing actual discharge levels with the 'decision threshold'. This decision threshold relates to the activity of each radionuclide that would represent a dose of 0.005µSv/y to the most exposed members of the public. Our review confirms that for all radionuclides, other than Sb-125, the decision threshold requirements have been met over the period reviewed by Sellafield Ltd (January 2012 to December 2017). However, the Sb-125 decision threshold has been regularly exceeded from 2007 to the present time.

251. The main source of Sb-125 discharges is Magnox fuel decanning, which will end before or when Magnox reprocessing ends. We would want to see a review of the effect on discharges after decanning operations have ended, including discharge data in order to justify redesignating the stack. We expect Sellafield Ltd to provide further information, including post decanning discharge data, and to further consider the need for annual plant notification levels as a plant performance measure to be provided as part of submissions regarding CEAR requirement 4.2.2 part 2 paragraph 14.

252. We have decided not to accept Sellafield Ltd's proposal to downgrade the FHP stack until it has carried out a further review that includes discharge data following the end of decanning operations and Magnox reprocessing, and when it has set annual plant notification levels (table 6.4). It will need to provide this information as part of its submission regarding CEAR requirement 4.2.2 part 2 paragraph 14.

Waste Vitrification Plant (WVP) vessel and cell ventilation stack (disposal outlet reference A4)

253. Sellafield Ltd has proposed that the existing WVP plant limits should be replaced by annual plant notification levels, apart from the I-131 plant limit, which should be removed.

254. We have decided to accept Sellafield Ltd's proposal to remove the site limit for I-131 gaseous discharges. This is because there is no short cooled fuel left to reprocess, which was the main source of discharges in the past. We also note that I-131 discharges from WVP, which arise from spontaneous fission occuring with HAL, are very low and are expected to decline as HAL stocks are vitrified. Sellafield Ltd has confirmed that I-131 will not be routinely monitored to control the plant. However, samples taken for I-129 monitoring will be available for I-131 analysis if there is a need to investigate an unexpected discharge event or trend.

255. We agree with the Sellafield Ltd proposal that the other existing gaseous plant discharge limits should be replaced by plant discharge notification levels (table 6.4). However, when auditing Sellafield Ltd's calculations of its proposed notification level for I-129, we determined that the value proposed was too high. We have, therefore, decided that the annual plant notification level should be at a lower level, based on how the other annual plant notification levels have been set, closer to the value Sellafield Ltd calculated in its most recent WVP trigger level review, and not challenged by the maximum I-129 discharge level reported over the last 5 years. This should ensure that the plant discharge notification level for I-129 allows for HAL stocks to be vitrified, while ensuring BAT is used for the vitrification process. There will be a need to review the WVP annual plant notification levels in future years as high active liquor stocks decline.

Removing plant limits from SIXEP stack (disposal outlet reference A7)

256. We have reviewed the calculations Sellafield Ltd has provided comparing actual discharge levels with the 'decision threshold'. These demonstrate that discharges from the SIXEP stack for the period 2002 to 2018 were very low and had very low radiation dose consequences. For clarity, the impact is calculated to be well below the relevant decision threshold for significant maximum dose to the public of 0.005µSv/y. Recent improvements in sampling capability for this stack have resulted in a small increase in reported discharges, but subsequent discharges still represent a fraction of the decision threshold value, and so are of very low impact.

257. We expect the challenge to SIXEP from waste retrievals will increase in future years, and consequently we requested further information from Sellafield Ltd on the projected change in discharges. This also recognises comments we received during the consultation on the application. Sellafield Ltd provided additional information as a memorandum on 13 February 2019 (Sellafield Ltd, 2019g). This sets out how the OESM has been used to predict future discharges from this outlet, accounting for the increased challenge that the facility will see from waste retrievals. The conclusion of this modelling work is that discharges are not expected to increase.

258. On the basis of currently available information, we have decided that the SIXEP stack can be redesignated as an 'approved outlet'. However, by revising CEAR requirement 4.2.2 part 2 paragraph 14, we will require a high level review of discharge data for all 'open fuel storage ponds and other approved outlets' from time to time. We believe that introducing this requirement will make sure that those stacks with significant potential to discharge maintain a monitoring capability so that we will be able to make sure that appropriate permit limits or annual plant notification levels are introduced should there be any unexpected increase in discharges in the future.

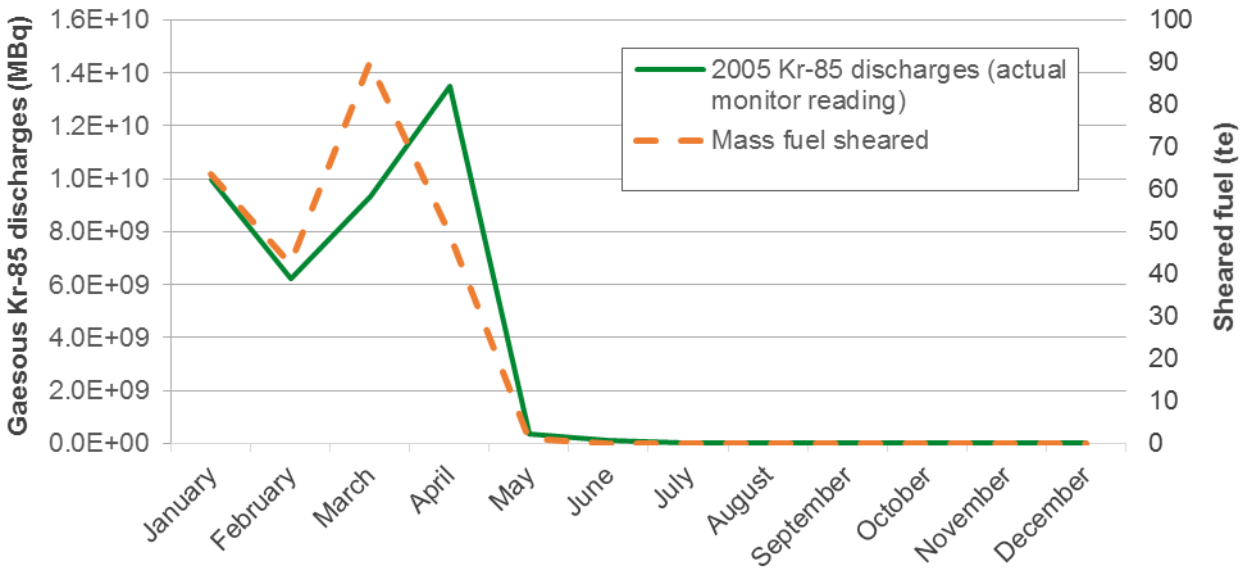
THORP gaseous (disposal outlet reference A8)

259. THORP has stopped reprocessing, so gaseous discharges are expected to decrease, but there will continue to be some gaseous discharges produced during POCO. The basis for Sellafield Ltd's proposed annual plant notification levels for H-3, C-14 and I-129 is a throughput-based calculation rather than a statistical analysis of past data. The proposed levels are based on the lowest throughput range. In the future, we expect Sellafield Ltd to use its routine statistical analysis of past data to determine the annual plant notification levels.

260. Discharges of Kr-85 are currently reported based on calculations regarding the fuel that has been reprocessed. As no more fuel will be reprocessed, these calculations will be zero. Figure 6.1 shows how Kr-85 discharges from THORP compare with the amount of fuel sheared and

subsequently dissolved. Data is provided from 2005, Kr-85 discharges were monitored at this time and there was a significant period when no shearing was carried out.

Figure 6.1: Krypton discharges (MBq) related to fuel sheared (Te) in 2005



261. We have accepted Sellafield Ltd's proposals to remove the gaseous site I-131 discharge limit. This is because THORP has stopped reprocessing and there is no short cooled Magnox fuel left to reprocess. Sellafield Ltd has confirmed that I-131 discharges will not be routinely monitored to control the plant, but samples taken for I-129 monitoring will be available for I-131 analysis if there is a need to investigate an unexpected discharge event or trend. I-129 discharge data will provide evidence regarding iodine abatement performance.

262. We have decided that the existing gaseous discharge plant limits for H-3, C-14, I-129 and alpha and beta emitting radionuclides associated with particulate matter should be replaced by plant notification levels set at the values Sellafield Ltd proposed in its application, and that the Kr-85 and I-131 gaseous discharge plant limits should be removed (table 6.4). There will be a need to review the annual plant notification levels when POCO is completed.

Solvent treatment plant (STP) and HALES (high activity liquor evaporation and storage) vessel ventilation stack (disposal outlet reference A9)

263. We have decided to accept Sellafield Ltd's proposal to remove the site limit for I-131 gaseous discharges. This is because there is no short cooled fuel left to reprocess, which was the main source of discharges in the past. We also note that I-131 discharges from the STP are very low and are expected to decline as HAL stocks are vitrified. Sellafield Ltd has confirmed that I-131 will not be routinely monitored to control the plant, but samples taken for I-129 monitoring will be available for I-131 analysis if there is a need to investigate an unexpected discharge event or trend.

264. We agree with the Sellafield Ltd proposal that the existing gaseous plant discharge limit for C-14 should be replaced by a gaseous annual plant notification level. However, when auditing Sellafield Ltd's calculations of its proposed annual plant notification level, we found that the value proposed was too low, being close to the average discharge level over the last 5 years. We have, therefore, decided that the annual plant notification level should be higher, consistent with how the other gaseous annual plant notification levels have been set. This should ensure that the gaseous annual plant notification level for C-14 allows for the evaporation, storage and timely vitrification of high active liquor while providing adequate control of discharges.

265. We agree with Sellafield Ltd's proposals that the existing plant limits for gaseous discharges for I-129 and alpha and beta emitting radionuclides associated with particulate matter should be replaced by gaseous annual plant notification levels set at the values it proposed in its application, and that the I-131 gaseous plant discharge limit should be removed (table 6.4). The C-14 annual plant notification level will be set at a level higher than Sellafield Ltd's proposal to ensure the timely

reduction of HAL stocks. There will be a need to review the annual plant notification levels in future years as HAL stocks decline.

Analytical Services and Plutonium Finishing and Storage Stack (disposal outlet reference A10)

266. We agree that Sellafield Ltd's proposed annual plant notification levels for Cs-137, Pu-alpha, Am-241 and Cm-242 and alpha and beta emitting radionuclides associated with particulate matter should replace the existing plant limits (table 6.4). In considering the proposed annual plant notification levels for this stack, we accepted the approach that Sellafield Ltd had taken to remove 'outliers' in the data. These outliers represent times when discharges had been higher than normal, for example, due to dislodging of historic radioactivity in the ventilation system. Removing these outliers reduces the annual plant notification level proposed. This ensures that potential deviations from using BAT will be more apparent, as we will be notified at a lower level of discharge.

Waste Encapsulation Plant (WEP) stack (disposal outlet reference A11)

267. We agree with the Sellafield Ltd proposals that the existing gaseous discharge plant limits for C-14, I-129 and alpha and beta emitting radionuclides associated with particulate matter should be replaced by annual plant notification levels set at the values it proposed in its application (table 6.4). There will be a need to review the annual plant notification levels in future years as the Waste Encapsulation Plant transitions away from encapsulating THORP reprocessing waste to encapsulating waste from the legacy ponds and silos and site wide site decommissioning.

National Nuclear Laboratory (disposal outlet reference A13)

268. We agree with the Sellafield Ltd proposals that the existing gaseous plant discharge limits for alpha and beta emitting radionuclides associated with particulate matter should be replaced by annual plant notification levels. Having carried out our own analysis, using monthly discharge data, we concluded that the proposed value of the annual plant notification level for beta emitting radionuclides associated with particulate matter is appropriate. However, based on this analysis, we have decided that the value of the annual plant notification level for alpha emitting radionuclides associated with particulate matter should be set at a lower value than Sellafield Ltd proposed in its application (table 6.4).

Decontamination centre stack (disposal outlet reference A15)

269. As discussed in chapter 5, Sellafield Ltd is carrying out a major asset inspection programme, covering the external ventilation ducting associated with the nuclear facilities across the Sellafield site. As part of this site wide inspection programme, it identified a small hole in the ventilation ducting serving the decontamination centre and notified us through a RSA permit part A notification dated 18 February 2019. Shortly afterwards, Sellafield Ltd took the decision to permanently turn off the ventilation system. It made this decision on the basis that routine discharges are low, much of the plant radioactive inventory has been removed as plant operations were run down over the last few years, and there are plans to reuse the facility for waste characterisation, sorting and segregation but using modular self-ventilated plant (this is known as an 'active demonstrator' project). Sellafield Ltd has ensured the ventilation system is isolated and contained, and now plans to decommision and remove the external ventilation system over the coming year. Consequently, we have decided to remove the decontamination centre stack (disposal outlet reference A15) from the permit, and a new 'active demonstrator' outlet has been added to the 'other approved outlet' in the CEAR document (table 6.4).

Separation Area Ventilation (disposal outlet reference A16)

270. In considering the proposed annual plant notification levels for this outlet, we requested more information from Sellafield Ltd regarding H-3, C-14 and Kr-85 as discharges of these radionuclides depend on fuel reprocessing rates. Sellafield Ltd provided revised proposals for annual plant notification levels based upon a different statistical approach rather than the standard approach of 'mean discharge plus 3 standard deviations'. We have accepted the revised proposals as we believe this approach is more appropriate for setting annual plant notification levels that relate to fuel reprocessing rates and noted that the values determined by the different statistical approach are lower than those calculated by the standard approach. We have also decided that the plants limits for I-129 and alpha and beta emitting radionuclides associated with particulate matter should be replaced by annual plant notification levels at the levels Sellafield Ltd proposed.

271. We have accepted removing the plant limit for I-131. This reflects our assessment that discharges are typically at limit of detection and that the previous limit was based upon reprocessing of short cooled Magnox fuel which has now ended. Our review shows that discharges are well below the 'decision threshold' and so of little significance (discharge at this level for a year represents dose of 0.005µSv/y). The annual plant notification level for I-129 will act as a check that plant abatement is working effectively and so act to highlight any unexpected change.

272. We have accepted removing the plant limits for Pu-alpha and Pu-241. This reflects our assessment that discharges typically are at limit of detection. Our review also shows that discharges are well below the 'decision threshold' and so of little significance (discharge at this level for a year represents a radiation dose to the most exposed members of the public of 0.005µSv/y). Removing the plant limits is acceptable based on the lack of source for future discharges as demonstrated by results being below the the limit of detection since SAV became operational. Retaining the alpha and beta emitting radionuclides associated with particulate matter monitoring and annual plant notification levels will indicate any change in the position, in other words if future discharges increase this will be apparent.

273. We have decided that the plants limits for H-3, C-14, Kr-85, I-129 and alpha and beta emitting radionuclides associated with particulate matter should be replaced by annual plant notification levels and that the plant limits for I-131, Pu-alpha and Pu-241 should be removed (table 6.4).

Open fuel storage ponds and other approved outlets gaseous discharges (disposal outlet reference A18)

274. Sellafield Ltd proposed that the existing gaseous plant discharge limits for this group of outlets should become annual plant notification levels. Sellafield Ltd's approach for proposing alternative annual plant notification levels in its application was based on its aerial trigger levels. Since there are no aerial trigger levels for the open fuel storage ponds and other approved outlets, it did not propose any changes.

275. The existing gaseous plant discharge limits cover H-3, C-14 and alpha and beta emitting radionuclides associated with particulate matter. The limits for H-3 and C-14 only apply when operations associated with removing fuel, isotopes or graphite from piles 1 and 2 are ongoing.

276. We have decided that there should be annual plant notification levels for this group of outlets set on a similar basis to other gaseous annual plant notification levels, as the open fuel storage ponds are the most significant source of gaseous radioactive discharges associated with partculate matter (table 6.4).

277. We have agreed annual plant notification levels for alpha and beta emitting radionuclides associated with particulate matter, based on the same approach that Sellafield Ltd used for stack discharges. For H-3 and C-14, we consider that it is appropriate to keep the same values for annual plant notification levels as previously set for plant discharge limits since there is no basis on which to change these, as the pile 1 and 2 decommisioning operations that require the levels have not yet started.

Aqueous discharges to the environment

278. The limits on disposals of aqueous radioactive waste are shown in schedule 3 to the draft permit. This section summarises our assessment and conclusions for each radionuclide, firstly for those where Sellafield Ltd applied to remove the limits, and secondly for those with changes to the limits.

279. The permit has 3 tables, including site limits and annual plant notification levels for aqueous discharges. Site limits are detailed in table S3.2A, this is the total for all outlets. Table S3.2B details annual plant notification levels for the major component aqueous waste streams that discharge via the sea pipelines and for the factory sewer and Calder interceptor sewer.

280. All, except for a very small fraction, of the site discharges are made via the sea pipelines, which discharge about 2km offshore into the Irish Sea. The limits for the sea pipelines are the same as the site discharge limits. The factory sewer and Calder interceptor sewer are subject to much lower annual plant notification levels, recognising that they discharge much closer to land, into the confluence of the rivers Ehen and Calder and about 800m offshore respectively.

281. As noted previously, we will be including a revised CEAR requirement 4.2.2 part 2 paragraph 14. This requirement will ensure the discharge limits and levels continue to be reviewed, taking account of changes within Sellafield facilities and operations.

282. As noted in chapter 3, we made a formal request to Sellafield Ltd when reviewing the permit change, asking questions about the proposed site limits in its original application. In response, Sellafield Ltd changed its proposed site limits. Table 6.5 shows a summary of Sellafield Ltd's revised proposed site limits and our decision on site limits.

Table 6.5: Summary of Sellafield Ltd revised proposals, and our decision, for site limits covering aqueous waste discharges

Radionuclide or radionuclide group	Current limit (GBq)	Sellafield Ltd proposed upper limit (GBq)	Environment Agency draft upper limit (GBq)	Sellafield Ltd proposed lower limit (GBq)	Environment Agency draft lower limit (GBq)
H-3	1.8E+07	3.0E+06	3.0E+06	7.0E+05	7.0E+05
C-14	2.1E+04	1.3E+04	1.3E+04	5.1E+03	5.1E+03
Co-60	3.6E+03	3.6E+03	3.6E+03	2.5E+03	2.5E+03
Sr-90	4.5E+04	3.2E+04	3.2E+04	1.4E+04	1.4E+04
Zr-95 + Nb-95	2.8E+03	-	-	-	-
Tc-99	1.0E+04	7.5E+03	7.5E+03	4.5E+03	4.5E+03
Ru-106	5.1E+04	1.0E+04	1.0E+04	3.1E+03	3.1E+03
I-129	2.0E+03	8.0E+02	8.0E+02	3.2E+02	3.2E+02
Cs-134	1.6E+03	-	-	-	-
Cs-137	3.4E+04	2.4E+04	2.4E+04	1.7E+04	1.7E+04
Ce-144	4.0E+03	-	-	-	-
Np-237	7.3E+02	-	-	-	-
Pu-alpha	7.0E+02	5.0E+02	5.0E+02	2.9E+02	2.9E+02
Pu-241	2.5E+04	1.8E+04	1.8E+04	6.0E+03	6.0E+03
Am-241	3.0E+02	2.2E+02	2.2E+02	1.4E+02	1.4E+02
Cm-243+244	5.0E+01	-	-	-	-
Alpha	9.0E+02	6.0E+02	6.0E+02	3.4E+02	3.4E+02
Beta	1.8E+05	1.2E+05	1.2E+05	6.3E+04	6.3E+04
Uranium (kg)	(2000kg)	7.0E+01 (2000kg)	7.0E+01 (2000kg)	2.0E+01 (600kg)	2.0E+01 (600kg)

283. Table 6.6 shows our decision on QNLs.

Table 6.6: Summary of our decision on QNLs covering site aqueous waste discharges

Radionuclide or radionuclide group	Environment Agency draft upper QNL (GBq)	Environment Agency draft lower QNL (GBq)
H-3	7.5E+05	1.8E+05
C-14	3.3E+03	1.3E+03
Co-60	9.0E+02	6.3E+02
Sr-90	8.0E+03	3.5E+03
Tc-99	1.9E+03	1.1E+03
Ru-106	2.5E+03	7.8E+02
I-129	2.0E+02	8.0E+01
Cs-137	6.0E+03	4.3E+03
Pu-alpha	1.3E+02	7.3E+01
Pu-241	4.5E+03	1.5E+03
Am-241	5.5E+01	3.5E+01

Radionuclide or radionuclide group	Environment Agency draft upper QNL (GBq)	Environment Agency draft lower QNL (GBq)
Alpha	1.5E+02	8.5E+01
Beta	3.0E+04	1.6E+04
Uranium	1.8E+01	5.0E+00

284. Table 6.7 shows which aqueous site limits (upper or lower) will be in force when the permit change comes into effect and what is expected to trigger a move from upper to lower site limits.

Table 6.7: Summary of our decision for which upper or lower aqueous waste discharge site limits will be in force when the permit change comes into effect

Radionuclide or radionuclide group	Upper/lower	Trigger for move to lower
H-3	Upper	End of Magnox reprocessing
C-14	Upper	End of Magnox reprocessing
Co-60	Lower	N/A
Sr-90	Lower	N/A
Tc-99	Upper	End of Magnox reprocessing
Ru-106	Lower	N/A
I-129	Lower	N/A
Cs-137	Lower	N/A
Pu-alpha	Lower	N/A
Pu-241	Lower	N/A
Am-241	Lower	N/A
Alpha	Lower	N/A
Beta	Lower	N/A
Uranium	Lower	N/A

Removing aqueous site limits

285. Sellafield Ltd has proposed that the following limits are removed zirconium-95 (Zr-95) and niobium-95 (Nb-95) in total, caesium-134 (Cs-134), cerium-144 (Ce-144), neptunium-237 (Np-237), and curium-243 (Cm-243) + curium-244 (Cm-244) in total. We have reviewed Sellafield Ltd's application and information regarding future discharge predictions for these radionuclides.

286. We refer throughout this section to our limit setting criteria which are summarised at the start of chapter 6 and detailed in our guidance (Environment Agency 2012b).

Removing zirconium-95 (Zr-95) and niobium-95 (Nb-95) in total aqueous site limit

287. Zr-95 and Nb-95 are metals produced during reactor operations that become trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Zr-95 and Nb-95 being directed into solid radioactive waste, but a small fraction is discharged into the sea. Zr-95 has a half-life of 64 days and concentrates on sediments. It does not concentrate or accumulate in sea life. Nb-95 has a half-life of 35 days, concentrates on sediments and may consumed by sea life ingesting sediment. Discharges have been significantly less than 1TBq/y for many years and discharges after Magnox reprocessing ends are expected to decline further (down to ~3GBq/y). The radiation dose to the most exposed people from expected future discharges will be very much less than 1µSv/y, and predicted future discharges do not meet any of our limit setting criteria.

288. There is no reason to consider that discharges will increase in the future, although any significant increases would be expected to be picked up by the review of monitoring data we require Sellafield Ltd to carry out (CEAR requirement 4.2.2 part 2 paragraph 14) as well as through our own review of Sellafield Ltd discharge data, our discharge check monitoring programme and our environmental

monitoring programme. This is because discharge and environmental monitoring information will still be available from high resolution gamma spectrometry, alpha and beta analysis.

289. Sellafield Ltd will continue to have permit limits and levels regarding beta emitting radionuclides, so will carry out sampling and analysis to report these discharges. If there is a higher than normal result for beta emitting radionuclides, additional analyses can be carried out to determine discharges of specific radionuclides.

290. We have decided that there should be no requirement for a site limit or quarterly or annual plant notification levels for Zr-95 and Nb-95 in total as none of our limit setting criteria are met (table 6.5).

Removing caesium-134 (Cs-134) aqueous site limit

291. Cs-134 is a metal produced during reactor operations that becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Cs-134 being directed into solid radioactive waste, but a small fraction is discharged into the sea. It has a half-life of about 2 years and concentrates on sediments. Aquatic plants may take in caesium from the water and sediment, and similarly aquatic animals can concentrate caesium from water, sediment and via the food chain. Discharges have been significantly less than 1TBq/y for many years and discharges after Magnox reprocessing ends are expected to decline further (down to ~44GBq/y). The radiation dose to the most exposed people from predicted future discharges will be very much less than 1µSv/y, and predicted future discharges do not meet any of our limit setting criteria.

292. There is no reason to consider that discharges will increase in the future, although any significant increases would be expected to be picked up by the review of monitoring data we require Sellafield Ltd to carry out (CEAR requirement 4.2.2 part 2 paragraph 14) as well as through our own review of Sellafield Ltd discharge data, our discharge check monitoring programme and our environmental monitoring programme. This is because discharge and environmental monitoring information will still be available from high resolution gamma spectrometry, alpha and beta analysis.Sellafield Ltd will continue to have permit limits and levels regarding beta emitting radionuclides, so will carry out sampling and analysis to report these discharges. If there is a higher than normal result for beta emitting radionuclides, additional analyses can be carried out to determine discharges of specific radionuclides.

293. We have decided that there should be no requirement for a site limit or quarterly or annual plant notification levels for Cs-134 as none of our limit setting criteria are met (table 6.5).

Removing cerium-144 (Ce-144) aqueous site limit

294. Ce-144 is a metal produced during reactor operations that becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Ce-144 being directed into solid radioactive waste, but a small fraction is discharged into the sea. It has a half-life of 258 days and concentrates on sediments. It does not concentrate or accumulate in sea life but aquatic animals may ingest cerium from the water. Discharges have been significantly less than 1TBq/y for many years and discharges after Magnox reprocessing ends are expected to decline further (down to ~100GBq/y). The radiation dose to the most exposed people from expected future discharges will be very much less than 1µSv/y, and predicted future discharges do not meet any of our limit setting criteria.

295. There is no reason to consider that discharges will increase in the future, although any significant increases would be expected to be picked up by the review of monitoring data we require Sellafield Ltd to carry out (CEAR requirement 4.2.2 part 2 paragraph 14) as well as through our own review of Sellafield Ltd discharge data, our discharge check monitoring programme and our environmental monitoring programme. This is because discharge and environmental monitoring information will still be available from high resolution gamma spectrometry, alpha and beta analysis.programme.

296. Sellafield Ltd will continue to have permit limits and levels regarding beta emitting radionuclides, so will carry out sampling and analysis to report these discharges. If there is a higher than normal result for beta emitting radionuclides, additional analyses can be carried out to determine discharges of specific radionuclides.

297. We have decided that there should be no requirement for a site limit or quarterly or annual plant notification levels for Ce-144 as none of our limit setting criteria are met (table 6.5).

Removing neptunium-237 (Np-237) aqueous site limit

298. Np-237 is a metal produced during reactor operations that becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Np-237 being directed into solid radioactive waste, but a small fraction is discharged into the sea. It has a half-life of 2,100,000 years and concentrates on sediments. Aquatic animals may ingest neptunium on sediments. Discharges have been significantly less than 1TBq/y for many years and discharges after Magnox reprocessing ends are expected to decline further (down to ~12GBq/y). The radiation dose to the most exposed people from expected future discharges will be very much less than 1µSv/y and predicted future discharges do not meet any of our limit setting criteria.

299. Discharges are not expected to increase in the future, although some discharges may arise from the clean out of the reprocessing plant after operations have ended. Significant increases would be expected to be picked up by the review of monitoring data we require Sellafield Ltd to carry out (CEAR requirement 4.2.2 part 2 paragraph 14) as well as through our own review of Sellafield Ltd discharge data, our discharge check monitoring programme and our environmental monitoring programme. This is because discharge and environmental monitoring information will still be available from high resolution gamma spectrometry, alpha and beta analysis.

300. Sellafield Ltd will continue to have permit limits and levels regarding alpha emitting radionuclides, so will carry out sampling and analysis to report these discharges. If there is a higher than normal result for alpha emitting radionuclides, additional analyses can be carried out to determine discharges of specific radionuclides.

301. We have decided that there should be no requirement for a site limit or quarterly or annual plant notification levels for Np-237 as none of our limit setting criteria are met (table 6.5).

Removing curium-243 (Cm-243) + curium-244 (Cm-244) aqueous site limit

302. Cm-243 and Cm-244 are metals produced during reactor operations that become trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Cm-243 and Cm-244 being directed into solid radioactive waste, but a small fraction is discharged into the sea. They have half-lives of 28.5 years (Cm-243) and 18 years (Cm-244) and concentrate on sediments. Curium does not concentrate or accumulate in sea life but aquatic animals may ingest it on sediments. Discharges have been significantly less than 1TBq/y for many years and discharges after Magnox reprocessing ends are expected to decline further (down to <1GBq/y). The radiation dose to the most exposed people from expected future discharges will be very much less than 1µSv/y and predicted future discharges do not meet any of our limit setting criteria.

303. There is no reason to consider that discharges will increase in the future, although any significant increases would be expected to be picked up by the review of monitoring data we require Sellafield Ltd to carry out (CEAR requirement 4.2.2 part 2 paragraph 14) as well as through our own review of Sellafield Ltd discharge data, our discharge check monitoring programme and our environmental monitoring programme. This is because discharge and environmental monitoring information will still be available from high resolution gamma spectrometry, alpha and beta analysis.programme.

304. Sellafield Ltd will continue to have permit limits and levels regarding alpha emitting radionuclides, so will carry out sampling and analysis to report these discharges. If there is a higher than normal result for alpha emitting radionuclides, additional analyses can be carried out to determine discharges of specific radionuclides.

305. We have decided that there should be no requirement for a site limit or quarterly or annual plant notification levels for Cm-243 and Cm-244 as none of our limit setting criteria are met (table 6.5).

Revising aqueous site limits and quarterly notification levels

Revised tritium (H-3) aqueous site limit and quarterly notification level

306. Tritium is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in some tritium being directed into solid radioactive waste, but a significant fraction is discharged into the sea. It has a half-life of about 12 years, rapidly disperses in the environment and typically does not concentrate in sea life. Some concentration of organically bound tritium can occur in certain cirumstances, but this is not considered to be significant for Sellafield's discharges.

307. Sellafield Ltd has proposed significant reductions in the site limits. Past discharges have been dominated by reprocessing operations and have already declined as a result of THORP closing. There will be a further significant decline in discharges when Magnox reprocessing ends. The main discharges when the Magnox reprocessing plant closes will be due to downstream treatment of effluents from the Magnox reprocessing plant, POCO, the storage of fuel and the retrieval of legacy waste.

308. While Sellafield Ltd provides limited explanation for why the proposed site limits have headroom in excess of the OESM projected discharges, including uncertainty and model uncertainty, it is recognised that the upper limits are close to the maximum level of recent discharges and that the proposed lower limit is below the current level of discharge. Accepting that there is uncertainty in future discharges, there is no specific abatement of aqueous tritium discharges, the low radiation doses to members of the public associated with this radionuclide discharge, and that the lower limit aligns with the UKSRD 2020 expected outcome, we do not believe there is merit in constraining discharges further with lower value limits at this time. There is now only limited Magnox fuel left to be reprocessed and, therefore, high Magnox reprocessing fuel throughput rates are no longer credible. This indicates that the proposed upper limit provides reasonable headroom to allow the completion of Magnox reprocessing.

309. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect and, unless a BAT case can be made and agreed, the lower limit will then apply from the end of Magnox reprocessing. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised carbon-14 (C-14) aqueous site limit and quarterly notification level

310. C-14 is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in some C-14 being directed into solid radioactive waste, but some is discharged into the sea. C-14 has a half-life of about 5,730 years, rapidly disperses in the environment and becomes concentrated in aquatic organisms.

311. Sellafield Ltd has proposed significant reductions in the site limits. Past discharges have been dominated by reprocessing operations and have already declined as a result of THORP closing. There will be a further significant decline in discharges when Magnox reprocessing ends. The main discharges when Magnox reprocessing ends will be due to downstream treatment of effluents from the Magnox reprocessing plant (including effluent from a caustic scrubber), POCO, the storage of fuel and the retrieval of legacy waste.

312. Sellafield Ltd's proposed limits align with the OESM projected discharges, including uncertainty plus model uncertainty. There is now only limited Magnox fuel left to be reprocessed and, therefore, high Magnox reprocessing fuel throughput rate are no longer credible. This indicates that the proposed upper limit provides reasonable headroom to allow the completion of Magnox reprocessing. After reprocessing ends, the main uncertainty in discharges is associated with Magnox Swarf Storage Silo waste retrievals. We carried out a high level assessment, with available information from the UK Radioactive Waste Inventory 2016, which suggests that the MSSS inventory is unlikely to have a major impact on discharges once partitioning between the solid waste and cover water and the duration of waste retrievals are taken into account.

313. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect and, unless a BAT case can be made, the lower limit will then apply from the end of Magnox reprocessing. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised cobalt-60 (Co-60) aqueous site limit and quarterly notification level

314. Co-60 is produced during reactor operations and becomes trapped in the spent fuel, in particular it is associated with fuel cladding. Reprocessing and associated waste treatment operations result in much of the Co-60 being directed into solid radioactive waste, but a small fraction is discharged into the sea. It has a half-life of about 5 years, concentrates on sediment and can concentrate in sea life.

315. Sellafield Ltd has proposed an upper limit at the value of the current site limit and a lower limit. The main source of Co-60 discharges in the past has been associated with the handling of pressurised water reactor (PWR) and in particular boiling water reactor (BWR) fuel in the THORP fuel storage ponds, but much of this BWR fuel has now been reprocessed. Consequently, current discharges are a small fraction of the current site limit. After reprocessing ends, Sellafield Ltd is concerned that discharges may increase significantly as MSSS waste retrievals progresses, rising to more than 2TBq/y by the mid 2020s and to more than 5TBq/y by the mid 2030s. However, the assessment recognises that there are significant uncertainties regarding the release fraction from legacy waste and the SIXEP decontamination factors for Co-60.

316. Sellafield Ltd's proposed lower limit aligns with the OESM projected discharges, including model and lower input uncertainty. However, the proposed upper limit is significantly less than the OESM projected discharges, including model and higher input uncertainty, indicating that future discharges could exceed the proposed upper limit. Given the high level of uncertainty associated with future discharges, we have decided to place the following improvement condition on Sellafield Ltd:

'The operator shall undertake an assessment of future aqueous discharges of cobalt-60 from legacy waste. A report containing the output from this assessment and substantiated proposals for revised cobalt-60 site aqueous discharge limits shall be submitted to the Environment Agency in writing by 1-10-23'.

317. In the meantime, we accept that Sellafield Ltd's proposed upper and lower limits are appropriate. For the upper limit, this is mainly based on not unduly constraining HHRR despite predictions in the OESM that the limit could be exceeded by projected discharges at higher uncertainty. For the lower limit, this is mainly on the basis that the proposal matches the OESM projected discharge at lower uncertainty. The timing of the improvement condition is aligned to the annual permit review report submission date and before significant increases in Co-60 discharges have been predicted from MSSS retrievals.

318. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. Unless Sellafield Ltd can make a BAT case that we agree with, the lower limit will apply when we issue the permit. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised strontium-90 (Sr-90) aqueous site limit and quarterly notification level

319. Sr-90 is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Sr-90 being directed into solid radioactive waste, but a small fraction is discharged into the sea. Sr-90 has a half-life of about 29 years, and can concentrate in sea life.

320. Sellafield Ltd has proposed significant reductions in the site limits. Past discharges have been dominated by reprocessing operations and have declined significantly since the benefit of Magnox medium active concentrate diversion (from 2006 onwards) to HALES was realised. Discharges associated with reprocessing operations will decline as Magnox reprocessing ends and associated waste concentrates are processed. However, Sellafield Ltd is concerned that discharges may increase as MSSS waste retrievals progresses.

321. Sellafield Ltd's proposed lower limit aligns with the OESM projected discharges, including model and lower input uncertainty. However, the proposed upper limit is slightly higher than the OESM projected discharges, including model and higher input uncertainty. Sellafield Ltd explains that this is based on a lack of knowledge of the impact on discharges from future MSSS retrievals operations. We accept the upper limit, mainly because of the need to retain headroom that allows HHRR operations to progress.

322. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. Based on the recent past level of discharges compared to the the proposed limits, we expect the lower limit to be applied when the permit is issued, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised technetium-99 (Tc-99) aqueous site limit and quarterly notification level

323. Tc-99 is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations now result in much of the Tc-99 being directed into solid radioactive waste, but a small fraction is discharged into the sea. It has a half-life of about 210,000 years, disperses widely and can concentrate in sea life, particularly shellfish.

324. Sellafield Ltd has proposed significant reductions in the site limits. Discharges have been dominated by reprocessing operations and have declined significantly since the benefit of Magnox medium active concentrate diversion (from 2006 onwards) to HALES was realised. Discharges associated with reprocessing operations will decline as Magnox reprocessing ends and associated waste concentrates are processed.

325. Sellafield Ltd's proposed limits align with the OESM projected discharges, including input and model uncertainty. There is now only limited Magnox fuel left to be reprocessed and, therefore, high Magnox reprocessing fuel throughput rates are no longer credible. This indicates that the proposed upper limit provides reasonable headroom to allow the completion of Magnox reprocessing. After reprocessing ends, the main uncertainty in discharges is associated with Magnox Swarf Storage Silo (MSSS) waste retrievals. We carried out a high level assessment, with available information from the UK Radioactive Waste inventory 2016, which suggests that the MSSS inventory is unlikely to have a major impact on discharges once partitioning between the solid waste and cover water and the duration of waste retrievals are taken into account. A lower limit of 4.5E3GBq is acceptable as it is broadly consistent with the 2020 expected outcome in the UKSRD (3.0E3GBq), taking into account that headroom is required between expected discharges and limits.

326. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. The upper limit will apply from the date the permit comes into effect and, unless Sellafield Ltd can make a BAT case, the lower limit will then apply from the end of Magnox reprocessing. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised ruthenium-106 (Ru-106) aqueous site limit and quarterly notification level

327. Ru-106 is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Ru-106 being directed into solid radioactive waste, but a fraction is discharged into the sea. It has a half-life of about 1 year, concentrates on sediment and accumulates in sea life, particularly shellfish.

328. Sellafield Ltd has proposed significant reductions in the site limits. Discharges have been dominated by reprocessing operations and will decline as Magnox reprocessing ends and associated waste concentrates are processed.

329. Sellafield Ltd's proposed lower limit aligns with the OESM projected discharges, including model and lower input uncertainty. However, the proposed upper limit is higher than the OESM projected discharges, including model and higher input uncertainty. Sellafield Ltd notes that there is low overall uncertainty and impact on site discharges, and that peak impact may increase slightly if retrievals schedules are accelerated, but total overall discharge will be the same. We recognise that the main source of discharges, the processing of salt evaporator concentrate (SEC), will continue for a few years after reprocessing ends. We have carried out a high level assessment, with available information from the UK Radioactive Waste Inventory, which suggests that the MSSS inventory is unlikely to have a major impact on discharges once partitioning between the solid waste and cover water, the duration of waste retrievals and radioactive decay are taken into account. We consider that Sellafield Ltd's proposed upper limit of 1.0E4GBq is acceptable as it offers a significant reduction from the current permit limit, but provides reasonable headroom to allow the completion of Magnox reprocessing and SEC processing, if required. We accept the proposed lower limit of 3.1E3GBq, mainly because it is closely aligned with the OESM projected discharge at lower uncertainty and provides reasonable headroom to allow for projected discharges.

330. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. Based on the recent past level of discharges compared to the the proposed limits, we expect the lower limit to be applied when the permit is

issued, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised iodine-129 (I-129) aqueous site limit and quarterly notification level

331. I-129 is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in some of the I-129 being directed into solid radioactive waste, but a fraction is discharged into the sea. It has a half-life of about 15,700,000 years, disperses widely and accumulates in sea life, particularly in some algae and seaweed, and can be consumed by mammals and birds that eat contaminated foodstuff.

332. Sellafield Ltd has proposed significant reductions in the site limits and has suggested that we may wish to consider removing the I-129 aqueous site discharge limits. Discharges have been dominated by THORP's operations, which have now ended and discharges are now declining. There is uncertainty over the level of future discharges that will arise from POCO and MSSS waste retrieval operations.

333. We consider that these limits should be retained to make sure that discharges decline as expected. However, we expect that we could remove these limits at a future date if discharges decline. Sellafield Ltd's proposed lower limit aligns with the OESM projected discharges, including model and lower input uncertainty. However, the proposed upper limit is slightly higher than the OESM projected discharges, including model and higher input uncertainty. We have carried out a high level assessment, with available information from the UK Radioactive Waste Inventory, which suggests that the MSSS inventory is unlikely to have a major impact on discharges.

334. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. Given that current discharges are declining, we expect the lower limit to be applied when the permit is issued, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised caesium-137 (Cs-137) aqueous site limit and quarterly notification level

335. Cs-137 is a metal produced during reactor operations that becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in much of the Cs-137 being directed into solid radioactive waste, but a small fraction is discharged into the sea. It has a half-life of about 30 years and concentrates on sediments. Aquatic plants may take in caesium from the water and sediment, and similarly aquatic animals can concentrate caesium from water, sediment and via the food chain.

336. Sellafield Ltd has proposed significant reductions in the site limits. Magnox reprocessing and legacy fuel and waste storage have been the dominant sources of past discharges and have declined in the past when the benefit of Magnox medium active concentrate diversion (from 2006 onwards) to HALES was realised. THORP closing has had only a minor impact on discharges. There is significant uncertainty over future discharges associated with legacy waste retrievals operations, fuel storage, sludge chemistry and SIXEP abatement.

337. Sellafield Ltd's proposed limits align with the OESM projected discharges, including model and input uncertainty. We consider that these limits provide reasonable headroom for future operations, including the treatment of waste from reprocessing and legacy waste retrievals.

338. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. While we accept there is significant uncertainty over future discharges, which supports the difference between proposed upper and lower limits, we expect the lower limit to be applied when the permit is issued given the recent past level of discharge, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised plutonium-alpha (Pu-alpha) aqueous site limit and quarterly notification level

339. Plutonium alpha covers the main alpha emitting plutonium radionuclides (Pu-238, Pu-239 and Pu-240), which are produced during reactor operations and become trapped in the spent fuel. Reprocessing and associated waste treatment operations result in the recovery of plutonium into a solid material, but a small fraction is discharged into the sea. Pu-238 has a half-life of about 88

years, Pu-239 24,000 years and Pu-240 6,500 years. Plutonium concentrates on sediments and accumulates in sea life, particularly in some shellfish.

340. Sellafield Ltd has proposed significant reductions in the site limits. Site discharges arise mainly from reprocessing operations and storage of fuel and legacy waste, and have declined significantly since the Enhanced Actinide Removal Plant (EARP) started operations in 1994. There is significant uncertainty in future discharges associated with EARP/SIXEP abatement performance for effluents arising from POCO and legacy waste retrievals, sludge chemistry, waste retrievals and potential for release, the behaviour of colloids and fuel storage.

341. Sellafield Ltd's proposed limits align with the OESM projected discharges, including input and model uncertainty. We consider that these limits provide reasonable headroom to allow for future discharges.

342. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. While we accept there is significant uncertainty over future discharges, which supports the difference between the proposed upper and lower limits, we expect the lower limit to be applied when the permit is issued given the recent past level of discharge, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised plutonium-241 (Pu-241) aqueous site limit and quarterly notification level

343. Pu-241 is produced during reactor operations and becomes trapped in the spent fuel. Reprocessing and associated waste treatment operations result in the recovery of plutonium into a solid material, but a small fraction is discharged into the sea. Pu-241 has a half-life of about 14 years. Plutonium concentrates on sediments and accumulates in sea life, particularly in some shellfish.

344. Sellafield Ltd has proposed significant reductions in the site limits. Site discharges arise mainly from reprocessing operations and storage of fuel and legacy waste, and have declined significantly since EARP started operations in 1994. There is significant uncertainty in future discharges associated with EARP/SIXEP abatement performance for effluents arising from POCO and legacy waste retrievals, sludge chemistry, waste retrievals and potential for release, the behaviour of colloids and fuel storage.

345. Sellafield Ltd's proposed limits align with the OESM projected discharges, including input and model uncertainty. We consider that these limits provide reasonable headroom to allow for future discharges.

346. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. While we accept that there is significant uncertainty in future discharges, which supports the difference between proposed upper and lower limits, we expect the lower limit to be applied when permit is issued given the recent past level of discharge, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised americium-241 (Am-241) aqueous site limit and quarterly notification level

347. Am-241 is produced during reactor operations and becomes trapped in the spent fuel and also arises from the radioactive decay of Pu-241. Reprocessing and associated waste treatment operations result in much of the Am-241 being directed into solid radioactive waste, but a small fraction is discharged into the sea. Am-241 has a half-life of about 432 years. Am-241 concentrates on sediments and accumulates in sea life, particularly in some shellfish.

348. Sellafield Ltd has proposed significant reductions in the site limits. Site discharges arise mainly from reprocessing operations and storage of fuel and legacy waste, and have declined significantly since EARP started operations in 1994. There is significant uncertainty in future discharges associated with EARP/SIXEP abatement performance for effluents arising from POCO and legacy waste retrievals, sludge chemistry, waste retrievals and potential for release, the behaviour of colloids and fuel storage.

349. Sellafield Ltd's proposed limits align with the OESM projected discharges, including input and model uncertainty. We consider that these limits provide reasonable headroom to allow for future discharges.

350. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. While we accept that there is significant uncertainty in future discharges, which supports the difference between proposed upper and lower limits, given the recent past level of discharge we expect the lower limit to be applied when permit is issued, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised alpha (Alpha) emitting radionuclides aqueous site limit and quarterly notification level

351. The alpha emitting radionuclides in Sellafield Ltd's discharges mainly arises from isotopes of plutonium and americium as discussed above.

352. Sellafield Ltd has proposed significant reductions in the site limits. Site discharges arise mainly from reprocessing operations and storage of fuel and legacy waste, and have declined significantly since EARP started operations in 1994. There is significant uncertainty in future discharges associated with EARP/SIXEP abatement performance for effluents arising from POCO and legacy waste retrievals, sludge chemistry, waste retrievals and potential for release, the behaviour of colloids and fuel storage.

353. Sellafield Ltd's proposed limits align with the OESM projected discharges, including input and model uncertainty. The lower limit of 3.4E2GBq is broadly consistent with the 2020 expected outcome in the UKSRD (1.0E2 GBq), taking into account that headroom is required between expected discharges and limits.

354. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. We consider that these limits provide reasonable headroom to allow for future discharges associated with environmental clean-up. While we accept that there is significant uncertainty in future discharges, which supports the difference between proposed upper and lower limits, given the recent past level of discharge we expect the lower limit to be applied when the permit is issued, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised beta (Beta) emitting radionuclides aqueous site limit and quarterly notification level

355. The beta emitting radionuclides in Sellafield Ltd's discharges arise from C-14, Co-60, Sr-90, Tc-99, Ru-106, I-129 and Cs-137, which are discussed above. It is important to note that the beta emitting radionuclide category takes into account the relative efficiency in the measurement of each radionuclide, according to the defined analytical technique used. The analytical technique used cannot measure low energy beta radiation. Consequently, H-3 and Pu-241 are not detected using this technique and radionuclides such as C-14 can only be detected with low efficiency.

356. Sellafield Ltd has proposed significant reductions in the site limits. Reprocessing operations are currently the main source of discharges. Discharges have declined significantly in the past since the benefit of Magnox medium active concentrate diversion (from 2006 onwards) to HALES was realised. After reprocessing ends the main sources of discharges will be from legacy waste discharged via SIXEP. The main sources for this will arise from storing and retrieving fuel and waste, with FHP and MSSS likely to be the two major sources. There are significant uncertainties in future discharges associated with: EARP/SIXEP performance for effluents arising from POCO and legacy waste retrievals, impact of retrieving waste and storing legacy fuel, and the availability of SIXEP Continuity Plant (SCP).

357. Sellafield Ltd's proposed limits align with the OESM projected discharges, including input and model uncertainty. The lower limit of 6.3E4GBq is broadly consistent with the 2020 expected outcome in the UKSRD (1.8E4GBq), taking into account that headroom is required between expected discharges and limits. We consider that these limits provide reasonable headroom to allow for future discharges associated with environmental clean-up.

358. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. While we accept that there is significant uncertainty in future discharges, which supports the difference between Sellafield Ltd's proposed upper and lower limits, given the recent past level of discharge we expect the lower limit to be

applied when permit is issued, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Revised uranium aqueous site limit and quarterly notification level

359. Uranium is a natural material used as a fuel in nuclear reactors. In its natural state, it mainly comprises 3 isotopes, U-234, U-235 and U-238. During fuel manufacture and reactor operations the relative composition of these isotopes can change and new uranium isotopes (U-232, U-233 and U-236) can be created. Analysing past discharges shows that U-234, U-235, U-236 and U-238 are present in discharges and has allowed a standard conversion factor of 3.54E4Bq/g to be developed. Reprocessing, recovery and associated waste treatment operations result in the refinement of uranium into a solid material, but a small fraction is discharged into the sea. Uranium isotopes have half-lives ranging from about 70 to 4,500,000,000 years. Uranium disperses widely and can concentrate in sea life.

360. Sellafield Ltd has proposed an upper limit in becquerels, which is equivalent to the current site limit (specified in kg), and a lower limit in becquerels at a significantly lower level (Sellafield Ltd, 2019d). Reprocessing operations are currently the main source of discharges. After reprocessing ends, discharges are expected to decline, with the main sources of discharges arising from storing fuel and storing and retrieving waste.

361. We agree with Sellafield Ltd's proposed upper and lower site limits (table 6.5) and have confirmed that one or more of our limit setting criteria is met. As the permit relates to controlling radioactive substances, we intend to specify these limits in bequerels rather than kilogrammes. We consider that these limits provide reasonable headroom to allow for future discharges. While we accept that there is significant uncertainty in future discharges, which supports the difference between Sellafield Ltd's proposed upper and lower limits, given the recent past level of discharge we expect the lower limit to be applied when the permit is issued, unless Sellafield Ltd can make a BAT case that we agree with. We have agreed quarterly notification levels based on 25% of these proposed limits (table 6.6).

Aqueous annual plant notification levels

362. As noted in chapter 3, we raised a number of questions with Sellafield Ltd when assessing its application. As a result, Sellafield Ltd revised some of its proposed annual plant notification levels. Table 6.8 shows Sellafield Ltd's proposed annual plant notification levels ('*' denotes where these are different from the original proposal) and our draft annual plant notification levels compared with current plant limits. In some circumstances, our decision to put in place or not specify plant notification levels, does not align with Sellafield Ltd's orginal application.

Table 6.8: Summary of Sellafield Ltd revised proposals, and our decision, for annual plant notification levels covering aqueous waste site discharges

Plant	Radionuclide	Current plant limit (GBq)	Sellafield Ltd proposed annual plant notification level (GBq)	% of current plant limit	Environment Agency draft annual plant notification level (GBq)	% of current plant limit
SETP	H-3	1.8E+07	2.5E+06	14%	2.5E+06	14%
	C-14	2.1E+04	6.3E+03	30%	6.3E+03	30%
	Co-60		1.8E+01	-	1.8E+01	-
	Sr-90	8.9E+03	8.3E+02	9%	8.3E+02	9%
	Ru-106	1.1E+04	3.9E+02	4%	3.9E+02	4%
	I-129		8.0E+01	-	8.0E+01	-
	Cs-137	2.3E+04	2.0E+03	9%	2.0E+03	9%

Plant	Radionuclide	Current plant limit (GBq)	Sellafield Ltd proposed annual plant notification level (GBq)	% of current plant limit	Environment Agency draft annual plant notification level (GBq)	% of current plant limit
	Am-241	1.8E+02	1.8E+01	10%	1.8E+01	10%
	Pu-alpha	4.2E+02	8.0E+01	19%	8.0E+01	19%
	Pu-241	1.8E+04	1.8E+03	10%	1.8E+03	10%
	Alpha	6.0E+02	1.0E+02	17%	1.0E+02	17%
	Beta	4.2E+04	4.3E+03	10%	4.3E+03	10%
	Uranium* (kg)	(2000kg)	12.4GBq (350kg)	18%	12.4GBq (350kg)	18%
EARP - Lower	H-3	6.3E+05	3.2E+04	5%	N/A	N/A
	C-14	1.4E+03	2.7E+01	2%	N/A	N/A
	Sr-90	1.4E+04	9.6E+02	7%	N/A	N/A
	Tc-99	1.0E+04	1.3E+03	13%	N/A	N/A
	Ru-106	4.2E+04	2.5E+02	1%	N/A	N/A
	Cs-137	1.0E+03	2.0E+02	20%	N/A	N/A
	Am-241		7.0E+00	-	N/A	N/A
	Pu-alpha	2.9E+01	6.0E+00	21%	N/A	N/A
	Pu-241		7.0E+01	-	N/A	N/A
	Alpha	4.5E+01	1.4E+01	31%	N/A	N/A
	Beta	1.2E+05	3.0E+03	3%	N/A	N/A
EARP - Upper	H-3	6.3E+05	3.2E+04	5%	3.2E+04	5%
	C-14	1.4E+03	8.0E+02	57%	8.0E+02	57%
	Sr-90	1.4E+04	1.2E+03	9%	1.2E+03	9%
	Tc-99	1.0E+04	2.3E+03	23%	2.3E+03	23%
	Ru-106	4.2E+04	1.7E+03	4%	1.7E+03	4%
	Cs-137	1.0E+03	5.0E+02	50%	5.0E+02	50%
	Am-241		1.7E+01	-	1.7E+01	-
	Pu-alpha	2.9E+01	7.0E+00	24%	7.0E+00	24%
	Pu-241		7.0E+01	-	7.0E+01	-
	Alpha	4.5E+01	2.6E+01	58%	2.6E+01	58%
	Beta	1.2E+05	5.6E+03	5%	5.6E+03	5%
SIXEP	H-3	1.1E+05	2.0E+04	18%	2.0E+04	18%
	C-14	4.3E+02	-	-	3.4E+01	8%
	Co-60		1.8E+01	-	1.8E+01	-
	Sr-90	6.8E+03	1.7E+03	25%	1.7E+03	25%
	Tc-99		6.0E+02	-	6.0E+02	-
	Ru-106		1.9E+02	-	1.9E+02	-
	Cs-137	1.7E+04	2.0E+03	12%	3.0E+03	18%
	Am-241		4.0E+00	-	4.0E+00	-
	Pu-alpha	4.0E+02	1.4E+02	35%	1.4E+02	35%
	Pu-241	1.5E+04	2.0E+03	13%	2.0E+03	13%

Plant	Radionuclide	Current plant limit (GBq)	Sellafield Ltd proposed annual plant notification level (GBq)	% of current plant limit	Environment Agency draft annual plant notification level (GBq)	% of current plant limit
	Alpha	9.0E+02	1.5E+02	17%	1.5E+02	17%
	Beta	9.5E+04	6.7E+03	7%	6.7E+03	7%
Lagoon	H-3		1.0E+01	-	1.2E+01	-
	Sr-90*		1.5E+03	-	1.5E+03	-
	Am-241		2.0E-01	-	2.0E-01	-
	Alpha	5.1E+00	3.5E-01	7%	3.5E-01	7%
	Beta	3.8E+03	2.3E+03	61%	2.3E+03	61%
THORP R&S	H-3		7.0E+01	-	7.0E+01	-
	Co-60	3.6E+03	4.0E+01	1%	4.0E+01	1%
	Ru-106		4.2E+01	-	4.2E+01	-
	Cs-137	7.2E+03	8.5E+02	12%	8.5E+02	12%
	Pu-alpha		9.0E+00	-	9.0E+00	-
	Pu-241		2.0E+02	-	2.0E+02	-
	Alpha	1.5E+01	1.1E+01	73%	1.1E+01	73%
	Beta	9.9E+03	9.7E+02	10%	9.7E+02	10%
THORP C-14 Removal Plant*	H-3*	3.6E+03	9.9E+02	28%	9.9E+02	28%
	C-14*	5.0E+02	1.9E+02	38%	1.9E+02	38%
	I-129*	1.7E+03	4.8E+02	28%	4.8E+02	28%
	Alpha*	8.5E-01	1.8E-01	21%	1.8E-01	21%
	Beta*	9.7E+02	3.4E+02	35%	3.4E+02	35%
FS	H-3*	**6.8E+01**	1.0E+01	15%	1.0E+01	15%
	Alpha	**3.0E-01**	1.5E-01	50%	1.5E-01	50%
	Beta	**6.0E+01**	7.0E+00	12%	7.0E+00	12%
CIS	H-3	**6.8E+01**	1.0E+01	15%	1.0E+01	15%
	Alpha	**3.0E-01**	1.5E-01	50%	1.0E-01	33%
	Beta	**6.1E+00**	6.0E+00	98%	1.0E+00	16%

Segregated Effluent Treatment Plant (SETP) aqueous discharges

363. We agree with Sellafield Ltd's proposals that the existing aqueous plant discharge limits for H-3, C-14, Sr-90, Ru-106, Cs-137, Pu-alpha, Pu-241, Am-241, alpha emitting radionuclides, beta emitting radionuclides and uranium should be replaced by plant notification level set at the values it proposed in its application and further information it provided (Sellafield Ltd, 2019d).

364. We also agree that the Zr/Nb-95, Cs-134, Ce-144, Np-237 and Cm-243/244 aqueous plant limits should be removed as we have accepted Sellafield Ltd's proposals to remove these aqueous site limits (see above). We note that Zr/Nb-95, Cs-134 and Ce-144 are short-lived radionuclides and discharges are mainly associated with reprocessing operations, which are coming to an end. The total beta annual plant notification level and gamma spectrometry (for other radionuclides such as Cs-137) will continue to provide reassurance that discharges of these short-lived radionuclides are insignificant and decline as expected.

365. For the longer-lived radionuclides Np-237 and Cm-243/244, the alpha and beta emitting radionuclide annual plant notification levels and associated monitoring will provide oversight of these discharges. If there are unusually high discharges, additional analyses can be carried out to

determine discharges of specific radionuclides. In addition, our amendment to CEAR 4.2.2 requirement 14 will require periodic waste stream characterisation following major changes to the source terms and/or effluent management at Sellafield. This should provide reassurance that any unexpected increase in these discharges will be identified.

366. Sellafield Ltd has also proposed that new annual plant notification levels for Co-60 and I-129 should be introduced as the SETP discharges transitions from reprocessing to POCO. We agree that these new plant discharge notifications level should be set at the values Sellafield Ltd proposed in its application.

367. There will be a need to review the annual plant notification levels as POCO progress and as the planned diversion of discharges from SETP to EARP occurs.

Enhanced Actinide Removal Plant (EARP) aqueous discharges

368. EARP has 2 different processing streams: bulks and concentrates. The bulks stream comes from routine reprocessing effluents. There are different effluent streams that are processed as concentrates, these are: floc from the Floc Retrieval Plant (FRP), salt evaporator concentrate (SEC) from the salt evaporator, and medium active liquor (MAL) from the reprocessing streams. Sellafield Ltd proposed that, uniquely, EARP would apply either an upper or lower annual plant notification level for some radionuclides depending on the operations being carried out. This would allow a much lower notification level to be in force routinely and an upper plant notification level to be in force when certain concentrate campaigns (resulting in higher discharges) are underway. MAL and SEC are expected to result in higher discharges than FRP. However, Sellafield Ltd's plan for processing of these streams is such that there will not, in the next ten years, be a full year when only FRP will be processed. Given that an annual plant notification level will be in force for a full year, the lower annual plant notification level would not be used over the next ten years. It has therefore been decided only to include one group of annual plant notification levels, set at the upper level to enable SEC and MAL processing.

369. We agree with Sellafield Ltd's proposals that the existing plant limits for H-3, C-14, Sr-90, Tc-99, Ru-106, Cs-137, Pu-alpha, Am-241, total alpha and total beta should be replaced by aqueous plant notification levels for H-3, C-14, Sr-90, Tc-99, Ru-106, Cs-137, Pu-alpha, alpha emitting radionuclides and total beta emitting radionuclides set at the values it proposed in its application.

370. We also agree with Sellafield Ltd that the Co-60 aqueous plant limits should be removed and no notification level set. While it is possible that EARP Co-60 aqueous discharges could increase in future years, when SETP discharges are diverted to EARP, we note that broadly equivalent discharges from reprocessing will have ended and that the EARP abatement process is expected to decontaminate SETP discharges by around a factor of 8. In addition, we note that total beta aqueous annual plant notification levels and associated monitoring will provide oversight of these discharges. If there are unusually high discharges, then additional analyses can be carried out to determine discharges of specific radionuclides. In addition, our amendment to CEAR 4.2.2 requirement 14 will require periodic waste stream characterisation following major changes to the source terms and/or effluent management at Sellafield. This should provide reassurance that any unexpected increase in these discharges will be identified.

371. Sellafield Ltd has proposed new annual plant notification levels for Pu-241 and Am-241 as the EARP discharges transition from reprocessing to POCO. We agree that these new annual plant notification levels should be set as Sellafield Ltd proposed in its application.

372. There will be a need to review the annual plant notification levels as POCO progress and when the planned diversion of discharges from SETP to EARP occurs.

Site Ion Exchange Plant (SIXEP) aqueous discharges

373. We agree with Sellafield Ltd's proposals that the existing aqueous plant limits for H-3, Sr-90, Pu-alpha, Pu-241 and alpha and beta emitting radionuclides should be replaced by plant notification levels set at the values it proposed in its application.

374. We agree with Sellafield Ltd's proposals to introduce new annual plant notification levels for Co-60, Tc-99, Ru-106 and Am-241 set at the values it proposed in its application. The main reason for these is uncertainty in the aqueous effluent generated during waste retrieval operations that support HHRR.

375. However, when auditing Sellafield Ltd calculations of its proposed Cs-137 annual plant notification level, we found that the value proposed was too low. We have, therefore, decided that the annual plant notification level should be increased to 3.0E+03GBq and set on the same basis as the other annual plant notification levels.

376. We have agreed that an annual plant notification level should be set at 3.4E+01GBq for C-14 based on the same method Sellafield Ltd used to determine other annual plant notification levels. Our main reason for doing this is the uncertainty over future discharges associated with waste retrievals from MSSS.

377. In considering the proposed annual plant notification levels, we accepted the approach that Sellafield Ltd had taken to remove 'outliers' in the data. These outliers represent times when discharges had been higher than normal, for example, elevated beta emitting radionuclide levels following an ion bed change in January 2018. Removing these outliers reduces the value of the annual plant notification level proposed. This ensures potential deviations from using BAT will be more apparent, and we will be notified at a lower level of discharge than would otherwise be the case.

Laundry and lagoon aqueous discharges

378. We agree with Sellafield Ltd proposals that the existing aqueous plant limits for alpha and beta emitting radionuclides should be replaced by plant notification levels set at the values it proposed in its application.

379. However, when auditing Sellafield Ltd calculations of its proposed H-3 notification levels, we found that the value proposed was too low. We have, therefore, decided that the notification level should be increased and set on the same basis as the other aqueous annual plant notification levels.

380. We also agree with Sellafield Ltd that the Cs-137 and Pu-alpha aqueous plant discharge limits should be removed and no notification levels set for these radionuclides. The Cs-137 and Pu-alpha plant limits were introduced in the early 2000s to monitor the residual impact from a leak that had occurred a number of years earlier. Alpha and beta discharges are now dominated by Am-241 and Sr-90, consequently it is more appropriate to set annual plant notification levels for these radionuclides.

381. Accordingly, Sellafield Ltd has proposed new annual plant notification levels for Am-241 and Sr-90. We agree that these new plant discharge notifications levels should be set at the values it proposed .

382. The lagoon radioactive discharges arise from cooling, surface and groundwater. There will be a need to review the annual plant notification levels as these inputs change over time.

THORP receipt and storage pond aqueous discharges

383. We agree with Sellafield Ltd's proposals that the existing aqueous plant limits for Co-60, Cs-137 and alpha and beta emitting radionuclides should be replaced by plant notification levels set at the values it proposed in its application.

384. As THORP shearing of fuel has ended, the THORP receipt and storage pond is transitioning into an interim storage pond for advanced gas reactor (AGR) fuel that is intended to be disposed of as spent fuel in the geological disposal facility. To make sure that the best conditions are used for interim storage, the operating pH of the pond is to be increased to pH11. Sellafield Ltd has proposed new annual plant notification levels for H-3, Ru-106, Pu-alpha and Pu-241 to monitor future discharges. We have decided that these new annual plant notification levels should be set at the values in the Sellafield Ltd application.

385. We agree with Sellafield Ltd's proposal to remove the aqueous site limit for Cs-134, and do not intend to set an annual plant notification level for this radionuclide. Cs-134 has a half-life of 2 years and will be of limited value as an indicator of plant performance in future due to radioactive decay. Cs-137, which has a half-life of ~30 years, will continue to be analysed and reported. This will provide information on the abatement of caesium in the pond.

THORP carbon-14 removal plant aqueous discharges

386. As THORP shearing of fuel has ended, it is not expected that gaseous effluent C-14 will continue to be generated as much as previously. However, Sellafield Ltd will continue to operate the C-14 removal plant, which will produce aqueous effluent until sustained conditions demonstrate that it is

no longer BAT to operate it. At the time of permit application and determination, this position had not been reached. Following POCO, discharges are expected to reduce to below the limit of detection.

387. Sellafield Ltd proposed a set of annual plant notification levels in its variation application. Subsequently (Sellafield Ltd, 2019b), it submitted a revised set of annual plant notification levels. We agree with Sellafield Ltd's revised proposals that the existing aqueous plant limits for H-3, C-14, I-129 and alpha and beta emitting radionuclides should be replaced by plant notification levels set at the values Sellafield Ltd proposed.

Factory sewer (FS) (discharge outlet W2)

388. Sellafield Ltd proposed that the existing plant limits are replaced by annual plant notification levels with lower values. Taking account of past discharges, we agree with Sellafield Ltd's proposed values for tritium, total alpha and total beta annual plant notification levels, and consider that annual plant notification levels should be set. There will be a need to regularly review the annual plant notification levels in future to make sure that they reflect operational needs.

389. We gave serious consideration to retaining limits for the FS discharges, however, we have taken account of Sellafield Ltd's arguments regarding replacing them with annual notification levels. In the future, In the future, Sellafield Ltd might wish to engineer new routes for other aqueous effluents via the FS. To make sure that these plans are appropriate, we will include a new pre-operational measure:

The Operator shall submit proposals for any new engineered routing of effluent via the Calder Interceptor Sewer or Factory Sewer, including a report which demonstrates how best available techniques (BAT) will be used to minimise the activity of discharges of aqueous radioactive waste to the environment and to minimise its radiological effects on the environment and members of the public. These proposals will require approval in writing from the Environment Agency prior to such disposals being made.

Calder interceptor sewer (CIS) (discharge outlet W3)

390. Sellafield Ltd proposed that the existing plant limits should be replaced by annual plant notification levels with lower values. It should be noted that there is too little reported discharge data for the CIS to calculate annual plant notification levels values. Instead, Sellafield Ltd's proposals are based on the calculations for the FS discharges for tritium and alpha emitting radionuclides. Sellafield Ltd did not use the FS discharges for beta emitting radionuclides as this has groundwater feeds into the system which impact on those discharges. We agree with the value Sellafield Ltd proposed for tritium. However, the proposed values for the alpha emitting radionuclides and beta emitting radionuclides annual plant notification levels are similar to the previous plant limits, and we consider that they should be set at lower values to make sure that elevated discharges are highlighted. There will be a need to regularly review the annual plant notification levels in future years to make sure that they reflect operational needs.

391. We gave serious consideration to retaining limits for the CIS discharges, however, we have taken account of Sellafield Ltd's arguments regarding replacing them with annual notification levels. In the future, Sellafield Ltd might wish to engineer new routes for other aqueous effluents via the Calder interceptor sewer. To make sure that these plans are appropriate, we will include a new pre-operational measure:

The Operator shall submit proposals for any new engineered routing of effluent via the Calder Interceptor Sewer or Factory Sewer, including a report which demonstrates how best available techniques (BAT) will be used to minimise the activity of discharges of aqueous radioactive waste to the environment and to minimise its radiological effects on the environment and members of the public. These proposals will require approval in writing from the Environment Agency prior to such disposals being made.

Disposals by burial in an engineered facility on the site

392. The Sellafield RSA environmental permit includes disposals at Sellafield Ltd's on-site CLESA disposal facility. Sellafield Ltd initially submitted a request to increase the specific tritium (H-3) disposal limit for CLESA to 1.0 E+05Bq/g taken as an average across each consignment load.

Following discussions with the Environment Agency, this was subsequently revised to change the concentration limit for tritium (H-3) to 4.0E+04Bq/g and then to 1.2E+04Bq/g.

393. Applications for disposal are assessed against the requirements of the 'Near-Surface Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation' (Environment Agency et al, 2009) (the NS-GRA). This includes a set of risk and dose based constraints which ensure that risks to people and the environment are acceptably low.

394. Prior to this submission, as part of a minor permit review specific to CLESA, we assessed the CLESA environmental safety case (ESC) and post-closure radiological safety assessment (PCRSA) against the requirements of the NS-GRA. This gave us confidence that disposals at CLESA would ensure that risks to people and the environment are acceptably low. With specific reference to the NS-GRA, Sellafield Ltd's assessments showed that during the period of authorisation, the source related dose constraint of 300μSv/y and site related dose constraint of 500μSv/y are not exceeded. For post-closure period, the risk guidance level of 10^{-6} per year (i.e. 1 in a million per year) to a person representative of those at greatest risk, and for human intrusion after the period of authorisation, the dose guidance level in the range of around 3,000μSv/y for prolonged exposures and around 20,000μSv/y for transitory exposures are not exceeded.

395. We propose to implement the changes to the limits and conditions Sellafield Ltd proposed to allow for greater flexibility in disposing of waste containing tritium at CLESA. We will do this when Sellafield Ltd has received confirmation that it does not need a Euratom Article 37 submission, or, if it does, when the Department for Energy and Industrial Strategy and Sellafield Ltd have received a positive opinion from the European Community (EC) on an Article 37 submission. These changes are highlighted in pink in the draft permit to denote that these cannot be made until this opinion has been received.

396. We considered the technical work and the overall quality of the CLESA ESC and PCRSA submission to be of a high standard and based on sound science. The clarity of the environmental and geological information was generally good, and showed a good understanding of the site and its evolution, while areas of uncertainty were identified and plans put in place to address these gaps in understanding.

397. The application to increase the specific activity of H-3 disposals included an assessment to support the revision to the ESC. The ESC and PCRSA had calculated the amount of each nuclide equivalent to the dose/risk criteria (as nuclide specific radiological capacity) and used a 'sum of fractions' approach to ensure that this was not exceeded. The supporting assessment showed that the requested H-3 limit was considerably below the calculated H-3 capacity, and that with appropriate use of the 'sum of fractions' approach it could allow an increase in the allowed disposal activity while still not challenging the dose and risk constraints imposed by the NS-GRA. It used existing information and assessments appropriately in order to make this case, and included a series of additional assessments specifically relating to increased H-3 disposal activities. The assessment also included a BAT analysis which demonstrates that increased H-3 disposals are not only possible within the constraints of the current ESC, but also that they will facilitate decommissioning activities on the site, increasing waste disposal opportunities and flexibility.

398. Overall, we are satisfied that, subject to application of item specific BAT assessments for high H-3 items, Sellafield Ltd has demonstrated that it has adequate arrangements in place to use BAT and to effectively manage radioactive waste at the CLESA disposal site with regard to meeting relevant statutory requirements and government guidance and policy. Additional recommendations arising from assessment of the proposals have been incorporated in to the CEAR, and relate to mainitaining and reviewing the CLESA closure and aftercare management plan. This should include regular updates to the ESC and PCRSA in light of any significant changes and to reflect as disposed activity.

Monitoring

Separation area ventilation (SAV) stack discharges move to standard reporting values

399. Currently, discharges that are below the limit of detection (LoD) for the analytical method used are reported at the LoD value. This means that reported discharges are higher than actual discharges

and consequently radiation doses to members of the public, calculated from these reported discharges, are higher than actual doses. To improve the consistency of discharges across the EU and to make dose assessments more realistic, required detection limits for different radionclides are defined in Annex 1 of EC recommendation on standardised information on radioactive airborne and liquid discharges (CEC, 2004). This EC recommendation is enacted in England through a Direction from BEIS (BEIS, 2018). The EC Recommendation states that the decision threshold can be taken to be half of the detection limit. In the UK, standard reporting values may be used for minor discharges (e.g. where they are routinely below the EC defined detection limits) using the environment agencies' 'Radiological monitoring technical guidance note 1: Standardised reporting of radioactive discharges from nuclear sites' (Environment Agency & SEPA 2010). The standard reporting value can be defined as half the decision threshold, where the monitored values are less than the decision threshold. Consequently, using standard reporting values may lead to a reduction in the numerical discharges. Widespread use of standard reporting values for Sellafield Ltd's gaseous discharges would reduce the gaseous discharge limits further.

400. Sellafield Ltd has proposed using standard reporting for gaseous discharges from the Separation Area Ventilation (SAV) stack.

401. We have reviewed the proposal to move to standard reporting values for gaseous total alpha and total beta emitting radionuclide discharges. There are no defined values for the detection limit for total alpha or total beta in Annex 1 of EC Basic Standards Directive (EU, 2013). We have therefore checked and confirmed that the decision thresholds (the level of discharge that equates to a dose of 0.005µSv/y if discharge was at this level for a year) have been calculated correctly and note that they have not been exceeded to date. On this basis, we accept the proposal that Sellafield Ltd moves to standard reporting values for total alpha and total beta discharges from the SAV stack when we issue a revised permit.

Check monitoring of gaseous and aqueous discharges

402. For many years, we have carried out check monitoring of the gaseous and aqueous discharges covering the most significant sources at Sellafield and other major nuclear sites in England. In line with legal requirements and international commitments, this supports independent verification that basic standards are being applied to protect people and the environment. This is specified through the permit in CEAR requirement 3.2.5(a). Sellafield Ltd has proposed some reductions to this monitoring. We have reviewed our independent check monitoring for radioactive discharges for Sellafield taking account of Sellafield Ltd's proposals, applying relevant standards to Sellafield's discharge monitoring programme, our wider nuclear sector check monitoring programme for radioactive discharges, changes at Sellafield as the site transitions from reprocessing operations to decommissioning and waste management, our decisions regarding future site limits and notification levels, and our desire for radioactive discharge monitoring to be accredited to ISO17025 and MCERTs. This has resulted in a number of changes to the check monitoring programme (appendix 5).

7. Our assessment - part 4: Assessment of doses to people and dose rates in the environment

Introduction

403. This section summarises the assessment of doses to the public and dose rates to non-human species (wildlife) from the Sellafield site. The assessments have been made by the operator of the site (Sellafield Ltd) and us. Our dose assessment has been carried out with contractor support (Environment Agency, 2019). The Food Standards Agency has also made an assessment of the impacts on the food chain. We assess doses to members of the public from discharges at the limits set out in the permit and compare them with the criteria specified in Schedule 23 part 4 section 1 of EPR 16. The current criteria are:

- the source constraint of 300µSv/y
- the site dose constraint of 500µSv/y
- the public dose limit of 1,000µSv/y

404. The assessments are of doses to people and dose rates to non-human species in the environment from past and future permitted discharges of radioactive waste into the sea and air and direct radiation. There are several part to the assessment. These are:

- doses to people and dose rates to non-human species from future permitted discharges
- doses from direct radiation emitted from the site
- total dose to the public from future discharges and from direct radiation
- doses from future discharges from the Sellafield site and other sites nearby
- doses to people from past discharges from the Sellafield site and past discharges from other sites nearby

405. The highest dose rates and highest doses to the public are expected close to the Sellafield site. The assessments also consider doses to people and dose rates to non-human species further from the site. Locations for assessment further from the site include the Isle of Man; Southern Scotland; North Wales, NW England; Northern Ireland and Republic of Southern Ireland.

Our assessment

406. We have carried out a prospective dose assessment to predict doses to people and dose rates to non-human species in the environment. The assessment uses the upper and lower site limits for gaseous and aqueous discharges and the annual plant notification levels we have decided to set in the varied permit.

407. We have assessed doses to the public from gaseous and direct radiation close to the Sellafield site and aqueous discharges to the marine environment around the Irish Sea. We calculated the dose to the representative person taking into account combinations of exposure routes. The representative person is drawn from groups living close to the site, using the environment around the site and consuming foods produced near the site. The representative person dose was previously known as the critical group dose. We have assessed the doses to people for different age groups – adults, children, infants and offspring (Environment Agency, 2019). Offspring are unborn babies (9 months) and for the first 3 months from birth. We have not presented the doses for offspring in this document, as they are similar to, or lower than, the doses for other age groups.

408. Radionuclides in the marine environment from past discharges from Sellafield are found in sediments and marine species around the Irish Sea. The assessment of doses to the public from future aqueous discharges to the marine environment takes into account the expected movement of radionuclides in the Irish Sea and build up in levels with time.

409. Radionuclides in the environment from past discharges to the air are mostly found close to the Sellafield site. Therefore, we carried out the assessment of doses to the public from gaseous discharges for the terrestrial environment in the vicinity of the site only. We also assessed doses from direct radiation in the vicinity of the site where dose rates are highest.

410. Our assessment included the potential doses from short-term releases to air based on the maximum anticipated short-term discharges from the facility in normal operation, collective doses for up to 500 years to the UK population, European population and world population and total dose to the public from all past discharges.

411. We assessed dose rates to non-human species (wildlife) near the Sellafield site from discharges at proposed limits and compared them with the appropriate dose criteria.

Our assessment - Source term

412. The source term for this assessment is derived from the upper and lower site limits for gaseous and aqueous discharges we have decided to set in the varied permit.

413. In addition to site limits, we have decided to set annual plant notification levels to regulate the discharges from specific nuclear facilities at Sellafield. For gaseous discharges, there are 12 stacks with annual plant notification levels for some radionuclides. The stacks have a range of heights and are distributed around the site. For our assessment, we grouped the stacks into 4 quadrants on the site. This allowed us to take into account the geographic spread of the stacks on the site.

414. In our assessment of gaseous discharges, we considered the relationship between the sum of the annual plant notification levels and the site limits for each radionuclide. We scaled the annual plant notification levels so that the sum of these matched the site limit. Therefore, our assessment is based on the site limits taking into account the distribution of release points and release heights on the site. We also adjusted the 'alpha emitting radionuclides associated with particulate matter' and the 'beta emitting radionuclides associated with particulate matter' limits to reduce double accounting of discharges as these categories would also include some of the individually limited radionuclides. The 'alpha emitting radionuclides associated with particulate matter' had the Am-241, Cm-242 and Pu-alpha discharge limits (annual plant notification level scaled) subtracted. The 'beta emitting radionuclides associated with particulate matter' category had the Cs-137 and Sr-90 discharge limits (annual plant notification level scaled) subtracted. The resulting atmospheric source terms for the upper and lower limits are given in our assessment of radiological impacts report (Environment Agency, 2019).

415. For aqueous discharges, we calculated the source term based on the site limits for individual radionuclide limits and an adjusted 'alpha emitting radionuclides' limit and 'beta emitting radionuclides' limit. As for gaseous discharges, we adjusted these to reduce double accounting of some of alpha emitting and beta emitting radionuclides discharge limits in the assessment. The result for the 'alpha emitting radionuclides' limit is zero. The 'beta emitting radionuclides' category had the Co-60, Ru-106, Cs-137 and Sr-90 limits subtracted. The resulting source terms for the upper and lower limit in the permit are given in our assessment of radiological impacts report (Environment Agency, 2019).

416. The assessments assumed 50 years of discharges at the permitted limits. This allowed for any build up of radionuclides in the environment.

Our assessment – Doses from gaseous discharges

417. We calculated doses from gaseous discharges at the upper and lower site limits, taking account of the annual plant notification levels that will be specified in the permit. We calculated doses at 4 locations near Sellafield. The assessments use habits profiles for adults, children and infants. We used the 2013 Sellafield habits data as 2013 was when the last full survey was carried out. A 2017 habits review focused on marine pathways, and the terrestrial related habits data were largely unchanged.

418. We carried out the assessment for 30 groups, with a range of habits. We formed the habits of people in the groups into habits profiles. The habits profiles are for groups around the site and are equivalent to candidates for the representative person. We assessed the dose for each of the

groups. The habits profile receiving the highest dose will be the representative person dose (critical group dose). The 'representative person' is the group receiving the highest dose.

419. Twenty-two of the groups we assessed were people who live near the site and consume various local foods, including milk and milk products, in different combinations, and make some use of the marine environment. These 22 groups are likely to be most exposed to gaseous discharges, with some more limited exposure to aqueous discharges. The group (habits profile) receiving the highest dose from gaseous discharges was people drinking milk.

420. Table 7.1 provides a summary of the highest doses to each age group (from upper and lower site limits) from the gaseous discharges at the most affected location. Our assessment of radiological impacts report (Environment Agency, 2019) provides breakdowns of the doses by pathway and radionuclide. The highest dose is for infants drinking milk, with a total dose of 16µSv/y. The main radionuclide contributing to the dose is I-129 at 83% from consuming cow's milk and cow's milk products.

Table 7.1: Summary of maximum terrestrial doses to the candidate representative person (2013 habit data) in the 50th year of future discharges (µSv/y)

Habits profile	Adult	Child	Infant
Upper permit limits – Milk consumers	15	14	16
Lower permit limits – Milk consumers	4.5	4.3	4.9

Our assessment – Doses from aqueous discharges

421. For aqueous discharges to the marine environment, we carried out the assessment of doses close to the site and also at other locations around the Irish Sea. The following are the locations we assessed:

- Sellafield vicinity
- North West England
- Southern Scotland
- North Wales
- Isle of Man
- Northern Ireland
- Republic of Ireland

422. We calculated doses from the aqueous discharges at the upper and lower site limits. We calculated these using appropriate habits data for adults, children and infants. Site-specific habits data provide local information on habits collected near to and around the location. At some locations, site-specific data is not available and, therefore, we used generic habits data.

423. For the marine area around Sellafield, the main habits data we used was from a survey carried out in 2013, where information was obtained for adults, children and infants. A review was carried out in 2017, which provided updated information for adults only. We have also used this data, where appropriate.

424. We used the habits data collected near Sellafield to form 30 habits profiles. The profiles represented groups of people. We calculated doses for each profile. The habits profile receiving the highest dose is the representative person. Nine of the habits profiles (out of 30) were representative of people who live near the site, spend time on the intertidal areas, consume a lot of local seafood (including fish, molluscs and crustaceans) and who also make some use of the local farmland (terrestrial environment), including eating local foods. These 9 habits profiles are likely to be most exposed to aqueous discharges and also some exposure to gaseous discharges.

425. The assessment also considered exposure of people further from the site. We used habits data for Barrow, Dumfries & Galloway and Wylfa in the assessments in North West England, Southern Scotland and North Wales, respectively. We assessed fewer habits profiles for these locations.

426. We used generic habits data for the assessments for the Isle of Man, Northern Ireland and Republic of Ireland. Generic habits data are available taken from national population surveys and can be used where site-specific data is unavailable. Use of generic habits data can lead to higher estimates of the dose than site-specific habits data. Guidance from the National Dose Assessment

Working Group (NDAWG, 2013) was used with the habits data to form the exposed groups. Table 7.2 provides a summary of the highest doses for the upper and lower site limit for the groups at each location and for each age group.

427. Our radiological impacts report (Environment Agency, 2019) provides breakdowns of the doses by pathway and radionuclide. The highest dose is for adults eating molluscs near Sellafield using 2017 habits data, with a total dose of 106µSv/y. The main radionuclides contributing to the dose are (other) beta emitting radionuclides at 27%, Co-60 at 24% and C-14 at 14% from eating crustaceans, molluscs and fish, and external dose from the beach.

Table 7.2 Summary of marine doses to the candidates for the representative person in the 50th year of future discharges (µSv/y)

Location	Habits profile or top 2 habits from generic habits data	Adult	Child	Infant
Upper permit limits				
Sellafield	Sea fish consumer (adult 2013 habit data) or Mollusc consumer (adult 2017 habit data) or Wild fruit and nut consumer (child 2013 habit data) or Crustacean consumer (infant 2013 habit data)	61 106	16	16
NW England	Mollusc consumer (adult) or Sea fish consumer (child and infant)	9.6	2.2	2.0
S Scotland	Crustacean consumer (adult and infant) Top two habits (child)	18	18	2.8
N Wales	Freshwater plant consumer (adult) or Crustacean consumer (child) or Domestic fruit consumer (infant)	0.8	0.5	0.01
Isle of Man	Top two habits	34	7.9	1.5
N Ireland	Top two habits	20	4.5	0.9
Eire	Top two habits	10	2.3	0.5
Lower permit limits				
Sellafield	Sea fish consumer (adult 2013 habit data) or Mollusc consumer (adult 2017 habit data) or Wild fruit and nut consumer (child 2013 habit data) or Crustacean consumer (infant 2013 habit data)	34 58	8.8	8.8
NW England	Mollusc consumer (adult) or Sea fish consumer (child and infant)	5.2	1.3	1.1
S Scotland	Crustacean consumer (adult and infant) or Top two habits (child)	9.9	9.2	1.7
N Wales	Freshwater plant consumer (adult) or Crustacean consumer (child) or Domestic fruit consumer (infant)	0.4	0.3	0.01
Isle of Man	Top two habits	18	4.2	0.8
N Ireland	Top two habits	11	2.4	0.5
Republic of Ireland	Top two habits	5.5	1.2	0.3

Our assessment – Doses from direct radiation

428. The Sellafield site contains sources of direct radiation. The areas most likely to be affected by direct radiation (ionising radiation emanating directly) are within 1km of the Sellafield site. We used a dose to the public of 4μSv/y (provided by ONR for 2017) for direct radiation (or direct shine) incorprated with the doses for the candidates for the representative person in the vicinity of Sellafield.

Our assessment – Total dose in Republic of Ireland, Northern Ireland, Isle of Man, Scotland, Wales and North West England

429. The highest total doses to the public in Republic of Ireland, Northern Ireland, Isle of Man, Scotland, Wales and North West England are from discharges of aqueous radioactive waste to the marine environment. Gaseous discharges do not contribute to the doses in these areas, because levels in the air fall significantly with increasing distance from the release point. The results in table 7.2 (summary of marine doses) are equivalent to the total dose from discharges from the Sellafield site. For discharges based on the upper site limit, the doses range from 0.01μSv/y to 34μSv/y.

Our assessment – Doses from short duration discharges to air

430. We made our assessment of doses from short duration gaseous discharges to air where there was evidence that the discharges showed significant variation with time and an enhanced proportion of the discharge could occur within a 24 hour period. If an enhanced proportion of the discharge, from some plants on site, occurs over a short period of time during the active growing season, this may lead to greater uptake into the foodchain. The discharges used in the assessment were calculated from the ratio of montly data to annual data and assumed to be released over 6 hours and that all the short duration releases occurred in the same time period. A summary of the doses from enhanced short duration gaseous discharges to air are shown in table 7.3. Our radiological impacts report (Environment Agency, 2019) provides breakdowns of the doses by stack and radionuclide for the assessed short duration releases.

Table 7.3 Summary of doses to the candidate representative person from short duration discharges (2013 habit data) (μSv)

Upper or lower permit limits	Adult	Child	Infant
Upper permit limits	13	9.3	8.1
Lower permit limits	1.9	0.9	1.3

Our assessment – doses from continuous and short duration gaseous discharges

431. The doses from short term releases to air from continuous discharges and from short duration releases can be combined because the basis of the assessments are similar. The highest doses from continuous releases at upper permit limits are 15μSv/y to an adult, 14μSv/y to a child and 16μSv/y to an infant. The combined doses from continuous and short term discharges at the upper permit limits are 28μSv/y to an adult, 23μSv/y to a child and 24μSv/y to an infant. At the lower permit limits, doses are 6.4μSv/y, 5.2μSv/y and 6.2μSv/y and to an adult, child and an infant respectively.

432. Doses from aqueous discharges are higher than from gaseous discharges therefore the representative person will be exposed mostly to aqueous discharges in the marine environment.

Our assessment – Representative person

433. The representative person (candidate representative person with the highest dose) for the Sellafield site for future expected discharges is an adult from an exposed group that lives close to the site and consumes higher than average amounts of shellfish (mollusc) taken from the marine environment close to the Sellafield site. The representative person consumes other seafood at lower rates and eats some farmed foods produced on farmland (terrestrial environment) around the site. We took the representative person's habits from habits survey data. Table 7.4 shows all the contributions to the representative person's dose. The habits profiles are derived from the person eating sea fish for 2013 habits and the person eating shellfish using 2017 habit review data.

Table 7.4 Annual dose to the adult representative person in the 50th year of future discharges using the 2013 and 2017 habits survey data and direct radiation, compared with the dose constraints (µSv/y)

Habits profile	Doses from future discharges			Site dose constraint	Dose from direct radia-tion[c]	Total dose (Aerial + Aqueous + Direct)	Source dose constraint
	Aerial[a]	Aqueous[b]	Total				
Upper permit limits							
Sea fish consumer (2013 habit data)	1.8	61	63	500	4	67	300
Mollusc consumer (2017 habit data)	1.7	106	108	500	4	112	300
Lower permit limits							
Sea fish consumer (2013 habit data)	0.7	34	35	500	4	39	300
Mollusc consumer (2017 habit data)	0.6	58	59	500	4	63	300

[a] Doses from farmed foods and from the plume

[b] Doses from the marine environment

[c] Direct radiation dose has been assumed to be the same for all the assessments of representative person dose.

Our assessment – Doses from past and other discharges

434. Past aqueous discharges from the Sellafield site have resulted in enhanced levels of radionuclides in the Irish sea. Also past gaseous discharges have resulted in enhanced radionuclide levels on farmland close to the site. We monitor the environment and report the results in the Radioactivity In Food and the Environment report series (RIFE) (Environment Agency and others, 2018). We assess the doses to the public from past discharges (retrospective assessment) using the monitoring results and report these annually in the RIFE report.

435. The highest doses that arose from radionuclides in the marine environment were to an adult eating molluscs between 2014 and 2017. In this time period, doses ranged from 220 to 420µSv/y. Past discharges from Sellafield contributed between 70 and 78µSv/y to these doses. The remainder of the dose was between 150 and 340µSv/y, which was mostly due to Po-210 in crabs and molluscs from past discharges from a phosphate works on the coast near Sellafield. In 2013, the highest dose was 76µSv/y to a different representative person - houseboat dwellers near Barrow-in-Furness some distance from Sellafield (from RIFE). In 2013 near Sellafield the highest dose was 61µSv/y to sea fish consumers. In 2013, the residual Po-210 levels in the environment from the phosphate works were low and contributed 21µSv/y to sea fish consumer; and past discharges from the Sellafield site contributed 40µSv/y to sea fish consumer.

436. The doses from future discharges from other operations, near a facility being assessed, need to be included in the total dose assessment. The phosphate works is now closed and, therefore, there are no on-going discharges to contribute to future doses.

437. The highest doses from past gaseous discharges were to local inhabitants and ranged from 8 to 12µSv/y between 2013 and 2017 (from RIFE).

Our assessment – Total dose from past and future discharges

438. The habits data and profiles are the same for the assessment of future discharges (prospective) and the past assessments of discharges (retrospective) for 2013 to 2017 (from RIFE). The representative person for future discharges and past discharges between 2014 and 2017 is adult consuming molluscs, whilst in 2013 it was sea fish consumers. The range of doses from past discharges between 2013 and 2017 are shown and have been combined with the modelled doses from future discharges. The combined dose provides a reasonable indication of the upper estimate of total dose. A cautious assumption in this assessment is that the doses from past discharges in 2013 to 2017 will be maintained for 50 years.

439. A summary of total dose from past and future discharges from Sellafield and past discharges from the now closed phosphate works are summarised in table 7.5. The habits profiles used to establish the representative person doses sea fish consumers (from the 2013 habits review) and mollusc eaters (from the 2017 habits review). All the doses are below the dose limit for members of the public of 1,000µSv/y.

Table 7.5 Representative person (adult) dose from future discharges and direct radiation from Sellafield and past discharges from Sellafield and phosphate works compared with dose limit for the public (µSv/y)

Habits profile	Doses from past discharges[1] from		All doses from past discharges	Total dose from future discharges and direct radiation	Dose from future discharges, direct radiation and past discharges	
	Sellafield	Phosphate works			Total	Dose limit
Upper permit limits						
Sea fish consumer (2013 habit data)	40[a]	21[a]	61[a]	67	130	1,000
Mollusc consumer (2017 habit data)	70 to 78[b]	150 to 340[b]	220 to 420[b]	112	330-530	1,000
Lower permit limits						
Sea fish consumer (2013 habit data)	40[a]	21[a]	61[a]	39	100	1,000
Mollusc consumer (2017 habit data)	70 to 78[b]	150 to 340[b]	220 to 420[b]	63	280-480	1,000

[a] Doses from past discharges from 2013.

[b] Doses from past discharges from 2014 to 2017.

Our assessment – Collective doses

440. We assessed collective doses (for up to 500 years) and doses per person for the upper and lower site limits for gaseous and aqueous discharges. These are presented in tables 7.6 and 7.7.

Table 7.6 Collective dose (manSv/y of discharge) for up to 500 years to UK, European and world populations

Upper or lower permit limits	UK	European	World
Upper permit limits gaseous	0.2	1.2	39
Upper permit limits aqueous	8.0	25	169
Lower permit limits gaseous	0.04	0.2	6.8
Lower permit limits aqueous	3.2	9.8	67

Table 7.7 Dose per person (nSv/y of discharge) to UK, European and world populations derived from collective doses for up to 500 years

Upper or lower permit limits	UK	European	World
Upper permit limits gaseous	3.6	18	5.0
Upper permit limits aqueous	122	69	22
Lower permit limits gaseous	0.6	3.3	0.9
Lower permit limits aqueous	48	27	8.7

441. The highest collective dose (for up to 500 years) from one year's gaseous discharges is 39manSv/y to the world population (table 7.6). This is mostly from carbon-14 gaseous discharges at the upper site limit. From discharges at the lower site limits, the collective dose is 6.8manSv/y of discharge. The reduction in collective dose between upper and lower limits is mainly due to the reduced value of the C-14 lower site limit. Collective dose from aqueous discharges at the upper site limits is 169manSv/y, also mostly arising from C-14 discharges at the upper site limit. At the lower site limit, the collective dose is 67manSv/y. The reduction in collective dose between upper and lower site limits is also due to the reduced value of the C-14 lower site limit.

442. Per person doses can be derived from collective doses (for up to 500 years) and used to represent average annual individual doses, as shown in table 7.7. Using collective doses for up to 500 years is cautious and is unlikely to lead to an underestimate of the average dose. The average annual doses range from 0.6nSv to 122nSv per year of discharge. The highest average doses are to the UK population from aqueous discharges at the upper permit limit. The lowest average doses are to the UK population from gaseous discharges at the lower permit limit. Average individual doses for a population group in the nanosievert range or below can be ignored when making decisions (Environment Agency and others, 2012). The associated risks are minuscule and the contribution to total doses to individuals will be insignificant. Annual doses, up to a few microsievert, can be considered trivial but may require some consideration, particularly at the higher end of the range.

Our assessment – Dose rates to non-human species

443. We have considered the radiological impact of the discharges on the environment. We have also considered the impact in relation to our duties under various statutory provisions as set out below in table 7.8. We call these 'conservation duties'.

Table 7.8 Summary of conservation duties

Provision	Duty
Section 6(1)(a) and (b) of the Environment Act 1995 (EA 95) (GB Parliament, 1995)	We must, to such extent as we consider desirable, generally promote: • the conservation and enhancement of the natural beauty and amenity of inland and coastal waters and of land associated with such waters • the conservation of flora and fauna which are dependent on an aquatic environment
Section 7(1)(b) of EA 95	We must have regard to the desirability of conserving flora, fauna and geological or physiographical features of special interest.
Section 7(1)c(ii) of EA 95	We must take account of the effect any proposal would have on any flora, fauna, features or sites.
Section 8(3) of EA 95	We take account of any notification and/or consultation responses received under section 8(3) of EA 95 (relating to sites of special interest and national parks).
Section 9 of EA 95	In discharging our duties under section 6(1), 7 or 8 of EA 95, we must have regard to any code of practice approved under section 9.
The Conservation of Habitats and Species Regulations 2010 (GB Parliament, 2010a)	Before deciding to give a permit which: 6. (a) is likely to have significant effect on a European site or a European offshore marine site (either alone or in combinations with other plans or projects), and 7. (b) is not directly connected with or necessary to the management of that site

Provision	Duty
	we must make an appropriate assessment of the implications for that site in view of that site's conservation objectives. And we must consult Natural England if there is a significant effect.
Section 28G of the Wildlife and Countryside Act 1981 (GB Parliament, 1981)	We must take reasonable steps, consistent with the proper exercise of our functions, to further the conservation and enhancement of the flora, fauna, or geological or physiographical features, by reason of which a site of special scientific interest (SSSI) is of special interest.
Section 28I of the Wildlife and Countryside Act 1981	We must consult Natural England before permitting any operation which is likely to damage any flora, fauna or geological or physiographical features by reason of which a SSSI is of special interest.
Section 85 of the Countryside and Rights of Way Act 2000 (GB Parliament 2000)	In exercising or performing any functions in relation to, or so as to affect, land in an area of outstanding natural beauty (AONB), we must have regard to the purpose of conserving and enhancing the natural beauty of the AONB.
Section 11A of the National Parks and Access to the Countryside Act 1949 (GB Parliament, 1949)	In exercising or performing any functions in relation to, or so as to affect, land in a National Park, we must have regard to the purposes of conserving and enhancing the natural beauty, wildlife and cultural heritage of the national park and of promoting opportunities for the understanding and enjoyment of its special qualities by the public.
Section 40 of the Natural Environment and Rural Communities Act 2006 (GB Parliament, 2006)	We must have regard to the purpose of conserving biodiversity when deciding whether to grant an authorisation (and what conditions to impose). Conserving biodiversity includes, in relation to a living organism or type of habitat, restoring or enhancing a population or habitat.
Sections 58, 125 and 126 of the Marine and Coastal Access Act 2009 (GB Parliament, 2009c)	Any authorisation decision we take must be in accordance with the appropriate marine policy document, unless relevant considerations indicate otherwise. Where capable of affecting (other than insignificantly) the protected features (or supporting processes) of a Marine Conservation Zone (MCZ), we must exercise our functions in a manner which we consider best furthers the conservation objectives stated for that MCZ, or, where this is not possible, in a manner which least hinders the achievement of those objectives. We must be satisfied that there is no significant risk of hindering the achievement of the conservation objectives stated for the MCZ.
Regulation 9 of the Marine Strategy Regulations 2010 (GB Parliament, 2010b)	We must have regard to the marine strategy (in so far as it has been developed and published to date).

444. The European research project, 'Framework for assessment of environmental impact' (FASSET) (Larsson and others, 2004), concluded that the threshold for statistically significant effects on organisms is about 100µGy/h. Allowing for the dose rate from natural background, which is at most about 60µGy/h (Brown and others, 2004), we have adopted a value of 40µGy/h as the level below which we consider there will be no adverse effect on non-human (wildlife) species. This dose criterion applies to all radiological discharges affecting a protected site.

445. We have considered the potential effects of discharges of radioactive waste from the Sellafield site on plant and animal life at:

- the relevant 'European sites' (special protection areas (SPAs) for birds, and special areas of conservation (SACs) for other species and for habitats) designated under the Conservation of Habitats and Species Regulations 2010, which implement the Habitats and Birds Directives
- the relevant Marine Conservation Zones (MCZs)

446. We assessed dose rates (µGy/h) to non-human species in the freshwater environment for locations on the Drigg coast Special Area of Conservation (SAC) and the River Ehen SAC using the Environmental Risk from Ionising Contaminants: Assessment and Management (ERICA) tool

(Brown and others, 2008; Brown and others, 2016). The results are based on the upper and lower site limits in the permit and are shown in table 7.9.

447. We assessed dose rates (µGy/h) for marine life for the 7 marine assessments considered for the human dose assessment derived for the upper and lower site limits. Each assessment used the average water activity concentration predicted for the relevant Irish Sea compartment. The locations do not match precisely with specific protected areas, but give an indication of the likely dose rates to non-human species that might be present at these 7 marine locations. The marine environment adjacent to Sellafield is part of the Cumbria Coast Zone 1 marine conservation zone. The results are shown in table 7.10.

448. We assessed dose rates (µGy/h) to non-human species on farmland (terrestrial environment) for Special Areas of Conservation (SAC) and SSSIs in the area. The assessed locations and results for the upper and lower site limits are shown in table 7.11.

449. None of the assessed dose rates for non-human species exceed the 40µGy/h dose rate threshold below which the Environment Agency and Natural England have agreed there would be no adverse effect to the integrity of a Natura 2000 site. We, therefore, consider that the discharges of radioactive waste into the environment at the proposed site limits, together with other relevant authorised discharges, would not:

- adversely affect the integrity of the European sites
- significantly affect the protected features of, or prevent conservation objectives being achieved for, the MCZs

Table 7.9 Summary of assessed non-human dose rates to most affected species in the freshwater environment (µGy/h)

Location	Species receiving highest dose	Upper permit limits	Lower permit limits
River Ehen SAC	Insect larvae	3.3	0.6
Ponds on Drigg coast SAC	Insect larvae	8.1	1.5

Table 7.10 Summary of assessed non-human dose rates to most affected species in the marine environment (µGy/h)

Location	Species receiving highest dose	Upper permit limits	Lower permit limits
Sellafield	Phytoplankton[a]	30	18
NW England	Phytoplankton	0.1	0.1
S Scotland	Phytoplankton	1.0	1.0
N Wales	Phytoplankton	0.01	0.01
Isle of Man	Phytoplankton	0.3	0.2
N Ireland	Phytoplankton	0.1	0.1
Republic of Ireland	Phytoplankton	0.1	0.03

[a] Microscopic plant life

Table 7.11 Summary of assessed non-human dose rates to most affected species in the terrestrial environment (µGy/h)

Location	Species receiving highest dose	Upper permit limits	Lower permit limits
Low Church Moss SSSI	Shrub Mammal - large	14	 0.001
River Ehen SAC	Shrub Mammal - large	3.0	 0.0008
Ponds on Drigg Coast SAC	Shrub Mammal - large	6.0	 0.001
Drigg Coast SAC	Shrub Mammal - large	5.3	 0.0005

Operator's dose assessment

450. Sellafield Ltd carried out a dose assessment to marine and terrestrial representative persons at the proposed upper and lower site limits using long-term aerial dose release ratios (LADRR) and marine dose release ratios (MDRR). The gaseous discharge ratios are derived taking into account effective stack heights for a critical group (analogous to the representative person as used in our assessment) assumed to be located 900m away from site. The aqueous discharge ratios apply to measures associated with discharges from the sea pipeline. These factors are then multipled by the individual radionuclide discharges, which added together give the total dose.

451. For gaseous discharges, site limits were not directly used, due to releases being from different stacks or with different physical properties. Consequently, the discharges at the annual plant notification levels for the contributing stacks were used to determine doses for each stack. These doses were then added together to give the total dose impact of the site. Individual radionuclides and 'alpha emitting radionuclides associated with particulate matter' and 'beta emitting radionuclides associated with particulate matter' limits were used in the assessment, as the over prediction was assessed as being small (around 5%).

452. For aqueous discharges, adjustments were made to the source term to take into account the 'alpha emitting radionuclides' and 'beta emitting radionuclide' limits. To avoid double counting of 'beta emitting radionuclides', the discharges of specific beta emitting radionuclides were subtracted from the 'beta emitting radionuclide' limit. However, as the sum of the limits for individually named alpha emitters was greater than the 'alpha emitting radionuclide' limit, the site discharge limit for 'alpha emitting radionuclides' would be the most restrictive and, therefore, only the 'alpha emitting radionuclides' limit was assessed.

453. The results of the Sellafield Ltd assessment are presented in tables 7.12 and 7.13.

Table 7.12 Summary of doses predicted by Sellafield Ltd from gaseous discharges (µSv/y)

Age group	Cumulative proposed notification levels
Adult (max)	5.9
Child (max)	5.1
Infant (max)	5.8

Table 7.13 Summary of doses predicted by Sellafield Ltd from aqueous discharges (µSv/y)

Age group	Upper limit	Lower limit
Adult (max)	132	67

Comparison of our assessment with operator's assessment

454. The results of our assessment and Sellafield Ltd's assessment for gaseous discharges are summarised in table 7.14.

Table 7.14 Comparison of doses predicted by Sellafield Ltd and our assessment from gaseous discharges (µSv/y)

Assessment	Upper limit – Adult	Upper limit – Child	Upper limit - Infant
Sellafield assessment	5.9	5.1	5.8
Our assessment	15	14	16

455. The doses from gaseous discharges in the Sellafield Ltd and our assessments are very similar. Both assessments show that the doses at the upper permit limits are low. Our assessment is higher at 14 to 16µSv/y. The highest contribution to the doses is from iodine-129 in milk and milk products assumed to be produced locally around the site. Sellafield Ltd's assessment is lower at 5 to 6µSv/y.

456. The results of our assessment (using the 2013 and 2017 habits data) and Sellafield Ltd's assessment for aqueous discharges are summarised in table 7.15.

Table 7.15 Comparison of doses predicted by Sellafield and our assessment from aqueous discharges (µSv/y)

Assessments	Upper limit - Adult	Lower limit - Adult
Sellafield Ltd assessment - Maximum	132	67
Our assessment - Sea fish consumer (2013 habit data)	61	34
Our assessment - Mollusc consumer (2017 habit data)	106	58

457. The doses from aqueous discharges in the Sellafield Ltd and our assessments are also similar. Both assessments show that doses are between 106 and 132µSv/y for the upper limit and 58 and 67 for the lower limit.

Comparison of Food Standard's Agency assessment with our assessment

458. The Food Standards Agency (FSA) has assessed the impact of discharges made using discharges at the revised permit limits on the foodchain (Food Standards Agency, 2019). The assessment is presented in terms of doses to the public from eating foods grown around the site and fished from the marine environment. The results of the FSA assessment are summarised in table 7.16.

Table 7.16 Summary of the doses predicted by the Food Standards Agency assessment compared with doses predicted by our assessment for future gaseous and aqueous discharges at upper and lower permit limits (µSv/y)

Assessments	Upper limit - Adult	Lower limit - Adult
Food Standards Agency assessment - Crustacean consumer	114-166	68-87
Our assessment - Mollusc consumer (2017 habit data)	108	59

Note – doses from short duration releases are not included.

459. In the FSA assessment, crustacean, fish and mollusc consumption and external gamma doses from time over sediments contributed 13%, 13%, 35% and 39% respectively to the estimated dose. The predominant radionuclides (that is contributing 10% or more to total dose) were Co-60, Ru-106, Cs-137 and Pu-239, contributing approximately 27%, 10%, 29% and 11% respectively to the estimated dose.

460. In our assessment the results were slightly lower. The majority of the dose for the upper limit (108µSv/y) was from aqueous discharges. The main radionuclides contributing to the dose are 'other beta emitting radionuclides' at 27%, Co-60 at 24% and C-14 at 14% from eating crustaceans, molluscs and fish, and external dose from the beach.

461. The main differences between our assessment and the FSA's assessment is that ours uses concentration factors (between seawater and fish and shellfish for several radionuclides, including C-14), which were derived from environmental measurements in the Irish Sea, while the FSA used concentration factors published by the IAEA, which were higher for C-14. Therefore, in the FSA assessment, C-14 was more important to doses by a factor of 4 than in our assessment.

Comparison with constraints and limits

462. The results of our assessment are discussed above and summarised in tables 7.1 and 7.2 and have been compared with dose constraints and limits (table 7.4 and table 7.5).

Comparison of doses with the source constraint

463. EPR 16 specifies a dose constraint of 300µSv/y for the maximum dose to people due to discharges from a single new source. While this constraint applies specifically to 'new' sources, we generally also apply it to existing sources. For this case, the source is defined as 'the entire Sellafield site'. The dose to be compared to this constraint should include the dose from current or proposed discharges and direct radiation, but exclude the dose from historical discharges and from any adjacent site.

464. The doses that should be compared to the source constraint are the sums of doses from discharges and direct radiation to the representative person of 112 and 63µSv/y (2017 habits data) for discharges at the upper and lower site limits respectively, and both are less than the source dose constraint.

Comparison of doses with the site dose constraint

465. EPR 16 also specifies a dose constraint of 500µSv/y for the maximum dose to people due to discharges from a site as a whole. The dose to be compared to this constraint is the dose from current discharges, including discharges made by adjacent sites. There used to be a phosphate works adjacent to the Sellafield site, but this is now closed, so there will be no future discharges to contribute to the site constraint. Doses arising from direct radiation and from historical discharges are excluded.

466. Taking into account all the discharges from the Sellafield site, the doses are 108 and 59µSv/y for discharges at the upper and lower site limits respectively. Both are less than the site dose constraint.

Comparison with the dose limit for members of the public

467. Under EPR 16, we must make sure that doses to members of the public from exposure to ionising radiation do not exceed 1,000µSv/y. The total dose to members of the public (representative person) near the site takes into account doses arising from:

- future discharges
- future direct radiation from the site
- future discharges from other sites in the vicinity of the site (none as phosphate works now closed)
- direct radiation from other nuclear sites in the vicinity of the site (none)
- the residue of radioactivity in the environment from past discharges (including those from the phosphate works)

468. The total doses from future discharges are 108 and 59µSv/y (2017 habits data) for the upper and lower site limits respectively. Total doses from past and future discharges and direct radiation were between 130 and 530µSv/y for upper permit limits and between 100 and 480µSv/y for the lower permit limits. All are below the dose limit for members of the public of 1,000µSv/y.

Comparison with the dose from the existing permit site limits

469. We previously calculated the total dose to the representative person for the existing site limits using our old methods. Adopting the new approach may result in different doses for current limits. Firstly, because the new approach does not include radionuclides that are proposed to be removed in the new permit. These radionuclides would be assessed through a generic radionuclide category (either other alpha or other beta), which is a more cautious assessment. Secondly, modelling assumptions for the marine assessment have been updated and thirdly, the new version of PC-CREAM has been adopted.

470. The total doses from future discharges and direct radiation are 112 and 63µSv/y (2017 habits data) for the upper and lower site limits respectively. Both are considerably lower than the doses at the existing permit site limits of 203µSv/y (Environment Agency, 2015b).

Conclusion

471. Overall, we are satisfied that:

- the doses to the public from the future permitted discharges from the Sellafield site will be below the dose criteria specified in Schedule 23 part 4 section 1 of EPR 16.
- the total doses from future permitted discharges, direct radiation, future short term discharges and from past discharges from the Sellafield site and from past discharges from the now closed phosphate works near Sellafield are well below the dose limit for the public.

- the dose rates to non-human species (wildlife) from the future permitted discharges from the Sellafield site will be below the threshold at which the Environment Agency and Natural England have agreed there would be no adverse effect to the integrity of a Natura 2000 site.

8. Our assessment - part 5: Non-radiological issues

General

472. Some environmental legislation that normally applies to waste or emissions does not apply when the waste is radioactive waste. We have, therefore, included a standard condition in our permits (condition 2.3.7) requiring the operator to minimise the risk of pollution from the non-radiological properties of the radioactive waste and from any non-radioactive substances associated with the disposal of the radioactive waste, to the extent that this is not addressed by other environmental permits.

473. Condition 2.3.7 reflects the duty given to us by government to consider the non-radioactive hazards associated with radioactive waste in the course of our regulation. This is not a new duty, but it is now considered preferable and more transparent to explicitly require operators to ensure operating techniques consider non-radioactive hazards. This is particularly important where, were it not for the presence of radioactivity, the process would be subject to other pollution control requirements. Clause (c) in the new condition 1.1.4 similarly reflects the obligations placed on us by the government guidance.

474. Environmental permits are in place for water discharge activities. These cover discharges from the water treatment system at Brow Top, the Wastwater pump house and major construction projects. Permits are also in place for operation of an installation. These cover the following activities listed in Schedule 1 of the EPR 16 - section 1.1 A (1) (a) - Burning any fuel in an appliance with a rated thermal input of 50 megawatts or more, section 4.2 A(1) (f) - Unless falling within any other section, any activity (other than the combustion or incineration of carbonaceous material as defined in the Interpretation of part A(1) of section 1.2), which is likely to result in the release into the air of any acid-forming oxide of nitrogen, section 3.1 B (b) - Blending cement in bulk or using cement in bulk other than at a construction site, including the bagging of cement and cement mixtures, the batching of ready-mixed concrete and the manufacture of concrete blocks and other cement products, and directly associated activities. The impacts of the significant non-radiological properties and content of the discharges have been assessed when determining those permits and will be controlled through them.

Other statutory considerations

EA 95, section 4: Principal aim of the Environment Agency ('sustainable development')

475. We are required to contribute towards achieving sustainable development, as considered appropriate by the ministers and set out in guidance issued to us. 'The Environment Agency's Objectives and Contribution to Sustainable Development: Statutory Guidance' (Defra, 2002) provides guidance to us on matters such as developing approaches that we should take to our work, decisions about our priorities and our allocation of resources. It does not directly apply to our individual regulatory decisions.

476. The statutory guidance states that our main contribution to sustainable development will be to meet our various objectives in a way that takes account (subject to and in accordance with EA 95 and any other enactment) of economic and social considerations. In respect of radioactive substances regulation, the guidance refers to the objective of regulating gaseous and aqueous radioactive discharges and solid radioactive waste disposal in accordance with statutory duties, statutory guidance and UK government policy.

477. We consider that the overall approach described in this document and, in particular, the application of BAT, which takes into consideration social and economic factors, and the assessment of the impact of the discharges on members of the public and environment, contribute appropriately to the aim of achieving sustainable development, having regard to the statutory guidance.

EA 95, section 5: Pollution control powers

478. Section 5 of EA 95 sets out the purpose for which our pollution control powers, including our powers under EPR 16, must be used. This is for 'preventing or minimising, or remedying or mitigating the effects of, pollution of the environment'. We consider that we have properly used our pollution control powers for that purpose, in that:

- we have set limits and conditions based on BAT, as specified in the statutory guidance, and having regard to government policy
- the impact of the permitted discharges on members of the public is as low as reasonably achievable (ALARA)
- the environment is protected.

EA95, section 7(1)(c)(ii): Amenity

479. Under section 7(1)(c)(ii) of EA 95, we must take into account any effect which our proposals may have on the amenity of any rural or urban area.

480. We are satisfied that our decision to permit the disposal of radioactive waste, in accordance with legal and policy requirements, will not lead to any harmful effects on local amenities.

EA 95, section 7(1)(c)(iii): Well-being of local communities

481. Under section 7(1)(c)(iii) of EA 95, we must have regard to the effect our proposals may have on the economic and social well-being of local communities in rural areas.

482. We have had regard, as appropriate, to the potential effect on the economic and social well-being of the local community as part of:

- our assessment of Sellafield Ltd's proposals in relation to using BAT, which involves considering costs and benefits
- our considerations in relation to the principal aim of the Environment Agency (sustainable development)
- our assessment of the impact of disposals.

483. We do not consider that any additional or different limits or conditions are required, in relation to this duty.

EA 95, section 39: Likely costs and benefits

484. We have a duty to take into account the likely costs and benefits of whether and how we exercise our powers ('costs' being defined as including costs to the environment as well as to any person). This duty, however, does not affect our obligation to discharge any duties imposed upon us in other legislative provisions.

485. We have taken into account the likely costs and benefits in our assessment of BAT. We are satisfied that the conditions in the permit are proportionate.

Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and Groundwater Directive (schedule 22 to EPR 16)

486. Under the Water Environment (Water Framework Directive) Regulations (GB Parliament, 2017a), we must exercise our functions to secure compliance with the Water Framework Directive (Directive 2000/60/EC), which seeks to protect ground and surface water on an integrated river basin management basis, and the Environmental Quality Standards Directive (Directive 2008/105/EC). We have considered Sellafield Ltd's proposals in relation to using BAT to minimise discharges of radioactivity to the environment and the impact of these discharges on members of the public and the environment. As stated earlier, we consider that Sellafield Ltd's proposals and the permit conditions represent the use of BAT to reduce the impact to ALARA. We are, therefore, satisfied that the conditions are sufficient in relation to these regulations, and that granting the permit with the conditions proposed will not cause the current status of the water body (that is, the coastal waters close to the Sellafield site) to deteriorate.

487. Schedule 22 of EPR 16 implements the Groundwater Directive (Directive 2006/118/EC) to require all necessary measures to be taken to prevent any hazardous substances, which includes radioactive substances, entering groundwater, and to limit non-hazardous pollutants entering

groundwater, so they do not cause pollution. No releases to groundwater from the radioactive substances activities are permitted by the permit.

Human Rights Act 1998

488. We have considered potential interference with rights addressed by the European Convention on Human Rights in reaching our decision. We consider that our decision is compatible with our duties under the Human Rights Act 1998 (GB Parliament, 1998). In particular, we have considered the right to life (Article 2), the right to a fair trial (Article 6) (which here includes the right to a reasoned decision - as provided in this document), the right to respect for private and family life (Article 8) and the right to protection of property (Article 1, First Protocol).

Public participation and duty to involve

489. Regulation 60 of EPR 16 requires us to prepare and publish a statement of our policies for complying with our public participation duties. We have published our document, 'Working together: your role in our environmental permitting' (Environment Agency, 2010a) and we have followed this when consulting on this application. This satisfies the requirements of the Public Participation Directive.

490. Section 23 of the Local Democracy, Economic Development and Construction Act 2009 (GB Parliament, 2009d) requires us, where we consider it appropriate, to involve interested persons in carrying out our work by providing them with information, consulting them or involving them in any other way.

491. We have described our consultation in relation to this application in chapter 3 of this document. We have described the way in which we have taken account of representations we have received in chapters 4 to 8 and appendix 2.

Deregulation Act 2015 - Growth duty

492. We considered our duty to promote economic growth set out in section 108(1) of the Deregulation Act 2015 (GB Parliament, 2015b) and the guidance issued under section 110 of that Act in deciding whether to grant this permit.

493. Paragraph 1.3 of the guidance says:

‘The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation.’

494. We have addressed the legislative requirements and environmental standards to be met in chapters 4 to 8 of this document. Paragraph 1.5 of the guidance is clear that encouraging economic growth should not be pursued at the expense of protecting the environment.

495. We consider that the requirements and standards we have set in this permit are reasonable and necessary to protect the environment and people. This also promotes growth among legitimate operators because the standards applied to the operator are consistent across businesses in this sector and have been set to achieve the required legislative standards.

Other considerations

EU directive on safe management of spent fuel and radioactive waste

496. The 'Safe management of spent fuel and radioactive waste directive' (EU, 2011) is intended to:

- establish a Community framework for ensuring responsible and safe management of spent fuel and radioactive waste to avoid imposing undue burdens on future generations
- ensure member states have national arrangements for a high level of safety in spent fuel and radioactive waste management to protect workers and the general public against the dangers arising from ionising radiation
- ensure the provision of necessary public information and participation in relation to spent fuel and radioactive waste management while having due regard to security and proprietary information issues.

497. It applies to spent fuel and radioactive waste from civilian activities, but does not apply to 'authorised releases', that is, permitted discharges, as these are covered by the Basic safety standards directive BSSD. It is similar to the International Atomic Energy Agency (IAEA) 'Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management'.

498. Our responsibilities under EPR 16 relate to limited aspects of the directive. Other regulators, such as the Office for Nuclear Regulation and the government are responsible for other parts of the directive. We consider that we are meeting the relevant principles and obligations of the directive. We provide national reports on the implementation of the directive to the EU Commission.

EU directive on nuclear safety

499. The objectives of the 'Nuclear safety directive' (EU, 2009) are to:

- establish a Community framework in order to maintain and promote the continuous improvement of nuclear safety and its regulation
- ensure member states have national arrangements for a high level of nuclear safety to protect workers and the general public against the dangers arising from ionising radiations from nuclear installations.

500. It applies to any civilian nuclear installation subject to a licence. It is similar to the IAEA 'Convention on Nuclear Safety', although this applies only to nuclear reactors.

501. Our responsibilities under EPR 16 related to limited aspects of the directive. Other regulators, such as ONR and the government are responsible for other parts of the directive. We consider that we are meeting the relevant obligations of the directive.

Other matters

502. Matters such as nuclear safety, the location of the facility, traffic movements and flood risk are generally dealt with under other regimes and/or by other bodies and not as part of our radioactive substances regulation permitting role. Where consultees have raised issues relating to these matters, we provide more information at the end of appendix 2.

9. Our decision

503. Our decision is that we should grant the application and issue a variation notice. A variation notice and consolidated permit, containing appropriate conditions, accompanies this document.

504. The requirements for improvements and information can be found in the permit and its associated Compilation of Environment Agency Requirements, Approvals and Specifications (CEAR) document. The conditions of the permit are legally binding on Sellafield Ltd. The CEAR is used to specify the detailed requirements of the permit conditions so that they are fully complied with. The CEAR is not legally binding in itself and we are not formally consulting on the details that it contains. We refer to the CEAR in the decision document where we think this is helpful and have highlighted key proposed changes to it in appendix 5. We will work closely with Sellafield Ltd to ensure that the CEAR is fully implemented, once our final decision on the application is made. Key improvements in the permit and the CEAR include:

- developing and maintaining a waste management plan and a site wide environmental safety case
- progress reports relating to improvements in Sellafield Ltd's asset management arrangements generally and, in particular, managing ventilation ducting
- an assessment of future aqueous discharges of cobalt-60 from legacy waste
- maintaining and reviewing the CLESA closure and aftercare management plan
- progress reports on higher activity waste records restoration work
- some changes to, remove and consolidate existing requirements relating to approved gaseous waste discharge outlets, discharge and waste reporting, discharge check monitoring and providing other information.

505. We have also made some changes to implement the Basic Safety Standards Directive 2013/59/Euratom and other minor updates.

506. We have decided that we could permit an increase in the tritium limit for disposals in CLESA landfill to an average consignment limit of 12,000Bq/g. This increase would mean decommissioning could progress more quickly. We plan to implement the changes to the limits and conditions Sellafield Ltd proposed to allow greater flexibility in the disposal of waste containing tritium at CLESA once Sellafield Ltd has received confirmation that it is not required to make a Euratom Article 37 submission, or, if it is, that the Department for Business Energy and Industrial Strategy (BEIS) and Sellafield Ltd have received a positive opinion that the discharges will not affect Member States from the EC on an Article 37 submission.

Conditions of permit

507. The permit is based on our standard template permit for radioactive substances activities carried out on a nuclear site. We have developed the standard template over a number of years. We regularly review it to make sure that it is up to date and effective, that permits for specific sites properly protect people and the environment, and that they are consistent with the relevant government policies. The permit template and its conditions are described more fully in the document '[How to comply with your environmental permit for radioactive substances on a nuclear licensed site]'.

508. The standard permit template consists mainly of:

- an introductory note (this is not part of the permit)
- a certificate page, granting the permit
- parts 1 to 4, being standard conditions about management, operations, disposals and monitoring, and providing information
- schedule 1, defining the activities permitted
- schedule 3, specifying routes for, and limits on, disposals
- schedule 7, being a site plan showing the geographical extent of the regulated facility.

509. The conditions in parts 1 to 4 of the proposed permit reflect the standard conditions of our template we have modified them to align with the structure of discharge controls (annual site upper and lower discharge limits, QNLs, annual annual plant notification levels and monthly triggers) we have decided to set through the permit.

510. In schedule 1, we have included 3 requests for improvements or information for the reasons explained in chapters 4 to 8. We have also included 2 pre-operational measures for future development.

511. Schedule 3 specifies the approved waste types and disposal routes and, as relevant, the limits that apply to specific radionuclides or groups of radionuclides for each of the approved disposal routes. We have also included 'quarterly notification levels' (QNLs) and annual annual plant notification levels for discharge of gaseous and aqueous waste into the environment. The purpose of notification levels is described in the 'notification' section of the guidance on how to comply.

512. We believe that our decision and permit conditions are consistent with the relevant legislation, and that we have assessed the application by taking into account the statutory guidance concerning the regulation of radioactive discharges into the environment and relevant government policy.

513. See chapters 4 to 8 for more detailed discussion of these matters.

References

Reference	Author / publication / website
BEIS, 2018	Department for Business, Energy & Industrial Strategy. 2018 'Direction to ensure reporting of standardised information on radioactive airborne and liquid discharges from nuclear power stations and reprocessing sites'
BIS, 2014	Department for Business, Innovation & Skills, Better Regulation Delivery Office. 2014 'Regulators' Code'. April 2014 https://www.gov.uk/government/publications/regulators-code
Brown and others, 2004	J E Brown, S R Jones, R Saxén, H Thørring and J Vives i Batlle. 2004 'Radiation doses to aquatic organisms from natural radionuclides'. J Radiological Protection 24, A63–A77
Brown and others, 2008	J E Brown, B Alfonso, R Availa, N A Beresford, D Copplestone, G Pröhl and A Ulanovsky. 2008 'The ERICA tool'. Journal of Environmental Radioactivity, 99, 1371-1383 http://www.erica-tool.com/
Brown and others, 2016	J E Brown, B Alfonso, R Availa, N A Beresford, D Copplestone and A Hosseini. 2016 'A new version of the ERICA tool to facilitate impact assessments of radioactivity on wild plants and animals'. Journal of Environmental Radioactivity, 153, 141-148 http://www.erica-tool.com/
CEC, 2004	Commission of the European Communities. 2004 'European Commission Recommendation of 18 December 2003 on standardised information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation'. Official Journal of the European Union, L 002, 0036 – 0046, 2004/2/Euratom
Defra, 2002	Defra. 2002 'The Environment Agency's Objectives and Contribution to Sustainable Development: Statutory Guidance'
Environment Agency, 2006	Environment Agency. 2006 'Initial radiological assessment methodology - Part 1 User report and Part 2 Methods and input data (science report SC030162)' Bristol: Environment Agency https://www.gov.uk/government/publications/initial-radiological-assessment-methodology
Environment Agency et al, 2009	Environment Agency, Northern Ireland Environment Agency, Scottish Environment Protection Agency. 2009 'Near-Surface Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation'. Bristol: Environment Agency https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/296507/geho0209bpjl-e-e.pdf
Environment Agency, 2010a	Environment Agency. 2010 'Working together: your role in our environmental permitting (edition 2)' Bristol: Environment Agency https://www.gov.uk/government/publications/environmental-permitting-public-participation-statement
Environment Agency, 2010b	Environment Agency. 2010 'Regulatory Guidance Series RSR1: Radioactive substances regulation - environmental principles (version 2)' Bristol: Environment Agency https://www.gov.uk/government/publications/radioactive-substances-regulation-environmental-principles
Environment Agency, 2010c	Environment Agency. 2010 'RSR: Management arrangements at nuclear sites (version 2)' Bristol: Environment Agency.

Reference	Author / publication / website
	https://www.gov.uk/government/publications/rsr-management-arrangements-for-nuclear-sites
Environment Agency, 2010d	Environment Agency. 2010 'RSR: Principles of optimisation in the management and disposal of radioactive waste (version 2)' Bristol: Environment Agency https://www.gov.uk/government/publications/rsr-principles-of-optimisation
Environment Agency, 2012a	Environment Agency. 2012 'Regulatory Guidance Series RSR 2: The regulation of radioactive substances activities on nuclear licensed sites (version 2)' Bristol: Environment Agency https://www.gov.uk/government/publications/rgn-rsr-2-regulation-of-radioactive-substances-activities-on-nuclear-licensed-sites
Environment Agency, 2012b	Environment Agency. 2012 'Criteria for setting limits on the discharge of radioactive waste from nuclear sites' Bristol: Environment Agency. https://www.gov.uk/government/publications/discharge-of-radioactive-waste-from-nuclear-sites-setting-limits
Environment Agency, 2015a	Environment Agency. 2015 'Radioactive Substances Compliance Assessment Report RASCAR-SEL-15-025'
Environment Agency, 2015b	Environment Agency. 2015 'Environment Agency Permitting Decisions: RSR Permits - Sellafield Limited EPR/KP3690SX/V004 Record of decision'
Environment Agency, 2016a	Environment Agency. 2016 'Radioactive Substances Compliance Assessment Report RASCAR-SEL-16-036'
Environment Agency, 2016b	Environment Agency. 2016 'Legal operator and competence requirements: environmental permits (web guide)' Bristol: Environment Agency https://www.gov.uk/guidance/legal-operator-and-competence-requirements-environmental-permits
Environment Agency, 2018a	'Environmental Permitting (England and Wales) Regulations 2016, Regulation 36: Enforcement Notice to take specified steps in relation to a breach/anticipated breach of permit conditions' Letter Reference SEL-18-42-O
Environment Agency, 2018b	'Environment Agency, 2018 Radioactive Substances Compliance Assessment Report' RASCAR-SEL-18-030
Environment Agency, 2018c	'Environment Agency, 2018 Radioactive Substances Compliance Assessment Report' RASCAR-SEL-18-031
Environment Agency, 2018d	'Environment Agency, 2018 Radioactive Substances Compliance Assessment Report' RASCAR-SEL-18-034
Environment Agency, 2019	Environment Agency. 2019. 'Prospective Radiological Assessment of Discharges from Sellafield at Proposed Permit Limits (Part B: Modified Permit Variation Request)'
Environment Agency and others, 2010	Environment Agency, SEPA & Food Standards Agency. 2010 Radiological monitoring technical guidance note 2 - Environmental radiological monitoring. Bristol: Environment Agency. http://www.sepa.org.uk/media/101506/radiological_monitoring_technical_guidance_note_2_environmental-radiological-monitoring.pdf
Environment Agency and others, 2012	Environment Agency, Scottish Environment Protection Agency, Northern Ireland Environment Agency, Food Standards Agency and Health Protection Agency. 2012 'Principles for the assessment of prospective public doses arising from authorised discharges of radioactive waste to the environment (Issue 2)' Penrith: Environment Agency https://www.gov.uk/government/publications/assessment-of-prospective-public-doses-from-authorised-discharges

Reference	Author / publication / website
Environment Agency and others, 2018	Environment Agency, Food Standards Agency, Food Standards Scotland, Natural Resources Wales, Northern Ireland Environment Agency and Scottish Environment Protection Agency. 2018 RIFE-23, Radioactivity in Food and the Environment https://www.food.gov.uk/sites/default/files/media/document/rife-23-web.pdf
Environment Agency and Office for Nuclear Regulation, 2012	Environment Agency and Office for Nuclear Regulation. July 2012 'HAW storage – report of a regulatory inspection'
Environment Agency and Office for Nuclear Regulation, 2013.	Environment Agency and Office for Nuclear Regulation. November 2013 'Regulatory inspection of RWMD's provision of disposability assessment and waste packaging advice' Issue 1.0
Environment Agency & SEPA, 2010	'Radiological monitoring technical guidance note 1 - Standardised reporting of radioactive discharges from nuclear sites' Bristol: Environment Agency & SEPA. http://www.sepa.org.uk/media/101584/radiological_monitoring_technical_guidance_note_1_standardised_reporting_of_radioactive_discharges_from_nuclear_sites.pdf
Environment Agency, SEPA and Natural Resources Wales, 2018	'Management of radioactive waste from decommissioning of nuclear sites: Guidance on Requirements for Release from Radioactive Substances Regulation' Version 1.0: July 2018. Environment Agency, SEPA and Natural Resources Wales https://www.sepa.org.uk/media/365893/2018-07-17-grr-publication-v1-0.pdf
EU, 1996	Council of the European Union. 1996 'Council directive laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation (96/29/Euratom)' Official Journal of the European Union, L 159, 1 - 114 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L:1996:159:FULL&from=EN
EU, 2009	Council of the European Union. 2009 'Council directive establishing a Community framework for the nuclear safety of nuclear installations (2009/71/ Euratom)' Official Journal of the European Union, L 172, 18 - 22
EU, 2010	European Commission. 2010 'Commission recommendation on the application of article 37 of the Euratom treaty (2010/635/Euratom)' Official Journal of the European Union, L 279, 36 - 67. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:279:0036:0067:EN:PDF
EU, 2011	Council of the European Union. 2011 'Council directive establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste' (2011/70/Euratom) Official Journal of the European Union, L 199, 48 - 56
EU, 2013	Council Directive 2013/59/Euratom 'Council directive laying down basic safety standards for the protection against the dangers arising from exposure to ionising radiation' https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2014:013:0001:0073:EN:PDF
Food Standards Agency, 2019	Food Standards Agency. August 2019 'Sellafield Radioactive Substances Activities (RSA) Major Permit Review food dose assessment'
GB Parliament, 1949	Great Britain. Parliament. House of Commons. National Parks and Access to the Countryside Act 1949. London: The Stationery Office

Reference	Author / publication / website
	http://www.legislation.gov.uk/ukpga/Geo6/12-13-14/97/contents
GB Parliament, 1965	Great Britain. Parliament. House of Commons. Nuclear Installations Act 1965. London: The Stationery Office http://www.legislation.gov.uk/ukpga/1965/57/contents
GB Parliament, 1981	Great Britain. Parliament. House of Commons. Wildlife and Countryside Act 1981. London: The Stationery Office. http://www.legislation.gov.uk/ukpga/1981/69/contents
GB Parliament, 1995	Great Britain. Parliament. House of Commons 'Environment Act 1995' London: The Stationery Office http://www.legislation.gov.uk/ukpga/1995/25/contents (Viewed 27 August 2019)
GB Parliament, 1998	Great Britain. Parliament. House of Commons 'Human Rights Act 1998' London: The Stationery Office http://www.legislation.gov.uk/ukpga/1998/42/contents (Viewed 27 August 2019)
GB Parliament, 2000	Great Britain. Parliament. House of Commons 'Countryside and Rights of Way Act 2000' London: The Stationery Office http://www.legislation.gov.uk/ukpga/2000/37/contents
GB Parliament, 2004	Great Britain. Parliament. House of Commons Statutory Instrument 2004 No. 1769 'The Justification of Practices Involving Ionising Radiation Regulations 2004' London: The Stationery Office http://www.legislation.gov.uk/uksi/2004/1769/made
GB Parliament, 2005	Great Britain. Parliament. House of Commons. Department of Energy & Climate Change (2005) SEA6 Section 5 - Physical and chemical environment. London: Department of Energy & Climate Change. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/194659/SEA_6_Section_5_web.pdf (Pg. 3)
GB Parliament, 2006	Great Britain. Parliament. House of Commons 'Natural Environment and Rural Communities Act 2006' London: The Stationery Office http://www.legislation.gov.uk/ukpga/2006/16/contents
GB Parliament, 2007	Great Britain. Parliament. House of Commons. Department for Environment, Food and Rural Affairs, Department of Trade and Industry, and the devolved administrations. 2007 'Policy for the Long Term Management of Solid Low Level Radioactive Waste in the United Kingdom' London: Department for Environment, Food and Rural Affairs https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254393/Low_level_waste_policy.pdf
GB Parliament, 2009a	Great Britain. Parliament. House of Commons. Department of Energy and Climate Change. 2009 'Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment' London: Department of Energy and Climate Change http://webarchive.nationalarchives.gov.uk/20121217150421/http://decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/nuclear/radioactivity/dischargesofradioactivity/1_20091202160019_e_@@_guidanceearadioactivedischarges.pdf
GB Parliament, 2009b	Great Britain. Parliament. House of Commons. Department of Energy and Climate Change, Welsh Assembly Government, Department of the Environment (Northern Ireland) & the Scottish Government, 2009. UK Strategy for radioactive discharges. London: Department of Energy and Climate Change http://www.gov.scot/Resource/Doc/280203/0084414.pdf
GB Parliament, 2009c	Great Britain. Parliament. House of Commons 'Marine and Coastal Access Act 2009' London: The Stationery Office http://www.legislation.gov.uk/ukpga/2009/23/contents

Reference	Author / publication / website
GB Parliament, 2009d	Great Britain. Parliament. House of Commons 'Local Democracy, Economic Development and Construction Act 2009' London: The Stationery Office http://www.legislation.gov.uk/ukpga/2009/20/contents
GB Parliament, 2010a	Great Britain. Parliament. House of Commons. Statutory Instrument 20160 No. 490 'The Conservation of Habitats and Species Regulations 2010' London: The Stationery Office http://www.legislation.gov.uk/uksi/2010/490/contents/made
GB Parliament, 2010b	Great Britain. Parliament. House of Commons. Statutory Instrument 2010 No. 1627 'The Marine Strategy Regulations 2010' London: The Stationery Office http://www.legislation.gov.uk/uksi/2010/1627/contents
GB Parliament, 2011	Great Britain. Parliament. House of Commons. Department for Environment, Food and Rural Affairs. 2011 'Environmental Permitting Guidance - Radioactive Substances Regulation (version 2)' London: Defra https://www.gov.uk/government/publications/radioactive-substance-regulations-rsr-guidance
GB Parliament, 2013	Great Britain. Parliament. House of Commons. Department for Environment, Food and Rural Affairs. 2013 'Environmental Permitting Guidance - Core guidance' London: Defra https://www.gov.uk/government/publications/environmental-permitting-guidance-core-guidance--2
GB Parliament, 2015a	Great Britain. Parliament. House of Commons. Department of Energy and Climate Change. 2015 '2010 to 2015 government policy: radioactive and nuclear substances and waste' London: DECC https://www.gov.uk/government/publications/2010-to-2015-government-policy-radioactive-and-nuclear-substances-and-waste/2010-to-2015-government-policy-radioactive-and-nuclear-substances-and-waste
GB Parliament, 2015b	Great Britain. Parliament. House of Commons 'Deregulation Act 2015' London: The Stationery Office http://www.legislation.gov.uk/ukpga/2015/20/contents
GB Parliament, 2016a	Great Britain. Parliament. House of Commons. Statutory Instrument 2016 No. 1154 'The Environmental Permitting (England and Wales) Regulations 2016' London: The Stationery Office http://www.legislation.gov.uk/uksi/2016/1154/contents/made
GB Parliament, 2016b	Great Britain. Parliament. House of Commons. Department of Energy and Climate Change, the Scottish Government, the Welsh Government, & Department of the Environment (Northern Ireland). 2016 'UK Strategy for the management of solid low level waste from the nuclear industry' London: Department of Energy and Climate Change https://www.gov.uk/government/consultations/consultation-on-an-update-of-the-uk-strategy-for-the-management-of-solid-low-level-radioactive-waste-from-the-nuclear-industry
GB Parliament, 2017a	Great Britain. Parliament. House of Commons. Statutory Instrument 2017 No. 407 'The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017' London: The Stationery Office
GB Parliament, 2017b	Great Britain. Parliament. House of Commons. Statutory Instrument 2017 No. 1075 'The Ionising Radiations Regulations 2017' London: The Stationery Office http://www.legislation.gov.uk/uksi/2017/1075/contents/made
GB Parliament, 2018a	Great Britain. Parliament. House of Commons. Department for Business, Energy & Industrial Strategy. 2018 'UK Strategy For Radioactive Discharges 2018 Review of the 2009 Strategy' London: Department for Business, Energy & Industrial Strategy

Reference	Author / publication / website
GB Parliament, 2018b	Great Britain. Parliament. House of Commons. Department for Business, Energy & Industrial Strategy. 2018 'The Justification of Practices involving Ionising Radiation Regulations 2004 Guidance on their application and administration' London: Department for Business, Energy & Industrial Strategy https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/717288/180618_JustificationGuidanceDoc_updatedannex.pdf
GB Parliament, 2018c	Great Britain. Parliament. House of Commons. Department for Business, Energy & Industrial Strategy. 2018 'Scope of and exemptions from the radioactive Substances regulation in the UK. Guidance document' London: Department for Business, Energy & Industrial Strategy https://www.gov.uk/government/publications/guidance-on-the-scope-of-and-exemptions-from-the-radioactive-substances-legislation-in-the-uk
Hunt GJ. 2004	Hunt GJ. 2004 'Radiological assessment of ocean radioactivity' In Marine Radioactivity, ed. H. Livingston, Radioactivity in the Environment, Vol 6. pp205 – 236
IAEA, 2010	IAEA-TECDOC-1638 'Setting Authorised Limits for Radioactive Discharges: Practical Issues to Consider' https://www-pub.iaea.org/MTCD/publications/PDF/te_1638_web.pdf
ISO, 2014	International Standards Organisation. 2014 'Asset management - Management systems - Requirements'. ISO 55001:2014. https://www.iso.org/standard/55089.html
Larsson and others, 2004	C-M Larsson, C Jones, J M Gomez-Ros and I Zinger. 2004 'Deliverable 6: Framework for Assessment of Environmental Impact of Ionising Radiation in Major European Ecosystems'. Framework for Assessment of Environmental Impact (FASSET) Project EC Contract No. FIGE-CT-2000-00102.
NDA, 2016	Nuclear Decommissioning Authority. 2016 'Strategy effective from April 2016' https://www.gov.uk/government/publications/nda-strategy
NDA, in prep	'Solid Radioactive Waste Characterisation Good Practice Guide' Nuclear Decommissioning Authority, in preparation
NDAWG, 2013	National Dose Assessments Working Group. 2013 'Use of Habits Data in Prospective Dose Assessments' https://srp-uk.org/resources/national-dose-assessment
NEA, 2017	'Radiological Characterisation from a Waste and End State Perspective: Practice and Experience' NEA No. 7373, Paris: Nuclear Energy Agency https://www.oecd-nea.org/rwm/pubs/2017/7373-rad-char-pers.pdf
OSPAR, 2010	Oslo and Paris Commission. 2010 'The North-East Atlantic Environment Strategy: Strategy of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic 2010–2020 (OSPAR Agreement 2010-3)' (Radioactive Substances Strategy included in Part 2 of the NEAE Strategy) http://www.ospar.org./convention/strategy
Sellafield Ltd, 2013a	Sellafield Ltd. 2013 SLF 2.11.109.01 'Public Dose Factor Tables' Issue 2: Sellafield Ltd
Sellafield Ltd, 2016	Sellafield Ltd. 2016 'Monitoring Our Environment. Discharges and Environmental Monitoring Annual Report 2016' Sellafield Ltd
Sellafield Ltd, 2017	Sellafield Ltd. 2017 'Letter EA-07-8313-60 RSR Permit CLESA Variation Application' Sellafield Ltd
Sellafield Ltd, 2018a	Sellafield Ltd. 2018 'RSA Environmental Permit Variation Application EM/2018/19' Sellafield Ltd

Reference	Author / publication / website
Sellafield Ltd, 2018b	Sellafield Ltd. 2018 'Assessment of radiological doses to marine and terrestrial representative persons (critical groups) at site limits as proposed for the Sellafield Major Permit Review' Sellafield Ltd
Sellafield Ltd, 2018c	Sellafield Ltd. 2018 'Annual Discharges Review, 2015 - 2017. Demonstration of the progressive reduction in discharges and hazard at Sellafield (NDA EPI Objective 5)' Sellafield Ltd
Sellafield Ltd, 2018d	Sellafield Ltd. 2018 'Major Permit Review Application – Framework of Arrangements for the Demonstration of BAT' Sellafield Ltd
Sellafield Ltd, 2018e	Sellafield Ltd. 2018 'DS-005-0179 - Sellafield Effluent Strategy Modelling Discharge Projections in support of the Sellafield Ltd Radioactive Substances Activity Environmental Permit Application Site Limit Proposals' Sellafield Ltd
Sellafield Ltd, 2018f	Sellafield Ltd. 2018 'Post Closure Radiological Safety Assessment, 60493376/MARP003' December 11 Sellafield Ltd (2018). Waste/Tech/838. 'BAT Justification of a Specific Tritium Limit for CLESA disposals' Sellafield Ltd
Sellafield Ltd, 2018g	Sellafield Ltd. 2018 'Proposal for the Removal of Discharge Limits from the First Generation Magnox Storage Pond Stack' Sellafield Ltd
Sellafield Ltd, 2018h	Sellafield Ltd. 2018 'Proposal for the removal of discharge limits from the SIXEP stack' Sellafield Ltd
Sellafield Ltd, 2018i	Sellafield Ltd. 2018 'SAV RSA Major Permit Review' Sellafield Ltd
Sellafield Ltd, 2019a	Sellafield Ltd. 2019 'Sellafield Ltd Radioactive Substances Activity Environmental Permit - Response to Environment Agency Request for Additional Information in Relation to October 2018 Variation Application' EM/2019/21
Sellafield Ltd, 2019b	Sellafield Ltd. 2019 'Sellafield Effluent Strategy Modelling Discharge Projections in support of the Sellafield Ltd Radioactive Substances Activity Environmental Permit Application Site Limit Proposals' DS-005-0179 v7.0
Sellafield Ltd, 2019c	Sellafield Ltd. 2019 'Best Available Techniques (BAT) assessment for the proposed WVP Ru-106 permit limits' ERA/WVP/315/Issue 1
Sellafield Ltd, 2019d	Sellafield Ltd. 2019 'TECH/19/16 – Proposed Uranium Limit for Major Permit Review'
Sellafield Ltd, 2019e	Sellafield Ltd. 2019 'Sellafield Effluent Management Strategy (SEMS) Response to Environment Agency Request for Provision of Additional Information in Relation to October 2018 Variation Application' DS-005-0344 v1.0
Sellafield Ltd, 2019f	Sellafield Ltd. 2019 'Assessment of radiological doses to marine and terrestrial representative persons (critical groups) at site limits as proposed for the Sellafield Major Permit Review' EM/2018/18
Sellafield Ltd, 2019g	Sellafield Ltd. 2019 'Memorandum: Future Projections of Aerial Discharges from FHP and SIXEP' ERA/SFM/274
Management School, University of Lancaster & Warwick Business School, University of Warwick, 2006	'Overall Effluent Strategy Model Review'
US DOE, 2012	US DOE. 2012 'O 231.1B Admin Chg 1, Environment, Safety and Health Reporting' https://www.directives.doe.gov/directives-documents/200-series/0231.1-BOrder-b-admchg1

Reference	Author / publication / website
USE DOE, 2013	'Guidance for the Preparation of Department of Energy Annual Site Environmental Reports for Calendar Year 2012' https://public.ornl.gov/sesa/environment/reports/aser/2012_ASER_Guidance.pdf
Wise Uranium, 2016	Wise Uranium project. 2016 'Uranium Radiation Properties: Wise Uranium' http://www.wise-uranium.org/rup.html

Glossary and abbreviations

Term	Meaning
Activity	A generic title for the practices or operations that need to be permitted (unless exempted from the need for a permit)
AGR	Advanced gas reactor
ALARA	As low as reasonably achievable (economic and social factors being taken into account). Radiation doses comply with ALARA when they have been reduced to a level that represents a balance between dose and other factors (including economics). This is a statement of the optimisation principle.
AM	Asset management
Article 37	Article of the Euratom Treaty requiring a member state to provide information to the European Commission relating to any plan for the disposal of radioactive waste
APNL	Annual plant notification level
AS	Analytical Services
BAT	Best available techniques - see below for full definition
BEIS	Department for Business, Energy and Industrial Strategy
Bq, kBq, MBq, GBq and TBq	Abbreviations meaning becquerels, kilobecquerels, megabecquerels, gigabecquerels and terabecquerels respectively
BRT	Below reporting threshold
BSSD	Basic Safety Standards Directive (Directive 96/29/EURATOM)
BWR	Boiling water reactor
CEAR	Compilation of Environment Agency Requirements, Approvals and Specifications
CIS	Calder interceptor sewer
CLESA	Calder Landfill Extension Segregated Area
D Bay	An area within the First Generation Magnox Storage Pond
1E+06	Scientific notation for numbers, this means 1000000
EARP	Enhanced Actinide Removal Plant
EARPOP	Enhanced Actinide Removal Plant Operating Programme
Evaporator C	One of the highly active liquor evaporators
FGMSP	First Generation Magnox Storage Pond
EE	Environmental equipment
EPC	Environmental procedural controls
EPR	Environmental Permitting (England and Wales) Regulations 2016
ESP	Electrostatic precipitator
FHP	Fuel handling plant
FS	Factory sewer
FSA	Food Standards Agency
GDF	Geological disposal facility

Term	Meaning
GRA	Guidance on requirements for authorisation Environment Agency guidance detailing the environmental objectives that an underground facility for the permanent disposal of radioactive waste must achieve. There are 2 versions of the GRA: one for geological disposal of higher activity radioactive waste, and one for near-surface disposal of lower activity radioactive waste
GRR	Guidance on requirements for release from radioactive substances regulation
Gy, µGy	Abbreviation meaning gray, microgray
HAL	Highly active liquor
HALES	Highly active liquor evaporation and storage
HAW	Higher activity waste meaning high-level radioactive waste (HLW), ILW and such LLW as cannot be disposed of at present
HEPA	High efficiency particulate air filter
HHRR	High hazard risk reduction - work undertaken at Sellafield to reduce the risk from high hazards.
HSE	Health and Safety Executive Regulator with responsibilities under IRR17 (GB Parliament, 2017b)
ICRP	International Commission on Radiological Protection
ILW	Intermediate level radioactive waste
IWM	Integrated waste management
IWS	Integrated waste strategy
FRP	Floc Retrieval Plant
Justification	The benefits and detriments of any practice that could result in exposure to ionising radiation must by assessed before the practice is permitted. If the benefits outweigh the detriments, the practice is justified.
LADRR	Long term aerial dose release ratios
LLW	Low level radioactive waste
Licensee	An operator licensed under NIA 65
LoD	Limit of detection
Magnox fuel	Fuel from the fleet of Magnox reactors in the UK
MAL	Medium active liquor
MCERTS	Monitoring Certification Scheme
MCZ	Marine Conservation Zone
MDRR	Marine dose release ratios
MGBW	Miscellaneous beta gamma waste
MSSS	Magnox Swarf Storage Silos
NDA	Nuclear Decommissioning Authority
NDP	Nuclear delivery plan
NIA 65	The Nuclear Installations Act 1965
NFLA	Nuclear free local authorities

Term	Meaning
NNL	National Nuclear Laboratory
NRW	Natural Resources Wales
OESM	Overall Effluent Strategy Model
ONR	Office for Nuclear Regulation: a statutory public corporation, responsible for regulating nuclear safety and security across the UK
Options assessment	Any formal and recorded method by which a preferred solution is determined from a number of possible alternatives
OSPAR	Oslo and Paris Convention for the protection of the marine environment in the north-east Atlantic The UK is a signatory to this Convention. Its Strategies aim to prevent pollution of the maritime area by continuously reducing discharges, emissions and losses of chemically hazardous substances and radioactive substances
PCRSA	Post closure radiological safety assessment
PF&S	Product finishing and storage
PHE	Public Health England (previously the Health Protection Agency (HPA))
POCO	Post operational clean out
Proximity principle	The aim of the proximity principle is to avoid excessive and unnecessary transportation of waste for disposal. It means allowing waste to be disposed of in one of the nearest appropriate installations.
PW IPT	Problematic Waste Integrated Project Team
PWR	Pressurised water reactor
QNL	Quarterly notification level
R&D	Research and development
Regulated facility (RF)	A collective term for the range of activities permitted under EPR
REP(s)	Radioactive Substances Regulation – Environmental Principles Environment Agency guidance that sets out, at a high level, the principles which the Environment Agency applies to RSR
Representative person	The representative person is ‘an individual receiving a dose that is representative of the more highly exposed individuals in the population’
RIFE	Radioactivity In Food and the Environment reports published each year
RSA	Radioactive substances activity
RSR	Radioactive substances regulation
RVS	Retrievals ventilation system for MSSS
RWML	Radioactive Waste Management Limited
SAC	Special Area of Conservation
SAV	Separation Area Ventilation
SCP	SIXEP Continuity Plant
SEC	Salt evaporator concentrate
SEF	Stack efficiency factors
SEMS	Sellafield effluent management strategy
SEPA	Scottish Environment Protection Agency

Term	Meaning
SER	Site environmental review
SETP	Segregated Effluent Treatment Plant
Sv, µSv, nSv	Abbreviation meaning sievert, microsievert, nanosievert
SIXOP	Site Ion Exchange Plant Operating Programme
SIXEP	Site Ion Exchange Plant
SLMS	Sellafield Ltd management system
SLP	Sellafield Ltd practices
SLSP	Sellafield Ltd supporting practices
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
STP	Solvent treatment plant
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Specific to radioactive waste, the government's policy is to 'ensure that radioactive waste is managed safely and that the present generation, which receives the benefit of nuclear power, meets its responsibilities to future generations'
SWESC	Site wide environmental safety case
THORP	Thermal Oxide Reprocessing Plant
THORP DOG	THORP dissolver off gas system
THORP R&S	THORP receipt and storage pond
UKSRD	UK Strategy for Radioactive Discharges
VLLW	Very low level waste
WAC	Waste acceptance criteria
Waste hierarchy	A principle of waste management that requires that (in order of preference) waste be: avoided minimised reused recycled disposed of
WCSSG	West Cumbria Site Stakeholder Group
WEP	Waste encapsulation plant
WMP	Waste management plan
WVP	Waste vitrification plant

BAT definition

The term 'best available techniques' means the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste. In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration shall be given to:

- comparable processes, facilities or methods of operation which have recently been successfully tried out;

- technological advances and changes in scientific knowledge and understanding;
- the economic feasibility of such techniques;
- time limits for installation in both new and existing plants;
- the nature and volume of the discharges and emissions concerned.

It therefore follows that what is 'best available techniques' for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

If the reduction of discharges and emissions resulting from the use of best available techniques does not lead to environmentally acceptable results, additional measures have to be applied.

'Techniques' include both the technology used and the way in which the installation is designed, built, maintained, operated and dismantled.

The use of the best available techniques shall emphasise the use of non-waste technology, if available.

Appendix 1 - Enforcement and recent regulatory history

514. Securing compliance with environmental permits is an important part of our regulation of nuclear sites. We expect full compliance with our permits and we will use our enforcement powers, including prosecution when necessary, to make sure that the operator takes relevant action. Our 'Enforcement and Sanctions Statement' provides a high-level view of our approach to enforcement. You can find further details in the associated 'Guidance and Offence Response Options' documents.

515. The methods of enforcement available to us include enforcement notices (to secure compliance with permit conditions), suspension notices where there is a risk of serious pollution, cancellation (revocation) of a permit, (change) variation of permit conditions and using injunctions. Where we believe an offence has been committed, we will consider prosecution, formal caution or a warning depending on the circumstances.

516. We have not taken any enforcement action greater than issuing a warning letter in the last 4 years. However, we did serve an enforcement notice on 5 November 2018 (Environment Agency, 2018a) regarding examination, inspection, maintenance and repair of the above ground gaseous radioactive waste systems related to the Analytical Services and Product Finishing and Storage stack disposal outlet. We subsequently closed this when Sellafield Ltd had completed the required work.

517. We conclude that this record does not indicate that the applicant is unwilling or unable to comply with the permit conditions.

Appendix 2 - Consultation on the application

518. We have advertised and consulted on the application in accordance with our public participation statement. This appendix summarises the way in which we carried this out, the result of our consultation, and how we have taken consultation responses into account in reaching our decision. We have placed copies of all consultation responses on our public register except where the person making the response asked us not to do so.

How we publicised the consultation on the application

519. We advertised the consultation on the application by a notice on GOV.UK from 26 October 2018 to 21 December 2018. The notice provided brief details of the application, and told people where and when they could see a copy of the application and where to send any comments. We made copies of the application available for public inspection by placing them in our public register at Ghyll Mount, Penrith and in Whitehaven, Workington and Seascale libraries. We provided copies of the application by e-mail or other means, on request. We also publicised the consultation by discussing it with the West Cumbria Sites Stakeholder Group, issuing press releases, displaying posters in local libraries, supermarkets and sports centres, posting on social media, and directly contacting a number of organisations and individuals inviting them to participate.

Who we consulted

520. We sent copies of the application to the following organisations, with whom we have 'working together agreements':

- Office for Nuclear Regulation
- Food Standards Agency
- Allerdale Borough Council
- Copeland Borough Council
- Cumbria County Council
- Public Health England

521. We also wrote to the following main interested groups, informing them of the consultation and inviting them to participate:

- National Decommissioning Authority (NDA)
- Committee on Medical Aspects of Radiation in the Environment (COMARE)
- Natural Resources Wales (NRW)
- Scottish Environment Protection Agency (SEPA)
- Northern Ireland Environment Agency (NIEPA)
- Ireland Environmental Protection Agency
- Isle of Man Department of Local Government and the Environment
- Marine Management Organisation (MMO)
- Natural England (NE)
- Inshore Fisheries & Conservation Authorities (IFCA)
- Department of Business, Energy and Industrial Strategy (BEIS)
- Department of Environment, Food and Rural Affairs (DEFRA)
- Department of Health and Social Care (DHSC)
- Copeland parish councils
- Allerdale coastal parish councils

- Sue Hayman MP
- Trudy Harrison MP
- John Woodcock MP
- Cumbria Wildlife Trust
- Royal Society for the Protection of Birds (RSPB)
- Rivers Trust
- Friends of the Lake District
- Low Level Waste Repository (LLWR)
- Existing operating reactors
- West Cumbria Site Stakeholder Group (WCSSG)
- Cumbrians Opposed to Radioactive Environment (CORE)
- Radiation Free Lakeland
- National Farmers Union (NFU)

Responses to the consultation on the application

522. We received 13 responses from organisations and individuals. We have summarised the points they raised into 29 topic areas, together with our consideration of them (table A2.1).

Table A2.1 Summarised responses and Environment Agency consideration of issues

Ref	Summarised version of response	Environment Agency consideration of issues
Topic: Other		
1	Copeland Borough Council commented that it would welcome comments and ongoing dialogue with the Environment Agency on how the proposed changes may affect Copeland's communities and residents, particularly in any cases where regulatory activities may decrease.	Before receiving this application, and throughout our determination process, we have liaised with Copeland's communities and residents through scheduled West Cumbria Site Stakeholder Group (WCSSG) meetings and provided written briefings and updates to a wide variety of interested groups, including parish councils, councillors and MPs. We have also displayed posters about the application and consultation in prime locations. This was so that people had the opportunity to understand the proposed changes and provide us with any information they felt is relevant to our decision making. We will continue to provide updates to our stakeholders through scheduled WCSSG meetings, written briefings and posters in community locations. We will notify them when the consultation on the draft decision goes live and when our decision on the permit has been finalised. Once this variation is concluded, we will continue to liaise with stakeholders through WCSSG meetings. At these meetings, our nuclear regulators are available to answer any specific questions raised about our regulation of the site and how any proposed changes may affect Copeland's residents and communities. We are happy to liaise with local councils, as well as the formal stakeholder group about our regulatory activities. If anyone has any queries, they can email our Communications and Engagement team at:

Ref	Summarised version of response	Environment Agency consideration of issues
		Correspondence.CMBLNC@environment-agency.gov.uk and phone: 0208 474 8810.
2	One individual entered a blank comment.	N/A
Topic: Matters outside the Environment Agency's permitting remit		
3	One individual did not believe Sellafield Ltd should be granted a change to its licence or any change of use for the storage of materials. The individual stated that Sellafield Ltd has enough land and buildings.	The Office for Nuclear Regulation grants and issues nuclear site licences under the Nuclear Installations Act 1965 and regulates the storage of radioactive material on nuclear licensed sites. Copeland Borough Council is responsible for granting permission for change of use under planning law. This consultation is not for a change in the site licence or change of use for the storage of materials. It relates to an application Sellafield Ltd has made to vary (change) its Environmental Permitting Regulations 2016 Radioactive Substances Activities permit. As per the description on our online consultation website (https://consult.environment-agency.gov.uk/cumbria-and-lancashire/sellafield-rsa-major-permit-review/), we can only take account of issues within the relevant environmental regulations or inside the remit of the Environmental Permitting Regulations 2016.
4	One individual commented that this approach (that is flexible proportionate regulatory control) should be considered by other more restrictive regulatory regimes.	Radioactive Substances Regulation is a flexible goal-oriented regime within the Environmental Permitting Regulations 2016 (GB Parliament, 2016a). Other regimes within Environmental Permitting Regulations 2016 have different approaches, for example best available techniques reference (BREF) notes published by the European Commission. The regulatory regimes enforced by the Environment Agency are set by government legislation. As per the description on our online consultation website (https://consult.environment-agency.gov.uk/cumbria-and-lancashire/sellafield-rsa-major-permit-review/), we can only take account of issues within the relevant environmental regulations or inside the remit of the Environmental Permitting Regulations 2016.
5	Nuclear Free Local Authorities (NFLA) quoted the UK Strategy for Radioactive Discharges (2009) and thought that the target dose of less than 20µSv/y to the critical group as a result of authorised discharges made from 2020 onwards should be reintroduced.	The 2009 UK Strategy for Radioactive Discharges (GB Parliament, 2009b) is a government document and considering whether to include target doses is a government decision and, as such, is outside of the Environment Agency's remit. Guidance on the application of that strategy is set out in the statutory guidance (GB Parliament, 2009a) (see para 22 and footnote 17 of the guidance), which replaced the 'threshold for optimisation' of 20µSv/y with a 10µSv/y (prospective dose at the limits) level for not needing to reduce discharge limits further providing BAT is being used.
Topic: Providing information		

Ref	Summarised version of response	Environment Agency consideration of issues
6	The COMARE Authorisations working group noted that the application was comprehensive with a significant amount of supporting documentation.	This consultation response broadly supports Sellafield Ltd's application and requires no further consideration by us.
Topic: Optimisation in the management and disposal of radioactive waste		
7	Several respondents commented that they welcomed the overall approach. They gave the view that the review appears to represent a move towards a proportionate, flexible approach to environmental protection from a 'best available techniques' perspective. A number of respondents commented that the changes would allow for more timely progress with hazard reduction and waste treatment, and reflected the site's change in focus from reprocessing to decommissioning. Copeland Borough Council noted that the proposals appeared consistent with the principles of proportionate regulation and would encourage optimised management of discharges and their environmental impact.	These consultation responses broadly support Sellafield Ltd's application and requires no further consideration by us.
8	One individual commented that the principle of including mechanisms for increased flexibility is only as good as the underlying procedures, working relationships and guidance and noted it would be key to have established terms of engagement between Sellafield Ltd and the Environment Agency.	As noted in the consultation response, Sellafield Ltd has applied for a number of mechanisms to allow increased flexibility. These include the proposal of replacing plant limits for specific radionuclides with annual plant notification levels and introducing a 2-tier site limit structure, with upper and lower site limits. In line with the Regulators' Code (BIS, 2014), we have established ways of working with Sellafield Ltd, including a series of routine formal meetings that we attend jointly with ONR. By working with Sellafield Ltd, we aim to provide prompt and clear advice and supporting innovation, leading to the best available techniques being used to minimise the impact on the environment. It should be noted that our routine meetings are at various organisational levels, which allows any issues that cannot be readily resolved to be escalated. Our established ways of working with Sellafield Ltd would apply in the future to discussions around aspects of this application, such as Sellafield Ltd seeking to move from lower to upper site limits. The requirement and approach that Sellafield Ltd would need to take to move from a lower to an upper site limit is clearly laid out in permit condition 3.1.2 and CEAR requirement 3.1.2(b)/v001. Sellafield Ltd's BAT arrangements are described in paragraphs 91 to 99. Sellafield Ltd will need to include new

Ref	Summarised version of response	Environment Agency consideration of issues
		arrangements for producing BAT submissions to support a move to an upper tier site limit, so a specific programme of work can be carried out. As worded in the application, if an annual plant notification level was exceeded, Sellafield Ltd would have to notify the Environment Agency. The processes for Sellafield Ltd to notify the Environment Agency are clearly laid out in permit conditions in section 4.3 of the permit. Paragraphs 45 to 49 detail how discharges are controlled. This includes a new CEAR for Sellafield Ltd to provide us with a quarterly report detailing any exceedances of its internal monthly 'trigger levels'. This will provide an early warning that notification levels could subsequently be exceeded. The upper and lower limits are illustrated in figure 3.1, how these changes will work in practice is explained in paragraphs 181 to 188.
9	NFLA stated in their response that in order to achieve the benefits of reduced emissions to the environment, as a result of the end of reprocessing, decommissioning should not be used as an excuse for increased discharges. NFLA commented that sustainable decommissioning policies should be based on principles such as 'the polluter pays', 'concentrate and contain' and 'the proximity principle' and that rising volumes of lower activity waste should not distract from the need to implement best practicable environmental option (BPEO). NFLA highlighted the need for systematic consultative decision making in the BPEO procedure. NFLA quoted the UK government's commitments under the OSPAR treaty. They stated that, in their view, using end of pipe filters to remove pollutants from discharges does not represent 'clean technology' as referred to by the guiding principles of the OSPAR strategy. NFLA's view is that the requirement for 'best available techniques' (and clean technology) means discharging radioactive waste into the environment when alternative management techniques are available is not permitted.	See line 19 of this table for our comment on increasing discharges as a result of decomissioning. Our assessment of BAT in relation to this application is detailed in chapter 5. Paragraph 85 notes that we require operators to use best available techniques (BAT) in the operation of their facilities to: • prevent and minimise (in terms of radioactivity) the creation of radioactive waste • minimise (in terms of radioactivity) discharges of gaseous and aqueous radioactive waste • minimise the impact of those discharges on people, and adequately protect other species • minimise (in terms of mass and volume) solid and non-aqueous liquid radioactive waste By 'operation' we mean how the facility has been designed, built, maintained, operated and dismantled (inclusive of decommissioning). Therefore, it is our expectation that BAT is applied during decommissioning to prevent and, where that is not practicable, to minimise discharges. We have made our decision taking into account all relevant legal, policy and regulatory matters. These are detailed in chapter 2, paragraphs 11 and 12 and the main considerations listed in table 2.1. The 'Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment' (GB Parliament, 2009a) and the 'UK Strategy for radioactive discharges' (GB Parliament, 2009b), indicates that the application of BAT is broadly equivalent to a combination of best practicable means (BPM) and best practicable environmental option (BPEO). This strategy also sets out the principles we should base our decisions on, including the 'polluter pays' and 'concentrate and contain' principles, as referred to by NFLA.

Ref	Summarised version of response	Environment Agency consideration of issues
		We expect operators to include these considerations in many aspects of their management arrangements, including their decommissioning policies. It is for operators to determine what is BAT for a given issue. It is also for operators to determine how consultative they want to be in making their decisions. Our RSR environmental principles (Environment Agency, 2010b) note that the approach for applying BAT (RSMDP4) should be inclusive so that the extent to which stakeholders are involved reflects: • the technical and societal significance and human health and environmental implications of the decision • the information that stakeholders can bring to the process • what the impact on the process and its conclusion might be of a wider range of stakeholder perspectives, established for example through sensitivity studies • whether stakeholder 'ownership' of the process is an objective • the need for wider confidence in the process We don't incorporate liaising with stakeholders in BAT decision making as the operator is the decision maker. We arbitrate based on the goal setting objectives in radioactive substances regulation. We do consult on permit applications and, where appropriate, draft decisions on those applications.
Topic: Operating techniques and monitoring		
10	Copeland Borough Council commented that the move towards a minimum number of discharge limits and notification levels must be accompanied by adequate control of discharges and monitoring of process performance. It noted that the practicability of monitoring should not come before the impact of discharges in determining monitoring regimes. Copeland Borough Council also raised a concern around changing from plant limits to notification levels in that exceeding a notification level would not constitute a breach of the permit. They noted that transparency on the reason for this change was essential.	It should be noted that Sellafield Ltd is required to apply best available techniques to all aspects of plant management, including control of process performance, to minimise discharges. Under normal operation, this should not result in the operation of plants above the annual plant notification levels. Paragraph 172 to 177 in chapter 6 explains our acceptance of annual plant notification levels, noting alignment with the government's ambition 'to continue to bear down on the costs to business of regulation while maintaining important regulatory protections', and that the cost to business of the steps taken to avoid or justify exceeding a plant limit are greater than those required for a notification level, and do not add an appropriate increase in value. We have taken this decision by considering the structure of discharge controls that will be in place to regulate discharges as illustrated in figure 3.2 in chapter 3 and discussed in paragraphs 45 to 49. This includes site limits, quarterly notification levels, annual plant notification levels and monthly triggers, making sure that there are several levels of control at which enhanced regulatory attention will be applied should discharges increase.

Ref	Summarised version of response	Environment Agency consideration of issues
		Sellafield Ltd is also required to use the best available techniques to demonstrate the suitability of its monitoring regimes. BAT assessments carried out by Sellafield Ltd will consider a range of factors, including, where relevant, the practicability of monitoring in determining the approach to monitoring that is BAT. Discussion of changes in relation to monitoring are discussed in paragraphs 399 to 402.
Topic: Disposal routes and limits		
11	Respondents commented that the review was timely and they welcomed the approach. Respondents noted that having fewer plant constraints while retaining tiered site limits seemed like a proportionate and agile solution that appeared to be consistent with the aims of close monitoring of discharges and timely notification to the Environment Agency of increasing discharge trends.	These consultation responses broadly support Sellafield Ltd's application and requires no further consideration by us.
12	Copeland Borough Council welcomed the fact that upper site limits would, in all but one case, be lower than current site limits. It also commented that it would expect to see these tiered limits progressively revised as information becomes available.	We have set limits on disposals in accordance with our document 'Criteria for setting limits on the discharge of radioactive waste from nuclear sites' (Environment Agency, 2012b). That is, we have set limits based on operators using BAT to minimise disposals to the environment, allowing for 'normal operation' of the facility. 'Normal operation' takes account of operational fluctuations, trends and events that are expected to occur over the likely lifetime of the facility. Our guidance takes account of the 'Statutory guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment' (GB Parliament, 2009a). As activities change on the Sellafield site, and more discharge information becomes available, site limits may be revised.
13	One individual stated it was important that site clean-up was not impeded by arbitrary limits, and queried whether there was scope to change the limits to accommodate new projects.	See above for details on how we set limits on disposals. We expect Sellafield Ltd to apply for further variations to its permit in the future to accommodate new projects, and this may include applications to vary limits. We will assess these applications at the time they arise, in line with relevant legal, policy and regulatory considerations.
14	The COMARE authorisations working group queried whether the requirement to notify the Environment Agency in advance of increased discharges would always be possible.	Sellafield Ltd has a framework of BAT arrangements that are described in paragraphs 91 to 99. As worded in the application, if an annual plant notification level was exceeded, Sellafield Ltd would be required to notify the Environment Agency. The processes for Sellafield Ltd to notify the Environment Agency are clearly laid out in permit conditions in section 4.3 of the permit. Paragraphs 45 to 49 detail how discharges are controlled. This includes a new

Ref	Summarised version of response	Environment Agency consideration of issues
		CEAR for Sellafield Ltd to provide us with a quarterly report detailing any exceedances of its internal monthly 'trigger levels'. This will provide an early warning that notification levels could subsequently be exceeded. The upper and lower limits are illustrated in figure 3.1, how these changes will work in practice is explained in paragraphs 162 to 168. On the basis of the above hierarchy of discharge controls and Sellafield Ltd's existing BAT framework, we expect that Sellafield Ltd will be able to provide prior notification and submission of a BAT argument.
15	The COMARE authorisations working group commented that the timescale for implementing the new Magnox Swarf Storage Silo (MSSS) stack was not clear, and queried whether this stack would be in place ahead of the expected increase in use of this facility.	The retrievals ventilation system (RVS) for MSSS is not expected to be operational for another 24 months, but this timeframe is currently under review and subject to change. The BAT position and timing of RVS availability with respect to progress of the retrieval programme will be kept under review. The RVS, which includes high efficiency particulate air (HEPA) filtration and a new stub stack will not be available before retrievals begin. However, a best available techniques (BAT) case has been developed to support a case to commence retrievals on compartment 10 miscellaneous beta gamma waste (MBGW) using extant abatement (scrubber and demister pad). Discharges will be via the extant second extension ventilation extract system and stack. Discharges are predicted to be within the proposed annual plant notification levels for this stack. Retrievals from compartment 10 are Retrievals from Compartment 10 are currently scheduled to commence in the 2019 to 2020 financial year, with active commissioning commencing in the second quarter.
16	The COMARE authorisations working group commented that it was difficult to find evidence of the improved transparency on the scale of Sellafield Ltd discharges compared to the UK Strategy for Radioactive Discharges referenced in the application.	This comment is noted. Our determination of site limits in chapter 6 makes comparisons between the application and the UK Strategy for Radioactive Discharges (GB Parliament, 2009b; GB Parliament, 2018a) expected outcomes. We requested further information (detailed in chapter 3 paragraph 33 and tables 3.2 and 3.3) on this topic: (b) Explaining or resolving differences in expected and projected discharge information in the variation application with the published discharge information in the UK Strategy for Radioactive Discharges review, 2018 (c) Demonstrating due consideration of the UK Strategy for Radioactive Discharges and its expected outcomes
17	The FSA commented that using upper and lower discharge limits in phase 2 appears to be a pragmatic solution to dealing with the appropriate decommissioning of the site. The FSA noted that if this	Any change from lower to upper site limits will be accompanied by a revision of the CEAR and a change to CEAR requirement 3.1.2(b). We routinely send FSA a copy of the CEAR when revisions are made and the CEAR is re-issued, therefore FSA will

Ref	Summarised version of response	Environment Agency consideration of issues
	approach were to be accepted in the final permit, then it would appreciate formal notification of any decision to raise limits to the upper level. This would allow FSA to consider specific implications to food consumers and account for this during its routine food sample analysis.	be notified this way of any decision to move from lower site limits to upper site limits.
18	NFLA noted that removing site limits for certain radionuclides and replacing plant limits with notification levels makes comparisons between the proposed and previous permitted levels of discharges difficult.	Sellafield Ltd has provided comparison tables of existing site limits, originally applied for site limits and the revised site limits they are applying for after receiving an Environment Agency information notice. This is included in tables 5 and 6 of the Sellafield Ltd 'Response to Environment Agency request to provide additional information' report, which you can find on the consultation website.
19	NFLA welcomed the fact that aerial discharges associated with reprocessing and site aqueous discharges would both reduce. They raised concerns about expected increases to Sr-90 and Cs-137 aerial discharges attributed to remediation activities and that the impact of some site discharges will remain significant after reprocessing ends due to ongoing effluent treatment and chemical processes. NFLA raised concerns about removing some site limits based on the impact of current discharges and commented that removing site limits (where the dose consequence has been demonstrated to be below 1µSv/y) should only be justified where a future operating strategy indicates that increases in discharges are unlikely. NFLA also raised concerns that the site limits proposed in the application amounted to activity totals that were higher than figures provided by BNFL in 2000, which showed expected discharges after the closure of Magnox reprocessing facilities. NFLA included data from this BNFL document and stated that for aerial emissions of tritium, the BNFL document refers to a 90% reduction in aerial tritium emissions, which would equate to 25TBq (based on 1998 data) and compares this with the proposed limit for the permit which amounts to 220TBq.	We take an overall risk informed approach to regulation, while ensuring that environmental standards are maintained or improved, where practicable. In reference to 'remediation activities' referred to by NFLA, in some cases this means supporting high hazard and risk reduction programmes to ensure that the lifetime environmental risk and burden from one generation to the next is minimised. Indeed, at Sellafield we have a site-specific environmental outcome that we will work with ONR, NDA and Sellafield Ltd to ensure environmental risks are reduced through a sustainable restoration programme for legacy facilities that prevents and minimises discharges and disposals. As Sellafield Ltd describes in its application, aerial discharges of Sr-90 and Cs-137 are expected to increase based on the planned future retrievals programme from MSSS. We require Sellafield Ltd to use BAT in retrieving waste from MSSS to minimise the discharges of gaseous radioactive waste. We will keep the BAT position under review. Our criteria for removing gaseous limits is detailed in chapter 6 paragraphs 160 to 161 and in detail for each proposed site limit removal. We are only proposing to accept the removal of site limits where there are no reasons to consider that discharges will increase in the future. Any future increases in discharges would be noted in Sellafield Ltd's reviews required by CEAR requirement 4.2.2 part 2 paragraph 14, as well as our own review of discharge data. We have not rejected any of the site limit removals in Sellafield Ltd's submission in response to our request for further information. It should be noted that the site limits applied for in Sellafield Ltd's response to our request for further information were generally lower than those in its original application.

Ref	Summarised version of response	Environment Agency consideration of issues
		Also, even where limits are not set, Sellafield Ltd is required to apply the best available techniques to prevent and, where that is not practicable, to minimise actual discharges to the environment and ensure doses are as low as reasonably achievable (ALARA). The figures presented by BNFL in 2000 were estimates at the time. These have now been superseded by Overall Effluent Strategy Model predictions, which is a much more sophisticated way of modelling. We have discussed using the OESM in chapter 6, paragraphs 155 to 157.
20	Copeland Borough Council (CBC) commented that it was reassuring that the Environment Agency's definition of 'normal operations' included decommissioning when setting limits to maintain a headroom for normal operations. It also welcomed the fact that where there was less certainty over future discharges, no change to limits has been applied for.	It is noted that CBC are reassured that the definition of 'normal' operations includes decommissioning when setting limits. It is assumed that the '…less certainty over future discharges, no change to limits has been applied for' part of this response refers to MSSS plant notification levels. MSSS annual plant notification levels (APNLs) will mirror the current plant limits for aerial discharges. This is to reflect the uncertainty associated with implementing retrievals and the revised ventilation arrangements being applied. The APNLs will allow for greater flexibility during retrievals but are based on demonstrating BAT (best available techniques) and ALARA (as low as reasonable achievable). The APNLs and BAT/ALARA demonstration will continue to be reviewed throughout the implementation of the retrievals programme.
21	NFLA raised numerous concerns about the large headroom between the limits and the expected discharges. They stated this could allow discharges to be higher than they have been in the past, without constituting a breach of the permit. They state, in some cases, (for example aerial tritium, carbon-14 and strontium-90 discharges), the site limits do not reflect recent reductions in emissions. NFLA commented that it would be better to reduce the headroom on the limits and request Sellafield Ltd to provide a case by case justification for having higher than expected discharges.	Following our request for further information, Sellafield Ltd has proposed new values for site limits. The majority of these represent a large reduction from those in place in the current permit. Notably, there are significant reductions in the lower site limits for gaseous carbon-14 and strontium-90. Paragraphs 142 to 159 in chapter 6 explain our determination of site limits. This notes that: • proposed lower tier site limits generally align with OESM lower uncertainty projected discharges plus 15% to account for model uncertainty • proposed upper tier site limits are generally based on the OESM higher uncertainty projections plus 15% to account for model uncertainty. In some cases where more headroom is proposed between the OESM prediction and the site limit, generally this is because of unquantified uncertainties It is also worth noting the structure of discharge controls as detailed in paragraphs 45 to 49 and figure 3.2. Detailed consideration of gaseous site limits is provided in chapter 6 for tritium (paragraphs 208 to

Ref	Summarised version of response	Environment Agency consideration of issues
		210), carbon-14 (paragraphs 211 to 213) and strontium-90 (paragraphs 216 to 219). We note the comment that we should reduce the headroom in limits and require Sellafield Ltd to make case-by-case justification for higher discharges. We set limits on disposals in accordance with our document 'Criteria for setting limits on the discharge of radioactive waste from nuclear sites' (Environment Agency, 2012b). These limits are defined clearly in the permit so it is clear what limits are in force. A case-by-case system would make it more difficult for stakeholders to understand what limits were in force at any time. While the process above has been followed, it should also be noted that Sellafield Ltd is continually required to apply the best available techniques to prevent and, where that is not practicable, to minimise actual discharges to the environment and ensure doses are as low as reasonably achievable (ALARA).
22	NFLA commented that the proposed downgrade of the SIXEP stack should not happen until after data was received following the anticipated increase in the use of this facility.	It is assumed that the '…anticipated increase in use of this facility' refers mainly to the treatment of discharges from the Magnox Swarf Storage Silo (MSSS). This is discussed in chapter 6 paragraphs 256 to 258. We expect the challenge to SIXEP from waste retrievals will increase in future years and consequently we requested further information from Sellafield Ltd on the projected change in discharges. Sellafield Ltd provided additional information as a memorandum on 13 February 2019 (Sellafield Ltd, 2019g). This sets out how it has used the OESM to predict future discharges from this outlet, accounting for the increased challenge that the facility will see from waste retrievals. The conclusion of this modelling work is that discharges are not expected to increase.
23	Respondents commented that it was difficult to find justifications of the statements made in section 6, regarding retaining, reducing or removing site limits due to the complex nature of the tables in appendices 1 and 2 of the application. Respondents noted that using 0% to represent good practice in appendix 2 needed further explanation.	These comments are noted. There is greater clarity regarding reducing site limits in Sellafield Ltd's response to our further information request (Sellafield, 2019a). Regarding using 0% to represent good practice in our determination of site limits in chapter 6, we describe our consideration of the amount of monthly discharges that exceed the good practice decision threshold. 0% in those tables, means that no discharges exceeded the good practice decision threshold. The good practice decision threshold concept is defined in 'Radiological monitoring technical guidance note 1: Standardised reporting of radioactive discharges from nuclear sites' (Environment Agency and SEPA 2010). The decision threshold is taken to be half of the detection limit (CEC, 2004). The guidance note states that where

Ref	Summarised version of response	Environment Agency consideration of issues
		the monitored value is less than the decision threshold, it can be reported as one-half of the decision threshold. Where all monitored values in the year are less than the decision threshold, then no discharge assessment is needed. Sellafield Ltd has used this guidance as part of its rationale for proposing removal of site limits.
Topic: Disposal routes and limits (Disposals by burial in an engineered facility on the site)		
24	The COMARE working group commented that the location of the CLESA landfill was not clear and questioned whether an evaluation of the flood risk had been carried out.	CLESA is located close to the point on the Sellafield site at which the River Calder enters the sea. The location is marked on the revised site plan in schedule 7 of the permit. We have required Sellafield Ltd to carry out an assessment of flood risk for now and into the future. Flood risk for CLESA specifically has been addressed in the 2015 environmental safety case and the 2017 post-closure radiological safety assessment (PCRSA). The recent PCRSA covers both riverine and tidal flooding scenarios. In addition to this, Sellafield Ltd also carried out a site-wide flood assessment covering short-term (1 in 10-year rainfall events) to long-term (1 in 10,000 year+ rainfall events. The site-wide flood assessment includes the area on which CLESA is located.
Topic: Radiological impact assessment (Comparison with constraints and limits)		
25	Respondents commented that it was unclear what the doses shown in table 1 of the application represented, and that current annual doses from historic discharges should have been included in the application.	We recognise that this part of the application was unclear. Sellafield Ltd provided further information on its dose assessment as part of its application (Sellafield Ltd, 2018b). It also provided an updated dose assessment for the site limits as proposed in response to our request for further information (Sellafield, 2019f). In summary, the annual doses calculated by Sellafield are: • current aerial limits: adult 40µSv, child 35µSv and infant 41µSv • proposed aerial annual plant notification levels: adult 6µSv, child 5µSv and infant 6µSv • current aqueous limits: 231µSv • proposed upper aqueous limits: 132µSv • proposed lower aqueous limits: 67µSv We have also provided our own dose assessments in chapter 7. Current annual doses from historic/past discharges are presented in chapter 7, paragraphs 434 to 437. The highest doses that arose from radionuclides in the marine environment were to an adult eating molluscs between 2014 and 2017. Past discharges from Sellafield contributed between 70 and 78µSv/y to these doses. In total, these ranged from 220 to 420µSv/y, due to an additional 150 to 340µSv/y. This was mostly due to Po-210 in crabs and molluscs from past discharges from a phosphate works on the coast near Sellafield. The highest doses from past

Ref	Summarised version of response	Environment Agency consideration of issues
		gaseous discharges were to local inhabitants and ranged from 8 to 12µSv/y between 2013 and 2017.
26	The FSA commented that the Radioactivity in Food and Environment Report for 2017 reports that the highest total dose in the vicinity of Sellafield was assessed to have been 0.25mSv, or 25% of the dose limit to members of the public. The doses from man-made and naturally occurring radionuclides were 0.077 and 0.18mSv respectively. Sellafield was the source of man-made radionuclides, while the naturally occurring ones came from the phosphate processing works near Sellafield at Whitehaven. Doses reported have varied in previous years but have been well within legal limits. These doses are based on the results of sampling carried out by the FSA and the Environment Agency.	This consultation response is noted.
27	FSA commented that it has been several years since it revised and updated its radiological assessment models, and that it intends to carry out a full assessment based on the proposed discharge limits given in the application during the next consultation phase. FSA requested further clarity on the likely contributors to the generic limits of Pu-alpha, alpha and beta radionuclides in order for it to produce a realistic assessment.	We have been in contact with the FSA and provided the same information that we provided to our contractors so that it can carry out the necessary radiological assessments. This has included a description of the approach our contractors took to deriving the source term for the grouped radionuclides of Pu-alpha, alpha and beta radionuclides. FSA provided a dose assessment from discharges at the upper limits of 114-166µSv/y. FSA's assessment is detailed in chapter 7, paragraphs 458 to 461. FSA's assessment is based on eating foods grown around the site and fished from the marine environment.
28	NFLA commented that given the contribution to doses from historic discharges from Sellafield Ltd, and that the figures given in the Sellafield annual discharge review 2015 to 2017 are calculated for adults and don't necessarily take into account the greater vulnerability of pregnant women and children, it is important to reduce additional doses from future discharges by the maximum amount feasible.	We requested information from Sellafield Ltd regarding its dose assessment approach used to derive the figures in its annual discharge review 2015 to 2017. Sellafield Ltd responded as follows: 'The aerial dose assessment methodology does include children and infants as well as adults and uses habit data that incorporates a high degree of conservatism, assuming that members of these groups live adjacent to the site and obtain all their foodstuffs from land adjacent to the site. The methodology uses high consumption rates for the two foodstuffs that contribute most to offsite dose (milk and root vegetables) and therefore also accounts for potential variability in the consumption habits of individuals. The marine dose assessment methodology applies to only one group, the high rate West Cumbrian adult seafood consumer, as this group was considered to

Ref	Summarised version of response	Environment Agency consideration of issues
		be the one most at risk from seafood consumption and exposure over intertidal sediment. The consumption rates that are applied specify that 94.8 kg of locally caught fish and shellfish are consumed per year which represents a very high rate of seafood consumption, whereby more than 250 grams of locally caught seafood are consumed each day. The assessment also assumed that exposure over sediments occurred for 830 hours per year (or for more than 2 hours per day every day of the year) which again represents a very high value for sediment exposure. As the doses from ingestion and exposure to sediments are additive it is clear that these assumptions in the assessment mean that the dose calculations represent an upper case for the high rate West Cumbrian adult seafood consumer. Doses to children and pregnant women would be considerably lower than the doses to the high rate West Cumbrian adult seafood consumer.' Our dose assessments are presented in Chapter 7. We have assessed doses to the public from past and future gaseous and direct radiation close to the Sellafield site and aqueous discharges to the marine environment around the Irish Sea. The representative person is drawn from groups living close to the site, using the environment around the site and consuming foods produced near the site. Dose assessments have been performed for adults, children, infants and offspring (Environment Agency, 2019), to determine the representative person. Offspring are unborn babies (9 months) and the first 3 months after birth. We have not presented the doses to offspring in this document as they are similar to, or less than, the doses for other age groups. The dose to pregnant women themselves will be the same as for an adult. The representative person for the Sellafield site for future expected discharges is an adult from an exposed group that lives close to the site and consumes higher than average amounts of molluscs taken from the marine environment close to the Sellafield site. The representative person consumes other seafoods at lower rates and eats some farmed foods produced on farmland (terrestrial environment) around the site. The representative person's habits were taken from habits survey data. The total assessed doses from past and future discharges and direct radiation are discussed in paragraphs 467 to 468 and are below the dose limit for members of the public of 1,000µSv/y. It should be noted that Sellafield Ltd is required to apply the best available techniques to prevent and, where that is not practicable, to minimise discharges

Ref	Summarised version of response	Environment Agency consideration of issues
		to the environment and ensure doses are as low as reasonably achievable (ALARA).
29	One respondent noted that the target dose of 20µSv/y for the critical group arising from aqueous discharges, made following the OSPAR and Paris conventions, was a large ask for Sellafield Ltd and noted that to achieve this before the end of Magnox reprocessing was a success.	Sellafield Ltd's dose assessment at the limits originally applied for gave a prospective dose to the representative person arising from aqueous discharges of 170µSv/y (phase 1 limits), 130µSv/y (upper limits) and 90µSv/y (lower limits). Sellafield Ltd's dose assessment at the revised limits gave a prospective dose to the representative person from aqueous discharges of 132µSv/y (upper limits) and 67µSv/y (lower limits). Our dose assessment at the revised limits Sellafield Ltd applied for gave a prospective dose to the representative person arising from aqueous discharges of 106µSv/y (upper limits) and 58µSv/y (lower limits). The results of our assessment, the Food Standard Agency's assessment and Sellafield Ltd's assessment are discussed in section 7 of the decision document, as well as a comparison with dose constraints and limits. This comparison demonstrates that the dose values from all three assessments are less than the relevant statutory source and site dose constraints and dose limits. We are therefore satisfied that the doses to the public associated with the permitted discharges from the Sellafield site will be below the dose criteria specified by the Environmental Permitting Regulations.

Appendix 3 Underpinning references to Sellafield Ltd's application

Sellafield Ltd (2018) RSA Environmental Permit Variation Application EM/2018/19. Sellafield Ltd. (Sellafield Ltd, 2018a)

Sellafield Ltd (2016) Monitoring Our Environment. Discharges and Environmental Monitoring Annual Report 2016. Sellafield Ltd. (Sellafield Ltd, 2016)

Sellafield Ltd (2018) Assessment of radiological doses to marine and terrestrial representative persons (critical groups) at site limits as proposed for the Sellafield Major Permit Review. Sellafield Ltd. (Sellafield Ltd, 2018b)

Sellafield Ltd (2018) Annual Discharges Review, 2015 - 2017. Demonstration of the progressive reduction in discharges and hazard at Sellafield (NDA EPI Objective 5). Sellafield Ltd. (Sellafield Ltd, 2018c)

Sellafield Ltd (2018) Major Permit Review Application – Framework of Arrangements for the Demonstration of BAT. Sellafield Ltd. (Sellafield Ltd, 2018d)

Department for Business, Energy & Industrial Strategy (2018) UK Strategy For Radioactive Discharges 2018 Review of the 2009 Strategy. London: Department for Business, Energy & Industrial Strategy. (GB Parliament, 2018a)

Sellafield Ltd (2018) DS-005-0179 - Sellafield Effluent Strategy Modelling Discharge Projections in support of the Sellafield Ltd Radioactive Substances Activity Environmental Permit Application Site Limit Proposals. Sellafield Ltd. (Sellafield Ltd, 2018e)

Letter EA-07-8313-60 RSR Permit CLESA Variation Application, March 2017 (Sellafield Ltd, 2017)

Post Closure Radiological Safety Assessment, 60493376/MARP003, December11Sellafield Ltd (2018). Waste/Tech/838. BAT Justification of a Specific Tritium Limit for CLESA disposals. Sellafield Ltd. (Sellafield Ltd, 2018f)

Sellafield Ltd (2018) Proposal for the Removal of Discharge Limits from the First Generation Magnox Storage Pond Stack. Sellafield Ltd. (Sellafield Ltd, 2018g)

Sellafield Ltd (2018) Proposal for the removal of discharge limits from the SIXEP stack. Sellafield Ltd. (Sellafield Ltd, 2018h)

Sellafield Ltd (2018) SAV RSA Major Permit Review. Sellafield Ltd. (Sellafield Ltd, 2018i)

Sellafield Ltd (2013) SLF 2.11.109.01 Public Dose Factor Tables. Issue 2. Sellafield Ltd. (Sellafield Ltd, 2013a)

Wise Uranium project (2016) Uranium Radiation Properties. [ONLINE] Available at: http://www.wise-uranium.org/rup.html. (Wise Uranium, 2016)

Department of Energy & Climate Change (2005) SEA6 Section 5 - Physical and chemical environment. (GB Parliament, 2005)

Hunt, G. J. (2004) Radiological assessment of ocean radioactivity. In Marine Radioactivity, ed. H. Livingston, Radioactivity in the Environment, Vol 6. pp205 – 236. (Hunt, G.J., 2004)

Appendix 4 Additional information provided during determination

Question	SL response by email: Date (time)
We requested that Sellafield Ltd provide an update to DS-005-0179 – Sellafield Effluent Strategy Modelling Discharge Projections in support of Sellafield Ltd Radioactive Substances Activity Environmental Permit Application Site Limit Proposals (referred to later as SEMS & the SEMS paper)	1/3/19 (15:27)
We requested reference(s) for a benchmarking report or external review for the SEMS model	4/2/19 (12:14)
We requested clarification on whether MSSS compartment 10 retrievals are included in the SEMS modelling	14/2/19 (15:53)
We sought an explanation of apparent differences between data in Sellafield Ltd's permit variation application and that provided under the UK Strategic Review of Discharges	2/10/18 (11:11) 15/2/19 (09:10) 15/2/19 (15:13)
We raised a query on Sellafield Ltd's dose assessment calculations	11/12/18 (15:05)
We requested clarification regarding total alpha and beta dose assessment methodology, analytical techniques and detection efficiency	24/5/19 (12:46) 28/5/19 (14:43) 11/6/19 (15:10)
We requested clarification regarding Sellafield Ltd's dose assessment methodology and how it accounts for pregnant women and children (including infants)	2/7/19 (08:36)
We requested underpinning calculations for Sellafield Ltd's proposed APNLs	15/1/19 (15:18) 21/1/19 (13:37) 21/1/19 (13:47) 25/1/19 (13:31)
We requested clarification on determination of aqueous trigger levels	25/1/19 (13:36)
We requested clarification on determination of aerial trigger levels	25/1/19 (13:31) 28/1/19 (14:29) 29/1/19 (13:36)
We confirmed our requirement for quarterly reporting of monthly trigger level exceedances	12/3/19 (09:43) 21/5/19 (14:47)
We requested clarification regarding the difference between aerial C-14 proposed limits and projected discharges	26/11/18 (14:46)
We requested clarification of the uncertainty in Kr-85 aerial discharges and whether this is due to uncertainty in the reprocessing schedule	27/2/19 (10:26) 6/3/19 (9:58)
We requested an explanation of apparent inconsistencies in 2 data sources for aqueous Co-60 projected discharges	1/3/19 (15:27)
We requested further explanation, or a lower proposed limit, for Ru-106 aqueous discharges, particularly as Ru-106 gives rise to the largest dose from aqueous discharges	27/2/19 (11:59) 5/3/19 (15:38)

Question	SL response by email: Date (time)
	1/3/19 (16:14)
We requested additional data to determine whether FGMSP should become an 'approved outlet', particularly in respect of the potential for increased discharges during D-bay retrievals	31/1/19 (15:38)
We requested future discharge projections for FGMSP, FHP and SIXEP, including where MSSS retrievals will increase the challenge on SIXEP	4/2/19 (12:14) 13/2/19 (14:57)
We requested clarification regarding MSSS annual plant notification levels and MSSS aerial trigger levels	8/2/19 (15:18)
We requested a copy of MSSS retrievals - retrievals ventilation system aerial flow sheet with 2nd extension scrubber and HEPA abatement	5/2/19 (9:16)
We requested Sellafield Ltd's techniques document changes regarding transfer to MSSS 2nd extension extract ventilation	18/1/19 (14:37)
We queried the proposed C-14 annual plant notification level for STP, and requested clarification on how Sellafield Ltd will provide reassurance in all cases that no significant unexpected and unmonitored discharges occur as a result of POCO or other changes to effluent management	14/2/19 (15:36)
We requested clarification as to how the THORP aerial trigger levels had been derived	6/12/18 (16:56) 14/2/19 (13:05) 15/2/19 (08:35)
We requested additional information to demonstrate that Kr-85 discharges from THORP are directly linked to fuel shearing	5/3/19 (11:18)
We requested clarification on proposed values for SAV monthly decision thresholds, stack dose triggers and annual plant notification levels	11/12/18 (15:39) 13/12/18 (15:28) 21/2/19 (11:37)
We requested clarification of the discharge data for the NNL (combined) stack, analysis of NNL trigger levels. We clarified the proposed annual plant notification level values in the application relative to the trigger levels	20/2/19 (11:30)
We asked whether continuing to have annual plant notification levels for Cs-134 in fuel storage ponds would provide useful information regarding the condition of stored fuel	22/2/19 (14:59)
We requested further information regarding THORP C-14 removal plant aqueous triggers and proposed limits	5/2/19 (10:02) 14/2/19 (13:05)
We proposed that Sellafield Ltd adopt a lower limit for Ru-106, and requested clarification on how Sellafield Ltd implements waste vitrification plant 'unblocking' operations, to inform the required timescale for implementing a CEAR change to an upper limit	13/2/19 (15:40) 4/2/19 (12:14)
We requested clarification of the aqueous Pu alpha discharge trend for EARP, and whether the lower notification level was appropriately set	14/2/19 (16:16)
We queried the large C-14 discharge uncertainty for SIXEP discharges, relating to legacy ponds and silos retrievals work, and proposed the need for an annual plant notification level	1/3/19 (15:27)

Question	SL response by email: Date (time)
We queried Sellafield Ltd's calculation of proposed annual plant notification levels for specific radionuclides in SIXEP discharges	14/2/19 (15:45) 14/2/19 (16:30)
We queried EARP Co-60 and SIXEP C-14 annual plant notification levels	13/12/18 (13:30)
We proposed a reduction in the uranium aqueous discharge limit, and consideration of a uranium aqueous annual plant notification level for SETP	12/3/19 (14:00) 13/3/19 (15:50) 15/3/19 (15.28)
We requested Sellafield Ltd provide proposed Sr-90 notification levels for lagoon aqueous discharges and associated past monitoring information	14/2/19 (16:16, 17:42) and related spreadsheet
We requested a boundary map detailing the location of CLESA within the Sellafield RSR permit boundary	29/7/19 (12:36)
We were originally notified that Sellafield intended to submit a proposal for increased H-3 limits at CLESA in March 2017. This was followed up on 28 September 2018 at 9:55am. We subsequently met with Sellafield Ltd on 5 October 2018 to discuss its outline proposals, where it was agreed that the proposal to increase the limits would be incorporated into the MPR Receiving the documentation, a number of significant issues were clear, which centred on the upper limit of H-3 being requested, and the general standard of the submission These issues were progressed through direct contact with the Sellafield CLESA team, and as such no request for further information is included here Our review comprised the following: review of draft 1 (generic H-3 increase) – sent 6 February 2019 at 8:54am review of draft 2 (2nd issue of generic H-3 increase and new technical note) – sent 19 June 2019 at 8:18am review of finalised version based on 12kBq limit – received 24 July 2019	25/10/18 (11:27) 17/10/18 (11:35) 30/10/18 (09:04) 07/11/18 (10:05) 07/11/18 (13:31) 14/11/18 (08:42) 16/11/18 (10:41) 29/11/18 (08:19) 06/02/19 (08:54) 15/02/19 (16:41) 27/02/19 (08:39) 27/02/19 (13:11) 28/02/19 (08:55) 06/03/19 (09:51) 06/03/19 (15:36) 22/03/19 (13:10) 21/06/19 (07:55) 09/07/19 (13:34) 12/07/19 (10:45) 24/07/19 (14:33) 25/07/19 (10:56) 25/07/19 (11:03) 25/07/19 (12:02)
We questioned whether the Ground Environmental Review Meeting was providing the required annual update on leak management technologies that could be used at MSSS and the First Generation Magnox Storage Pond (FGMSP) and surrounding areas.	01/08/19 (14:50) 02/08/19 (14:17)

Appendix 5 Detail regarding changes to the Compilation of Environment Agency Requirements (CEAR)

Revised CEAR

523. The requirements for improvements and information can be found in the permit and its associated Compilation of Environment Agency Requirements, Approvals and Specifications (CEAR) document. The conditions of the permit are legally binding on Sellafield Ltd. The CEAR is used to specify the detailed requirements of the permit conditions so that they are fully complied with. The CEAR is not legally binding in itself and we are not formally consulting on the details that it contains. We will work closely with Sellafield Ltd to ensure that the CEAR is fully implemented, once our final decision on the application is made. A copy of the revised CEAR will be placed on the Public Register when we have come to a final decision in respect of the application. This appendix is intended to provide a summary, by way of information only on the changes that have been requested to CEAR by Sellafield Ltd and those which have been proposed by the Environment Agency.

CEAR changes requested by Sellafield Ltd

Review of CEAR requirement 3.2.5(a)

524. For many years, we have carried out check monitoring of the gaseous and aqueous discharges covering the most significant sources at Sellafield and other major nuclear sites in England and Wales. In line with legal requirements and international commitments, this supports independent verification that basic standards are being applied to protect people and the environment. This is specified in the permit in CEAR requirement 3.2.5(a).

525. Sellafield Ltd has proposed that this check monitoring is reduced by approximately 50% simply by reducing the frequency of sampling and analysis from quarterly to biannually. Sellafield Ltd believes that there is a strong case for these reductions and that it is in line with proportionate regulation and BAT. In particular, in its application, Sellafield Ltd draws attention to the costs, and notes that agreement between its and our monitoring is high and has improved over the years, and also that performance is currently stable.

526. Separately, we have indicated to the nuclear industry that demonstrating high standards for monitoring and analysis strengthens the case for reducing independent check monitoring. Through our site inspection work, we are aware that Sellafield Ltd aims to conform with relevant international standards for sampling, and uses laboratories for analysis that are accredited to ISO17025. However, its laboratory has no current plans to obtain MCERTS accreditation for radiochemical analyses.

527. We have reviewed the Sellafield independent check monitoring for radioactive discharges taking account of:

- Sellafield Ltd's proposals
- the application of relevant standards to Sellafield Ltd's discharge monitoring programme
- our wider nuclear sector check monitoring programme for radioactive discharges
- changes at Sellafield as the site transitions from reprocessing operations to decommissioning and waste management
- our decisions regarding future site limits and notification levels
- our desire for radioactive discharge monitoring to be accredited to ISO17025 and MCERTs

528. On this basis we have decided that:

- the requirement for independent check monitoring for THORP C-14 removal plant/dissolver off gas aqueous and gaseous discharges and THORP reprocessing gaseous discharges will be removed as these plants are now running down operations and moving into POCO
- the requirement for independent check monitoring for the Magnox reprocessing stack gaseous discharges will be removed as the discharges have been diverted to the separation area ventilation stack.
- independent check monitoring for radionuclides where site limits have been removed will be stopped
- the requirement for reporting monthly discharges of antimony-125 from SIXEP and quarterly discharges of zinc-65 from SETP has been removed. We expect reporting under CEAR requirement 4.2.2 part 2 paragraph 14 to include any significant discharges of radionuclides that are not subject to site limits or annual plant notification levels

529. The word 'leachate' has been removed from the paragraph relating to CLESA of CEAR 3.2.5(a), so that the requirement applies to everything in the environmental monitoring programme. This is in line with Sellafield Ltd's proposal.

Review of CEAR requirement 4.2.2 part 2 paragraph 1

530. Currently, Sellafield Ltd is required to submit detailed waste return information (waste quantity and type) for the CLESA landfill each quarter. It then submits the same level of detail on a separate form annually. We agree with the proposal to remove the requirement for quarterly waste returns as they add little benefit to regulating this facility. The requirement to submit the detailed information annually will remain. The existing requirement to submit annual summary information in CEAR proforma 7 also remains unchanged.

Review of CEAR requirement 4.2.2 part 2 paragraph 3

531. Sellafield Ltd has proposed amending the wording for condition 4.2.2 part 2 paragraph 3 that covers the environmental monitoring programme from:

(e) any positive result which exceeds the mean plus 3 standard deviations of the previous 12 results shall be highlighted and, as far as reasonably practicable, an explanation shall be provided for any such elevated value.

(f) Any result, where the criteria in (e) cannot be applied (due to a lack of previous results), which exceeds three times the expected background value or twice the limit of detection in cases where the expected background is limit of detection, shall be highlighted and, as far as reasonably practicable, an explanation shall be provided for any such elevated value.

to:

(e) any positive result that exceeds the criteria agreed in writing with the Environment Agency and, as far as reasonably practicable, an explanation shall be provided for any such elevated value.

532. The reason for these changes is due to ongoing discussion between the Environment Agency and Sellafield Ltd regarding notification of results that exceed the above criteria. The current approach is not working because we are receiving notifications that are not of interest to us.

533. Since the variation application, we and Sellafield Ltd have subsequently agreed new wording of the CEAR that, if accepted after we have carried out an internal review, will represent a generic change to the CEAR. Until this new wording is finalised, we have taken the decision to reject the wording suggested by Sellafield Ltd in its variation application. The original wording of the CEAR will, therefore, remain for the time being.

Review of CEAR requirement 4.2.2 part 2 paragraph 4

534. The proposal to add the following bullet point into CEAR requirement 4.2.2 part 2 paragraph 4 is accepted with minor amendments. We have agreed the minor amendments with Sellafield Ltd by e-mail as part of the determination of this variation application.

- any positive result in the Calder Floodplain Landfill Extension – Segregated Area (CLESA) monitoring results which exceeds the control, action or trigger levels specified in the Environmental Monitoring Programme (Site Operational Phase) for Calder Landfill Extension Segregated Area and, as far as reasonably practicable, an explanation shall be provided for

any such elevated value. Where no explanation is available for any such exceedance, Sellafield Ltd shall inform the Environment Agency to that effect.

535. Including all CLESA monitoring under CEAR requirement 3.2.5(a) above makes it necessary to include this new requirement to inform the Environment Agency 'without delay' when any of the control, action or trigger levels are exceeded. The environmental monitoring programme (site operational phase) for Calder Landfill Extension Segregated Area contains a set of contingency actions to be taken if any control, action or trigger levels are exceeded.

Review of CEAR requirement 4.2.2 paragraphs 8, 26, 27, 28

536. These CEAR requirements state that Sellafield Ltd must notify us regarding specified circumstances.

537. Sellafield Ltd proposes that we combine current requirements 8, 26, 27 and 28 into a single requirement. We have decided that this proposal is acceptable and CEAR requirement 4.2.2 (8, 26, 27, 28) will be consolidated into a single CEAR requirement as paragraph 8. This will cover notifications regarding plant modification proposals, diversion of discharges from sea line 2 to sea line 3, and pumping of lagoon liquor to discharge via the factory sewer in exceptional storm conditions.

Review of CEAR requirement 4.2.2 part 2 paragraph 9

538. Sellafield Ltd has proposed removing the requirement for an annual CLESA leachate report. The current CEAR requirement is for Sellafield Ltd to submit CLESA leachate quality and level data quarterly, six-monthly and annually. This is in addition to the CLESA annual report (CEAR 4.2.2(9 a-e)). Including the new requirement to inform the Environment Agency 'without delay' if a control, action or trigger level (specified in the environmental monitoring programme - see above) means that there is no longer any need for Sellafield Ltd to report the raw data any more regularly than in the annual report. The requirement to report the leachate data remains, but only as part of the annual report as required by CEAR 4.2.2(9)(a-e). Any exceedences that require action to be taken will be flagged up and acted on at the time they occur.

Review of CEAR requirement 4.2.2 part 2 paragraph 10

539. Sellafield Ltd has requested that it is made clear that this CEAR requirement applies to the CLESA landfill. We have amended the CEAR accordingly.

Review of CEAR requirement 4.2.2 part 2 paragraph 15, 16, 17 and 18

540. These requirements relate to demonstrating that BAT has been used. A Sellafield BAT improvement programme, which we support, is currently underway. This will ensure greater clarity in Sellafield Ltd's arrangements for demonstrating it has used best available techniques. Once this position has been reached, we will consider with Sellafield Ltd how the arrangements can meet these 4 information requirements. It should also be noted that our review of CEAR requirement 24 (see section below covering our changes to the CEAR) concluded that we will require Sellafield Ltd to evaluate environmental performance reporting options and submit a report to us setting out its preferred option. This process may also help to meet the intent of these requirements.

Review of CEAR requirement 4.2.2 part 2 paragraph 23

541. Sellafield Ltd proposed that the SIXEP submission should only be submitted once every 5 years. The section below covering our changes to the CEAR outlines our consideration of this matter and wider changes to this requirement.

Review of CEAR requirement 4.2.2 part 2 paragraph 25

542. We consider the existing requirement does not give us a clear understanding of the BAT assessments Sellafield Ltd is using for low level waste and very low level waste at any given time. This revised requirement requires the operator to continue to review the BAT assessments to make sure they are always up to date. Sellafield Ltd will also be required to provide its summary document (specified) to us whenever it is updated, so we always have an up-to-date list of BAT assessments for LLW and VLLW. We are able to request the full BAT assessments at any time for regulatory purposes.

CEAR changes proposed by the Environment Agency

Table 1

543. This table has been revised to reflect all CEAR changes.

Review of CEAR requirement 3.1.1

544. To clarify understanding of the approved outlet, Ref. 110 ‘Settling tank area ventilation’ will be renamed as ' redundant sludge tank’.

545. As discussed in chapter 6, based on information currently available, we have decided to remove the SIXEP stack from the permit and have redesignated it as an 'approved outlet'. This is because the discharges from the SIXEP stack (disposal outlet reference A7) for the period 2002 to 2018 have been very low and had very low radiation dose consequences.

546. As discussed in chapter 6, the ventilation system serving the decontamination centre has been permanently switched off and Sellafield Ltd plans to decommision and remove the external ventilation system over the coming year. Sellafield Ltd also plans to reuse this facility for waste characterisation, sorting and segregation, but using modular self-ventilated plant (this is known as an 'active demonstrator' project). Consequently, we have decided to remove the decontamination centre stack (disposal outlet reference A15) from the permit and have resignated it as 'other approved outlets' in the CEAR document known as 'active demonstrator'.

547. Although it is not currently part of the MPR application, there may be an urgent requirement to register an approved outlet for the ‘interim storage facility (ISF)’ before the next revision of the CEAR. The Environment Agency and Office for Nuclear Regulation are currently assessing Sellafield Ltd’s proposals for storing zeolite skips in self shielded boxes (SSBs) in the ISF, and are not yet in a position to confirm the outcome of this review. This is anticipated later in 2019 and, therefore, will be actioned outside of the MPR.

548. We have taken the opportunity to spell out acronyms to increase transparency.

549. As set out in chapter 6 by revising CEAR requirement 4.2.2 part 2 paragraph 14, we will require a high level review of the discharge data for all ‘open fuel storage ponds and other approved outlets’, to understand and highlight the reasons for any significant changes in discharges and to summarise any changes required to ‘other approved outlets’. We believe that introducing this requirement will make sure that those stacks with significant potential to discharge maintain a monitoring capability so that we will be able to make sure that appropriate permit limits or annual plant notification levels are introduced should there be any unexpected increase in discharges in the future.

CEAR requirement relating to permit condition 3.1.2 (b) new requirement

550. A new CEAR requirement is needed regarding which upper site limits are currently in force. We have detailed in tables 6.3 and 6.7 which site limits will be in force when the permit variation comes into effect. There will be 2 important milestones that we will require Sellafield Ltd to notify us about, that will result in a number of the site limits moving from upper to lower. Once the lower limit is in force, it will routinely be in force. The upper limit will only be in force in cases where we have agreed that Sellafield Ltd has submitted a BAT case to us regarding the need to move to the upper limit for a certain period of time to carry out certain tasks. We will respond to this BAT case by letter, agreeing to move to the upper limit, or not. If we agree to move to the upper limit, then this CEAR will be modified accordingly.

551. In some cases, for example, to allow unblocking operations in waste vitrification plants, this change may be required quickly. In recognition of this, we have already accepted Sellafield Ltd’s BAT case (Sellafield Ltd, 2019c) supporting the need for upper limits for WVP unblocking operations. Therefore, if Sellafield Ltd proposes to carry out unblocking operations that may challenge the lower limit, as detailed in the BAT case, then we only require it to notify us of those operations, and we will change the CEAR to record that the upper limit is in force. However, Sellafield Ltd is continually seeking to improve vitrification operations, so there may be a circumstance in the future where an unblocking operation is planned that does not fit with the current BAT case. If that happens, Sellafield Ltd will need to provide an updated BAT case, which we will assess to decide whether to change the CEAR to record that the upper limit is in force.

Review of CEAR requirement 3.2.5(b)

552. To avoid the need to update this CEAR requirement when CEAR requirement 3.2.5(a) is revised, we have removed the version number of 3.2.5(a).

New CEAR requirement 4.2.1

553. Specification of the contact details for reports and notifications.

Review of CEAR requirement 4.2.2 part 1

554. Updating paragraph 1 to the latest template, including removing the schedule. In particular, the pollution inventory reporting form is no longer required to be specified as part of this CEAR, as it is available online. We have, therefore, removed it from the CEAR.

Review of CEAR requirement 4.2.2 part 2 paragraph 1

555. As noted in chapter 6, we will require Sellafield Ltd to provide us with quarterly reports regarding exceedances of internal triggers for monthly aqueous and gaseous discharges for plants with annual plant notification levels. For all exceedances, the operator must consider checking the laboratory analytical results and performing repeat analyses, if required. For more significant or repeat exceedances, the operator must investigate the cause. If the outcomes from analytical checks and investigations are not available at the time of reporting, the status will be reported and the issue will be included in the next report. These reports are required on 1 June, 1 September, 1 December and 1 March each year.

556. We have revised table 1 to reflect changes in the reporting requirements. We have removed proformas 2c and 5 as they are no longer required. Proformas 1c, 4 and 6a already had no requirements and consequently we have also removed them.

Review of CEAR requirement 4.2.2 part 2 paragraphs 3 and 7

557. References in these paragraphs to 'Annexes II and III to the Council Directive 96/29/Euratom of 13 May 1996' (EU, 1996) shall be replaced by 'Annexe II to the Council Directive 2013/59/Euratom of 5 December 2013' (EU, 2013).

Review of CEAR requirement 4.2.2 part 2 paragraph 6

558. We have identified asset management (AM) as one of our highest regulatory priorities, directly supporting compliance with environmental permits, including applying BAT. Effective AM will also bring overall efficiencies and cost savings that support our wider environmental outcomes, including reducing environmental risk, sustainable remediation and earlier decommissioning and clean-up. Modern AM requires whole lifecycle asset management to be considered. We consider effective and efficient AM to be crucial in ensuring the right investment decisions are made to minimise risks to people and the environment while ensuring the best use of resources. Following our themed inspection in 2018, we have agreed a set of recommendations for improvements to Sellafield Ltd's asset management arrangements. We are continuing to work with Sellafield Ltd as it develops an improvement programme, and to monitor progress of this programme. Consequently, we have decided to expand CEAR requirement 4.2.2 part 2 paragraph 6 to require Sellafield Ltd to report its progress to us against this AM improvement programme.

559. We expect that the operator will use formal asset management arrangements to ensure continuing permit compliance, and we consider ISO 55001:2014 (ISO, 2014) to be the benchmark standard for asset management arrangements.

560. We have a long-standing interest in managing redundant ductwork at the Sellafield site, and have placed repeated inspection recommendations in relation to this matter over the last 10 years. Concerns were first raised through a gaseous waste themed inspection in 2007. In 2013, Sellafield Ltd provided a report to us covering redundant ventilation systems on the Sellafield site and a summary of the plans to decommission or remove these systems. However, progress has been slow. We have a specific interest in redundant plant given our role in regulating discharges of radioactive waste by these systems and the expectation that radioactive waste remains within them, particularly upstream of abatement systems. Release of this radioactive waste due to a loss of containment of the ductwork would impact on people and the environment, and would be non-compliant with the RSA environmental permit for the site. Furthermore, we do not consider that discharge of this type of legacy waste from redundant systems still connected into operational

systems is consistent with using BAT. Consequently, we have decided to expand CEAR requirement 4.2.2 part 2 paragraph 6 to require an annual register of redundant radiological ventilation ducting, plans to decommission this ducting and summary details of the work carried out in the previous 12 months to decommission redundant ventilation ducting to be provided. We hope that this approach will raise the profile of this matter, and mean that it is addressed promptly, thereby avoiding foreseeable environmental events and associated enforcement action.

Review of CEAR requirement number 4.2.2 part 2 requirement 12

561. We have updated this requirement to refer to 'best available techniques' rather than 'best practicable means' and 'best practicable environmental option'.

Review of CEAR requirement number 4.2.2 part 2 requirement 14

562. This CEAR requirement relates to the need for Sellafield Ltd to develop and maintain an integrated waste strategy (IWS) and associated action plan, to provide annual reports on the overall effluent strategy, and to support our annual permit review.

563. We originally required integrated waste strategies to be developed and maintained for some of the more complex nuclear sites that we regulate. Subsequently, NDA working with regulators (Environment Agency/ONR/SEPA/NRW) established an IWS specification and required their nuclear sites to develop and maintain IWSs. As discussed in chapter 5 relating to permit conditions, working with SEPA and NRW, we have decided to introduce standard permit conditions for all nuclear sites relating to the need to prepare and maintain a waste management plan and site wide environmental safety case and to notify us of significant changes. Noting that the content of the WMP/SWESC covers very similar scope to an IWS, NDA intends to review its IWS specification over the coming year, consulting with regulators. It is important that we avoid duplicate or conflicting guidance on this matter, and we will work with NDA and our regulator colleagues to achieve this.

564. We are conscious that the submission date for the Sellafield Ltd WMP/SWESC is not until March 2023, in part due to the complexity of the Sellafield site, but also to allow limited specialist assessment resource across the nuclear sector to be used most effectively. To support this process, we intend to carry out a high level review of the Sellafield IWS in the context of the decommissioning strategy and plans and available information relating to the SWESC over the coming year. We will request the necessary information by corresponding with Sellafield Ltd rather than through the RSA permit. The review will support Sellafield Ltd's development of the WMP/SWESC, helping to make sure that the submissions in 2023 meet regulatory expectations and support using BAT for the decommissioning and clean-up of the Sellafield site. However, through the CEAR we will require Sellafield Ltd to submit an outline plan, with important milestones, for developing the WMP and SWESC so that we can monitor progress.

565. We consider that the annual permit review report and associated annual permit review continues to ensure that the Sellafield Ltd permit remains up to date, reflecting the site's needs while supporting progress towards meeting the environmental outcomes we seek from our regulation of the Sellafield site. Similarly, the annual overall effluent strategy report, which Sellafield Ltd also provides to a wider range of stakeholders, ensures that there is clarity regarding Sellafield Ltd's contribution to meeting the aims and expected outcomes of the UKSRD, along with assisting the UK to report discharges to OSPAR.

566. We note government policy on radioactive discharges states that unnecessarily introducing radioactivity into the environment is undesirable, even at levels where doses to humans and other species are low and, on the basis of current knowledge, is unlikely to cause harm. As noted in the 2018 review of the UKSRD, good progress has already been made towards achieving the 2020 and 2030 expected outcomes. For Sellafield Ltd, this is being achieved through long-term strategic planning. In order to encourage and support this longer-term strategic planning and in support of government policy, we have decided to require Sellafield Ltd to evaluate strategic options for ending sea pipeline discharges (and pipeline remediation) and for the lagoon drainage system to become purely a surface water drainage system. We believe that early consideration of these long-term objectives will help to guide shorter term effluent management decisions. We recognise that Sellafield Ltd has already given some consideration to these matters.

567. We have already discussed changes to this requirement in chapter 6 of this document, regarding annual plant notification levels. These changes will be amalgamated with the changes discussed above.

568. Consequently we have decided to:

- remove the requirement for Sellafield Ltd to develop and maintain an integrated waste strategy and associated plan to avoid duplication
- add a new requirement for Sellafield Ltd to submit an outline plan, with important milestones, for developing a waste management plan and site-wide environmental safety case
- retain the requirement to provide annual reports on the overall effluent strategy and to support our annual permit review
- make minor changes to the requirement to provide an annual permit review report to align with the new waste management plan permit condition
- add a new requirement for Sellafield Ltd to evaluate strategic options for ending sea pipeline discharges (and pipeline remediation) and for the lagoon drainage system to become purely a surface water drainage system
- modify the requirement regarding review of annual plant notification levels, as already discussed (chapter 6).

Review of CEAR requirement 4.2.2 part 2 paragraphs 15, 16, 17 and 24

569. We produce site environment review (SER) reports for all nuclear sites each year that set out our objectives for regulation in the context of the environmental setting, risks and challenges. These reports are an important tool for making sure that the sites we regulate can plan appropriately to ensure high levels of environmental performance. We also publish the results of our independent environmental monitoring annually in the RIFE reports. We expect the nuclear sites we regulate to be transparent about their challenges and the environmental implications of their activities, and to allow interested groups to be involved with important environmental decisions. Our regulation on behalf of citizens depends on good communication and stakeholdersbeing involved in environmental matters. This supports our decision making and future permit requirements that meet our regulatory environmental principles. Accordingly, our permit and associated CEAR requires operators to provide information to us, in particular CEAR requirement 4.2.2 part 2 paragraphs 15, 16, 17 and 24, but not confined to these specific requirements. We share this information on the public register. However, we recognise that there is substantial scope for environmental performance information to be reported and made accessible for interested groups in a more integrated and transparent way. For example, we are aware that similar legacy sites in the US DOE Environment programme are required (US DOE, 2012) to consolidate their environmental information into an annual site environment report (ASER) (US DOE, 2013). Information must highlight significant environmental performance indicators[1] and/or performance measures that reflect the size and extent of programmes at a particular site. In the light of this good practice, we expect Sellafield Ltd to consider ways it can improve the consolidation and linkage of environmental information shared with us and wider stakeholders. We have, therefore, decided to require Sellafield Ltd to evaluate environmental performance reporting options and submit a report to us setting out its preferred option. We expect Sellafield Ltd to consult on the options.

570. We will insert text into CEAR requirement 4.2.2 part 2 paragraph 24, requiring this evaluation. CEAR requirement 4.2.2 part 2 paragraphs 15, 16 and 17 will remain essentially unchanged, other than being consolidated into a single requirement, until we have considered the outcome of Sellafield Ltd's options evaluation.

[1] Note the Environment Agency is supporting the NDA and its SLCs with selecting environmental performance indicators to drive continuing improvement with environmental performance

Review of CEAR requirement 4.2.2 part 2 paragraph 18

571. Sellafield Ltd has recently implemented a new system (ACCOLADE) for collating all of its research and development (R&D) work. This system can be used to produce reports of the R&D relating to different topics. We do not require periodic updating of Sellafield Ltd's R&D, but we may need to understand the scope of R&D at different times as driven by our regulatory work. We will, therefore, adjust this information requirement to request a report on R&D that may result in improvements to environmental protection.

Review of CEAR requirement 4.2.2 part 2 paragraph 23

572. We have considered the proposal by Sellafield Ltd to submit information regarding SIXEP every 5 years within the context of the site's future aqueous effluent strategy and, in particular, the dependency on the successful operations of effluent management within SIXEP and EARP and effluent prevention or minimisation at the associated donor plants. We have decided that Sellafield Ltd's proposal is acceptable providing that the submission is captured within the Site Ion Exchange Plant Operating Programme (SIXOP) and also the Enhanced Actinide Removal Plant Operating Programme (EARPOP). In agreeing to an extended timescale, we will aim to liaise on an ongoing basis with Sellafield Ltd on the technical work for both effluent treatment plants through our routine regulation of the site. However, we accept that producing a report every two years has only limited benefit compared with five yearly reporting of the same information.

573. We do not seek to constrain nor direct the information that Sellafield Ltd includes in these operating programmes other than to require that it includes the necessary aspects captured in the above requirement.

Review of CEAR requirement 4.2.2 part 2 paragraph 24

574. As discussed above, we have decided to add a new part to this requirement, which will require an evaluation of the environmental performance reporting options, supported by consultation with stakeholder , and for a report setting out the preferred option to be submitted by 1 February 2021.

Removing CEAR requirement 4.2.2 part 2 paragraph 26

575. As there is no longer an additional component relating to the processing of more than 200 tonnes of Magnox rafinate in evaporator C, this information requirement is no longer necessary and we have, therefore, removed it.

Revising CEAR requirement 4.2.2 part 2 proformas

576. The proformas are revised in line with changes to limits and notification levels in the permit.

New paragraphs in CEAR requirement 4.2.2 part 2

577. Sellafield Ltd is currently in the process of preparing a closure and aftercare management plan and associated cap design for CLESA. It provided a first version of this document by 31 May 2018 in line with improvement requirement S1.2.5. We have provided a significant number of comments on this document to Sellafield Ltd, to make sure that the radiological aspects are adequately addressed in the plan. We have agreed with Sellafield Ltd that the date of submission for this improvement requirement has been revised to 31 March 2020. When the closure and aftercare management plan and associated cap design for CLESA is complete and we have agreed it, this new CEAR requirement will ensure the documents are regularly reviewed throughout the remaining operational phase of CLESA. This requirement is applied across the landfill industry via a permit condition. The requirement to review at least every 4 years is taken from our landfill sector guidance (EPR 5.02). This additional CEAR requirement brings CLESA in line with the rest of the landfill industry in relation to the closure and aftercare management plan requirements.

578. A joint regulatory inspection (Environment Agency and Office for Nuclear Regulation, 2012) at Sellafield highlighted issues regarding the vulnerability of paper records and the slow rate of converting to other media such as digital and microform in complying with regulatory requirements and managing them in the long term. More recently, the 2013 joint regulatory inspection of Radioactive Waste Management Limited's (RWML) provision of disposability advice (Environment Agency and Office for Nuclear Regulation, 2013) highlighted that a lack of agreed package records is a common reason for RWML not re-endorsing surviving letters of compliance (LoCs) following periodic review. Eventual disposal of higher activity waste to a geological disposal facility will

require good quality, accessible waste package records that satisfy the waste acceptance criteria for the GDF. The consequence of not meeting this may result in the need to recreate 'lost' records and/or re-characterise or re-package waste. It is imperative that RWML and waste producers agree on what constitutes a compliant waste package record. This includes requirements for linking or capturing any additional supporting information, the essential metadata necessary to ensure the long-term resilience of the records and its future uses, and to ensure stakeholder have confidence in waste disposals. Regulators will need assurance that risks to permitting of disposals have been adequately reduced. It is essential that waste producers improve the quality and resilience of records for their existing and future waste packages. We accept that Sellafield Ltd has recognised the importance of improving waste package records, but we also note that progress has been slower than expected due to the scale, condition and complexity of the existing records. We will require Sellafield Ltd to provide us with an annual report on progress with its programme to restore legacy records for higher activity waste packages and to meet the RWML standards on waste package records for new packages.

579. The Ground Environmental Review Meeting, which began in February 2018, has been set up to oversee the Magnox Swarf Storage Silo (MSSS) facility and management of land quality, containment assurance tactics and techniques, which demonstrate compliance. A requirement of this meeting is to provide an annual update on leak management technologies that could be used at MSSS and the First Generation Magnox Storage Pond (FGMSP) and surrounding areas. This requirement stemmed from a recommendation in a regulatory assessment of Sellafield Ltd's proposals for leak detection and mitigation as part of an ongoing BAT demonstration (Environment Agency, 2015a). To date, this annual update has not been provided to the meeting. Therefore, we consider it is appropriate to include a new CEAR requirement to ensure that this review is carried out in future. We will require an annual update report on the research and development into leak detection and mitigation technologies during retrieval operations from high hazard high risk (HHHR) legacy facilities.

CEAR requirement 4.2.2 part 2 other considerations

580. When Sellafield Ltd submitted its original application, the BAT and impact assessments for the diversion of CLESA leachate from the factory sewer to the Calder interceptor sewer were still in progress. This process is now complete and there are no requirements that need to be included in the CEAR.

581. We have considered whether to require Sellafield Ltd to provide a review of the alternative options and also the standards that Sellafield Ltd will apply to ongoing storage of fuels at the site. These requirements could ensure that fuel storage continues to use best available techniques to avoid producing and disposing of waste. At this stage, we are not going to require Sellafield Ltd to provide this information through the permit, but we may do so in the future.

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