NFLA Radioactive Waste Policy Briefing Number 74: UK Government consultation on the future regulation of nuclear sites as they reach their 'end' states

Prepared for NFLA member authorities, December 2018

Proposed Changes to Sellafield's Environmental Permits

i. Overview of Policy Briefing

This edition of the NFLA Radioactive Waste Policy provides members with a model response to an Environment Agency consultation considering a request from Sellafield Ltd (SL) for a variation in its Radioactive Substances Activities (RSA) permit. The RSA permit controls receipt and disposal of radioactive waste at the site.[1]

Fuel reprocessing is due to come to an end at the site over the next few years with reprocessing at the Thermal Oxide Reprocessing Plant (THORP) now ended and the Magnox Reprocessing Plant closing in 2020. The site should see significant reductions in discharges to the environment. Sellafield Ltd needs to have new environmental permits to better reflect the new discharge levels and reflect the site's changing focus from reprocessing to decommissioning. This is part of a major review of environmental permits at the site.

The changes applied for, according to Sellafield Ltd (SL), are as follows:

- some significantly reduced discharge limits
- removal of some site discharge limits where discharges have fallen below significant levels
- replacement of plant limits with plant notification levels to enable Sellafield Ltd to optimise discharge routing and the effective use of treatment plants
- the introduction of a 2 tier site limit structure after the end of Magnox reprocessing (i.e. upper and lower site limits). This will allow a time-limited increase to an upper limit (where necessary, providing an acceptable BAT justification is made)
- introduction of a specific tritium limit for solid waste disposals at the on-site landfill (CLESA)
- an updating of the permit to the latest template so that it reflects recent guidance changes.

Responses should be made by the **21st December** to the Nuclear Regulation Team nrg.north@environment-agency.gov.uk

1. The Application

This application is said to have evolved through extensive discussions between SL and the Environment Agency (EA), with both parties working to the mutually agreed aim of securing:

"*Environmental permits which ensure ongoing protection of the environment, focus on the use of Best Available Techniques (BAT), provide a clear line of sight to permit compliance and facilitate timely Post Operational Clean Out (POCO) of reprocessing facilities and decommissioning of the wider site.*"

SL says this variation application proposes significant reductions to Site Limits reflecting the current levels of discharges and predictions for future discharge reductions from the site. The environmental

[1] Sellafield Radioactive Substances Activities (RSA) Major Permit Review - Overview https://consult.environment-agency.gov.uk/cumbria-and-lancashire/sellafield-rsa-major-permit-review/

impact of the proposed variation has been assessed to establish the reductions to potential doses to the critical group.

The application seeks the removal of site limits for certain radionuclides plus the replacement of plant limits with lower notification levels. This makes comparisons between what is proposed and earlier permitted levels of discharge more difficult.

On the whole NFLA finds these proposals extremely disappointing with a large headroom usually allowed for between the allowable limits for discharges and the expected discharges which means that in almost every case actual discharges could theoretically end up being higher than they were in 2017 without breaching the allowable limits.

2. Best Practicable Environmental Option

What is important is that the full benefit in terms of reduced emissions to the environment are realised as a result of the closure of THORP followed by Magnox Reprocessing; that decommissioning is not used as an excuse for increasing discharges and that decommissioning uses the Best Practicable Environmental Option. (BPEO).

A sustainable decommissioning policy must be based on a clear set of environmental principles, in particular: the polluter pays principle, the concentration and containment principle and the proximity principle. Concerns about rising volumes of lower activity wastes should not be used to distract from the need to implement the Best Practicable Environmental Option (BPEO).

The concept of Best Practicable Environmental Option (BPEO) was first outlined in the Fifth Report of the Royal Commission on Environmental Pollution (RCEP) in 1976. The concept was elaborated in their Twelfth Report, "The Best Practicable Environmental Option" (1988) which defined it as "*the outcome of a systematic consultative and decision making procedure which emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes, for a given set of objectives, the option that provides the most benefits or the least damage to the environment, as a whole, at acceptable cost, in the long term as well as the short term*."

The crucial phrase here is "*systematic consultative … procedure*".

3. OSPAR

Under the OSPAR treaty the UK Government is committed to:

"...*progressive and substantial reductions of discharges, emissions and losses of radioactive substances, with the ultimate aim of [achieving] concentrations in the environment near background values for naturally occurring radioactive substances and close to zero for artificial radioactive substances*." [by 2020].

The application of "*best available techniques and best environmental practice, including, where appropriate, clean technology*" is one of the Guiding Principles of the OSPAR Strategy with regard to radioactive substances.[2]

"Clean Technology" should not, in the view of many environmental commentators, involve end-of - pipe filters to remove pollution from discharges to the environment – it should be a technique which produces no pollution to begin with. The requirement for 'Best Available Techniques' (and clean technology) means discharging radioactive wastes into the environment when alternative management techniques are available is not permitted.

[2] See Annex 1 of UK strategy for radioactive discharges 2001 – 2020, DEFRA, July 2002
http://www.scotland.gov.uk/Resource/Doc/46746/0024243.pdf

4. Radiation Doses

The UK Strategy for Radioactive Discharges published in 2009 says "*the unnecessary introduction of 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.*"[3]

However, the Strategy Target "…*of a local critical group of the general public being exposed to an estimated mean dose of no more than 0.02mSv* [20µSv] *a year as a result of authorised radioactive discharges made from 2020 onwards*"[4] appears to have been dropped.

This target should be re-introduced. The figure helps to put into perspectives the numbers in table 1 of the Application

Table 1[2]

	Aerial		Marine			
Dose Summary (in µSv)*	**Sum of Current Plant Limits**	**Sum of Proposed Notification Levels**	**Current Site Annual Limit**	**Phase 1 Site Limits**	**Phase 2 Upper Tier Site Limits**	**Phase 2 Lower Tier Site Limits**
Max Dose	41	13	210	170	130	90

***Note: This table assumes discharges are made at the respective Site Limits for all marine discharges and Plant Limits or Notification levels for aerial discharges. Aerial doses cannot be calculated at Site Limits due to the variation in dose factors between stacks.**

According to SL's Annual Discharges Review 2015 – 2017[5]:

- Aerial Emissions: Sellafield reference group[6] doses in 2017 based on measured environmental activity concentrations (Adult). Doses include contributions from historical discharges **9.8µSv**
- Sellafield reference group doses based on modelled predictions and calculations from aerial discharges in 2017 (Adult). Doses are from a single year's discharge. **2.5µSv**
- Sellafield reference group doses in 2017 based on measured environmental activity concentrations (Adult). Doses include contributions from historical discharges. **100µSv**
- Sellafield reference group doses in 2017 based on modelled predictions and calculations from liquid discharges (Adult). Doses are from a single year's discharge. **18µSv**

Given the higher dose from historic discharges and the fact that these are figures for adults which 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.

[3] UK Strategy for Radioactive Discharges DECC et al 2009, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/249884/uk_strategy_for_radioactive_discharges.pdf

[4] UK strategy for radioactive discharges 2001 – 2020, DEFRA, July 2002 p27 http://www.scotland.gov.uk/Resource/Doc/46746/0024243.pdf

[5] Annual Discharges Review, 2015 – 2017, Sellafield Ltd 25th July 2018 https://consult.environment-agency.gov.uk/cumbria-and-lancashire/sellafield-rsa-major-permit-review/supporting_documents/4.%20Annual%20Discharges%20Review%202015%20%202017.pdf

[6] No definition of "reference group" appears to have been given. It should be made clear whether this is different to a "critical group".

5. Welcome highlights from the Sellafield Ltd Application include:

- The impact from aerial discharges associated with reprocessing operations is expected to drop to negligible levels and will be difficult to detect from most discharge points.

- There will also be significant reductions to site liquid discharges; however these will occur gradually as liquid discharges will continue to be generated from the chemical stages of reprocessing and from downstream treatment plants.

- Aerial discharges of Kypton-85 and Antimony-125 are expected to end when reprocessing ends. Discharges are dominated by Thorp reprocessing and related Highly Active Liquor (HAL) storage hence significant reductions are expected.

6. And not so welcome…

- The impact of some site discharges will remain significant after reprocessing ends, due to the continued chemical processes and ongoing treatment of effluents through downstream plants.

- SL expects remediation activities to generate increased Sr90 and Cs137 aerial discharges.

7. NFLA also note:

- The removal of Site limits is proposed where the impact of discharges is demonstrated to be well below 1µSv per year. However, future discharges must be considered and removal of a Site limit can only be justified where future operating strategies indicate that increases in discharges above this threshold value are unlikely.

- Where limit removal is not justified, on the basis of past discharges and/ or potential future discharge levels, consideration has also been given to the reducing the 'headroom' between maximum discharges and current limits to align with EA limit setting methodology.

The following tables compare current discharges and discharge limits with what is proposed by SL.

Aerial Discharges Bq	**Actual discharges in 2017**[7]	**Discharge Limits in 2017**[8]	**Phase 2 Upper Limit**	**Phase 2 Lower Limit**
Tritium	9.95 E+13	1.10 E+15	5.50 E+14	2.20 E+14
Carbon 14	4.16 E+11	3.30 E+12	2.31 E+12	1.65 E+12
Krypron 85	4.33 E+16	4.40 E+17	Remove Limit	Remove Limit
Strontium-90	3.10 E+07	7.10 E+08	4.97 E+08	4.97 E+08
Ruthenium 106	6.51 E+08	2.30 E+10	1.96 E+10	1.96 E+10
Antimony 125	1.71 E+09	3.00 E+10	Remove Limit	Remove Limit
Iodine 129	6.52 E+09	7.00 E+10	4.20 E+10	2.80 E+10
Iodine 131	3.74 E+08	3.70 E+10	Remove Limit	Remove Limit
Caesium 137	4.16 E+07	5.80 E+09	4.80 E+09	4.80 E+09
Radon 222	3.91 E+10	5.00 E+11		
Plutonium – alpha	3.47 E+07	1.90 E+08	1.33 E+08	1.33 E+08
Plutonium - 241	3.32 E+08	3.00 E+09	Remove Limit	Remove Limit
Americium 241 and curium 242	1.69 E+07	1.20 E+08	8.40 E+07	8.40 E+07
alpha	1.10 E+08	8.80 E+08	6.60 E+08	4.40 E+08
Beta	1.20 E+06	4.20 E+10	3,15 E+10	2.10 E+10

[7] Numbers from RIFE 23

[8] RIFE 23

From the table above it can be seen that, although the aerial discharge limits proposed are lower than those in force in 2017, **the new phase 2 limits** – even the lower limits – **would allow higher discharges than the actual discharges seen in 2017 in every case** (apart from Radon-222 which isn't mentioned in the application).

Liquid Discharges Bq	Actual Discharges in 2017	Discharge Limits in 2017	Phase 2 Upper Limit	Phase 2 Lower Limit
Tritium	1.30 E+15	1.80 E+16	7.20 E+15	1.44 E+15
Carbon 14	3.60 E+12	2.10 E+13	1.05 E+13	8.40 E+12
Cobalt 60	2.12 E+10	3.60 E+12	3.60 E+12	3.60 E+12
Strontium 90	2.12 E+12	4.50 E+13	3.15 E+13	2.25 E+13
Zr-95 & Nb-95	6.36 E+10	2.80 E+12	Remove Limit	Remove Limit
Tc-99	1.57 E+12	1.00 E+13	8.00 E+12	6.00 E+12
Ru-106	1.03 E+12	5.10 E+13	1.53 E+13	1.02 E+13
I-129	2.59 E+11	2.00 E+12	8.00 E+11	4.00 E+11
Cs-134	4.24 E+10	1.60 E+12	Remove Limit	Remove Limit
Cs-137	3.31 E+12	3.40 E+13	2.28 E+13	1.70 E+13
Ce-144	1.24 E+11	4.00 E+12	Remove Limit	Remove Limit
Np-237	3.63 E+10	7.30 E+11	Remove Limit	Remove Limit
Pu-alpha	1.50 E+11	7.00 E+11	6.30 E+11	4.20 E+11
Pu-241	2.09 E+12	2.50 E+13	1.75 E+13	7.50 E+12
Am-241	2.02 E+10	3.00 E+11	2.40 E+11	1.50 E+11
Cm243+244	1.92 E+09	5.00 E+10	Remove Limit	Remove Limit
Alpha	1.84 E+11	9.00 E+11	7.20 E+11	4.50 E+11
Beta	1.21 E+13	1.80 E+14	1.26 E+14	8.10 E+13
Uranium in kgs	3.48 E+02	2.00 E+03	Remove Limit	Remove Limit

With liquid discharges the situation is the same. The new proposed Phase 2 lower limit could mean discharges end up being higher than they were in 1997 before either of the reprocessing plants closed down.

For tritium and carbon-14 aerial discharges, SL says recent emissions have been around 14% and 15% of the site limit respectively. However the proposed new limits do not appear to fully reflect these reductions.

The same applies to strontium-90 and it's a similar story with many of the other proposed limits for aerial discharges. The same trend is repeated for liquid discharges with SL insisting on maintaining a very high headroom between what they actually expect to discharge and the limit proposed/

Sellafield Ltd says:

"...*headroom may seem high in some areas primarily due to difficulty in predicting future discharges from Post Operational Clean Out (POCO) and site clean-up, and also acknowledging the lag in discharges from downstream plants following the end of reprocessing … considering long term, overall environmental impact. In some instances SL may seek to enable reduction of long term, overall environmental impact by justifying short term increases in discharges."*

In the view of the NFLA it would be much better to considerably reduce the headroom and then ask SL to make a case on each occasion it is expecting to have higher than expected discharges.

Finally, to emphasise what a disappointment the proposed new limits are it is worth going back to the figures provided by BNFL Ltd to National Stakeholder Dialogue in the year 2000 which show the expected reductions in discharges with just the Magnox reprocessing plant closing. These are given in the table below:

Magnox Reprocessing; indicative timescales for closure scenarios typically cover 2007/8 to about 2013/14	*Liquid discharges:* Cs-137 discharges cut by 30% two years later I-129 discharges cut by 30-50% Tc-99 discharges cut by 99% five years later C-14 discharges cut by 70% one year later Sr-90 discharges cut by 70% five years later Tritium emissions cut by 30% Pu/Am discharges cut very marginally *Aerial discharges:* I-129 emissions cut by 50% five years later Kr-85 emissions cut by 10% C-14 emissions cut by 70% Tritium emissions cut by 90%

Just considering aerial emissions of tritium: these were 250 TBq in 1998. A cut of 90% would bring this down to 25TBq. (And this without the closure of THORP). Yet the proposed limit amounts to 220TBq.

8. Conclusion

NFLA finds these proposals extremely disappointing with a large headroom usually allowed for between the allowable limits for discharges and the expected discharges which means that in almost every case actual discharges could theoretically end up being higher than they were in 2017 without breaching the allowable limits.

Given the relatively high dose from historic discharges to the critical group and the fact that these are figures for adults which 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.

NFLA calls for a considerable reduction in the headroom allowed with SL required to make a case on each occasion it is predicting higher than expected discharges.