WEST CUMBRIA & NORTH LAKES FRIENDS OF THE EARTH

EXAMINATION OF THE CUMBRIA MINERALS & WASTE LOCAL PLAN

November 2016

Statement (2)

Inspector's Draft Matters & Issues relating to Radioactive Waste

Question 2.

The Plan states that High Level Waste (HLW) only consists of waste that is generated from reprocessing spent nuclear fuel at Sellafield. The 2013 UK Radioactive Waste Inventory (RWI) indicates that future arisings will come from Magnox and oxide fuel reprocessing, which are scheduled to end in 2017 and around 2018 respectively. Does this mean that, if all goes to plan, there will be no new HLW generated from reprocessed spent fuel at Sellafield after these dates and, therefore, in the UK?

Reprocessing Plant Closures

The NDA's latest Business Plan (2016-19)[1] (page 16) shows Magnox reprocessing is likely to end in 2020 The latest Magnox Operating Plan (MOP9)[2], which is referred to several times in the Business Plan, confirms this, but also shows (page 11) that Magnox reprocessing could continue until 2028.

The NDA's Strategy effective from April 2016[3] confirms (page 45) that THORP is expected to close by the end of 2018.

Future HLW

If all goes according to plan, there will be no new liquid HLW generated from reprocessing spent fuel at Sellafield after these dates and, therefore, in the UK. However, it should be noted that whilst reprocessing has been carried out in the UK, spent nuclear fuel discharged from nuclear reactors has not been considered a waste. The July 1995 White Paper on Radioactive Waste Management Policy (Cmd 2919) states that:

"*…in accordance with IAEA and Euratom definitions, spent fuel should not be categorised as waste, while the option of reprocessing it remained open and a future use for the fuel could be*

[1] NDA Business Plan 2016-19
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/512786/Nuclear_Decommissioning_Authority_Business_Plan_financial_year_beginning_April_2016_to_financial_year_ending_2019.pdf

[2] Magnox Operating Plan (MOP9) 2012
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/457808/The_Magnox_Operating_Programme__MOP9_.pdf

[3] NDA Strategy April 2016
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/518669/Nuclear_Decommissioning_Authority_Strategy_effective_from_April_2016.pdf

foreseen." (page 26)

Logically therefore, once reprocessing ends spent fuel should be classified as waste, in which case it would be HLW.

There will be two main types of HLW/spent fuel generated after 2018. The first category is spent fuel discharged from the UK's existing AGR reactors, some of which is already stored at Sellafield. These reactors in England and Scotland are expected to continue to transport spent fuel by rail to Sellafield until they close. The last two AGR stations are currently scheduled to close in 2030, but the owner, EDF Energy, has suggested that it is looking at the possibility of further life extensions.[4] (It is also worth noting that four AGR stations had their lives extended as recently as February this year so this won't have been factored into the Radioactive Waste Inventory yet.)[5]

The second category is spent fuel from a new generation of nuclear reactors. The Government's 2008 White Paper on Nuclear Power[6] states that:

"… in the absence of any proposals from industry, the Government has concluded that any new nuclear power stations that might be built in the UK should proceed on the basis that spent fuel will not be reprocessed and that plans for, and financing of, waste management should proceed on this basis. We are not currently expecting any proposals to reprocess spent fuel from new nuclear power stations." [p30]

Spent Fuel from new reactors is, therefore, likely to be stored on the reactor sites. EDF Energy, for instance, says while it is possible that spent fuel might start to be transported off site during the lifetime of its proposed Hinkley Point C reactors, it is prudent to plan to store all of the lifetime arisings of the two reactors.[7] The plan is to store spent fuel from Hinkley Point C in spent fuel storage ponds. EDF is planning to be able to extend the life of the storage ponds for up to 100 years <u>after</u> the reactors close,[8] which means spent fuel could be stored on the Somerset site until 2185.

<u>Question 3</u>
Is it likely that Sellafield will continue to accept and process new overseas spent fuel, thereby generating new HLW? Is this likely to continue throughout the Plan period and/or beyond? What quantities of overseas HLW are envisaged will be generated over the Plan period? For how long is it anticipated this HLW will be stored at Sellafield before being returned overseas?

All spent fuel from overseas due to be reprocessed is here already. Since there are no proposals from industry to build any new reprocessing facilities it is highly unlikely that there

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[4] See Holyrood Magazine 17th Oct 2016 http://www.holyrood.com/articles/news/lifetime-scotlands-nuclear-plants-could-be-extended-says-edf and Times 19th Oct 2016 http://www.thetimes.co.uk/edition/scotland/nuclear-closures-could-be-delayed-to-keep-lights-on-mrd9xqj9j

[5] BBC 16th February 2016 http://www.bbc.co.uk/news/business-35583740

[6] Meeting the Energy Challenge: A White Paper on Nuclear Power, BERR January 2008 http://webarchive.nationalarchives.gov.uk/+/http:/www.berr.gov.uk/files/file43006.pdf

[7] Hinkley Point C Pre-application Consultation, See para 6.30 here: https://www.edfenergy.com/sites/default/files/V2%20C06%20Spent%20Fuel%20and%20Radioactive%20Waste%20Management.pdf

[8] As above para 6.42

will be anymore spent fuel imported from overseas.

Question 4
For how long is the HLW stored as Highly Active Liquor (HAL)?

According to the NDA's Strategy (page 105) the Agency expects to complete the vitrification of Highly Active Liquors by 2022/3.[9] Given the history of this programme it would not be a surprise if the ending of vitrification was delayed.

Question 6
What is the current requirement for storage of vitrified glass blocks and how is it likely to change over the Plan period in terms of facilities and land-take?

The important point to note here from our perspective is that transports of HLW to the deep geological repository are not expected to start until 2075. The transports are expected to take around 14 years to 2089. But clearly all of these dates will be very uncertain.[10]

Question 7
The RWI forecasts that vitrification will cease in around 2021, albeit further vitrified HLW will arise from post operational clean out until about 2027. Does this mean that the generation of all HLW will have ceased before 2027?

From the latest NDA Strategy it looks as though the date for vitrification to end is now 2022/3. But given that spent fuel will logically have to be declared HLW after reprocessing has ended, the generation of HLW will continue until the last of the new generation of nuclear power stations closes. The proposed new stations would have an expected life of around 60 years, so this could mean that HLW continues to be generated until around 2100.

New reactors currently proposed include:

	Capacity	Annual output (90% load factor)	Investment Decision	Expected Opening Date
Hinkley Point C2 x EPRs	3.2GW	25TWh	2016	2025
Sizewell C2 x EPRs	3.2GW	25TWh		2027 – 2028
Wylfa Newydd2 x ABWRs	2.7GW	21TWh	2018	2024
Oldbury2 x ABWRs	2.7GW	21TWh		2027

[9] NDA Strategy April 2016 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/518669/Nuclear_Decommissioning_Authority_Strategy_effective_from_April_2016.pdf
[10] As above page 105

Moorside3 x AP1000s	3.4GW	27TWh	End of 2018	2024 – 2026.

There are also plans by the Chinese National Nuclear Corporation to build an unspecified number of Hualong One reactors at Bradwell in Essex. This would bring the total capacity of new reactors up to 18GW.[11]

The UK Government has also launched a competition to find a partner to help bring "mini nuclear reactors" – known as Small Modular Reactors - to the UK energy market. The National Nuclear Laboratory (NNL) has suggested there might be a potential UK market of between 7GW and 21GW by 2035.[12]

Question 8

On the understanding that there is no disposal route for this waste type at the current time, will the quantity of vitrified packages existing at that time be the maximum that will require long-term storage?

Apart from any small quantities of material that might arise from post operational clean out, there doesn't seem to be any reason why packages of vitrified waste would arise after 2022/3 given or take delays and technical problems which are, judging by past experience, almost certainly inevitable.

Question 9

What are the forecast future arisings of new HLW?

Question 10

What is the forecast quantity of total HLW requiring long term storage?

Radioactive Waste Management Ltd (RWM) has developed a detailed inventory of radioactive waste for disposal in its proposed geological disposal facility (GDF) which it calls the 'Derived Inventory'. This inventory is subject to uncertainty due to a range of factors such as uncertainty about the life of the AGR reactors and what happens to the UK's plutonium inventory, and, of course proposals for new reactors.

The Derived Inventory is therefore updated periodically to take into account new information. RWM published a new 2013 Derived Inventory in July 2015. This can be compared with the previous 2010 Derived Inventory to obtain further information about the impact of a new reactor programme. The table below is from an RWM report which does just that. (See http://www.nda.gov.uk/publication/differences-between-2013-and-2010-derived-inventory/)

The 2010 inventory showed a derived inventory (2010 DI) which did not include any spent fuel or other waste from new reactors and an upper inventory (2010 UI) - which did include spent fuel and wastes from a 10GW new reactor programme. On the other hand the 2013 Derived Inventory has only one inventory which includes spent fuel and waste from a 16GW new reactor programme. As mentioned above this could increase in future to take account of the fact that the Government now anticipates the size of the new reactor programme will be 18GW, and there may be between 7 and 21GW of SMR capacity online by 2035.

[11] Baroness Neville-Rolfe's recent speech on 2nd November 2016 discussed proposals for 18GW of new nuclear capacity at 6 sites. http://www.wired-gov.net/wg/news.nsf/articles/Baroness+NevilleRolfes+speech+at+the+Office+for+Nuclear+Regulation+ONR+Industry+Conference+02112016151515

[12] Small Modular Reactors: Feasibility Study, NNL, Dec 2014 http://www.nnl.co.uk/media/1627/smr-feasibility-study-december-2014.pdf

The nuclear industry and government have repeatedly said the volume of nuclear waste produced by new reactors will be small, approximately 10% of the volume of existing wastes; implying this additional amount will not make a significant difference to finding a Geological Disposal Facility (GDF) for the wastes the UK's nuclear industry has already created. The use of volume as a measure of the impact of radioactive waste is, however, highly misleading.

Volume is not the best measure to use to assess the likely impact of wastes and spent fuel on the size or "footprint" of a GDF. New reactors will use so-called 'high burn-up fuel' which will be much more radioactive than the spent fuel produced by existing reactors. So rather than using volume as a yardstick, the amount of radioactivity in the waste – and the space required in a GDF to deal with it - are more appropriate ways of measuring the impact of nuclear waste from new reactors.

The total activity measured in Terabecquerels (TBq) of the 2010 Derived Inventory, (not including any wastes from new reactors) was 4,770,000 TBq. The total activity given in the 2013 Derived Inventory was 27,300,000 TBq. Not all of this huge increase in activity is down to new reactors. For instance there is a big jump in the activity of legacy spent fuel and 3,700,000 TBq from spent mixed plutonium-uranium oxide (MoX) fuel – a category which does not appear at all in the 2010 inventory. However, 19,793,000 TBq is activity from new reactor wastes and spent fuel. So **the activity of radioactive waste from a new reactor programme would be roughly four times the activity in the total 2010 inventory.**

Of course this figure is for a 16GW new reactor programme. For an 18GW programme the total activity of spent fuel and intermediate level waste would be 22,267,125 TBq or almost **five times** the activity of existing waste.

Table 5 **Total activities in TBq for each waste and material type at 2200. Data is shown for the 2010 Derived Inventory (2010 DI), 2010 Upper Inventory (2010 UI) and 2013 Derived Inventory (2013 DI)**

Waste category	2010 DI	2010 UI	2013 DI
HLW	1,170,000	2,190,000	1,090,000
Legacy ILW	388,000	580,000	372,000
LLW	6.31	70.7	2.48
Legacy SF	1,920,000	315,000	2,270,000
DNLEU	7,910	9,510	8,370
HEU	3.10	54.4	53.8
Pu	1,280,000	1,840,000	43,700
New build ILW	-	104,000	793,000
New build SF	-	14,100,000	19,000,000
New build DNLEU	-	3,800	-
MOX SF	-	-	3,700,000
Total	4,770,000	19,100,000	27,300,000

These numbers are significant because of the amount of repository space taken up by existing waste mostly located in Cumbria compared with waste stored on reactor sites outwith Cumbria.The NDA has estimated the total repository footprint for a baseline inventory (the total waste expected to be created by the existing programme) of between 5.6 km^2 and

8.8km^2 depending on the rock-type. However, the footprint from a maximum inventory which includes a 16GW new reactor programme would be between 12.3km^2 and 25km^2.

	Baseline Inventory	Maximum Inventory
High strength rock	5.6km^2	12.3km^2
Lower strength rock	10.3km^2	25.0km^2
Evaportite	8.8km^2	24.1km^2

Table 3: Repository Footprint for Maximum Inventory which includes a 16GW New Build programme.

Question 11

Is it envisaged that all of this long-term storage will occur at Sellafield, pending the location and preparation of an acceptable Geological Disposal Facility (GDF)?

The table above show that the space required in a repository by the new reactor programme is around double the space required by the existing wastes which are mostly stored at Sellafield.

Secondly, it means that the activity of existing waste - mostly stored at Sellafield amounts to 4,770,000 TBq.

The proposed reactors at Moorside would produce spent fuel and ILW with an activity of around 4,206,012 TBq making a total of 8,976012 TBq stored in Cumbria.

However **the activity of spent fuel and ILW stored at new reactor sites outwith Cumbria** would amount to 15,586,988 TBq – **almost twice as much**. And if we assume that the reactors at Bradwell go-ahead it will probably be more than twice as much.

Question 15

The Plan/RWI indicates that as of 1 April 2013 the reported volume of UK ILW was 95,600m^3 of which about 69,600m^3 (73%) was stored at Sellafield. How much of the UK's total ILW is generated at Sellafield as opposed to being stored there? How much is imported from elsewhere both within Cumbria, such as the Low Level Waste Repository (LLWR), and from outside?

Much of the ILW has been produced as a result of reprocessing. When reprocessing stops the waste management system will change. For instance the spent fuel cladding which is stripped off to reprocess spent fuel will remain part of that spent fuel which should, in theory at least, become High Level Waste in the non-reprocessing regime.

At the moment very little ILW is transported on its own to Sellafield (ie ILW which is not integral to spent fuel). It is mostly stored at the nuclear reactor sites awaiting a decision about a GDF.

Some ILW is being transported from Dounreay to Sellafield - but most of this will get reprocessed.

Pete Roche November 2016