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The Impact of a New Reactor Programme on the UK's Radioactive Waste Inventory

The proposed Hinkley Point C nuclear power station would produce radioactive wastes and spent fuel with a radioactivity inventory equal to roughly 80% of the radioactivity in all of the UK's existing radioactive wastes put together.

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 an underground dump 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. (1)

Volume is not the best measure to use to assess the likely impact of wastes and spent fuel from a new reactor programme, in terms of its management and disposal. 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 deep geological repository to deal with it - are more appropriate ways of measuring the impact of nuclear waste from new reactors.

New Reactor Programme to Quadruple Radioactive Waste Inventory

In 2006 the Government's advisory committee – the Committee on Radioactive Waste Management (CoRWM) estimated that a programme of ten new AP1000 reactors would add an amount of radioactivity, to that already held in all nuclear wastes, of 265% - a tripling the inventory of radioactivity. (2)

The latest figures from Radioactive Waste Management Ltd published in July 2015 suggest that waste from the proposed 16GW new reactor programme will be more than quadruple the inventory of radioactivity in the 2010 inventory. (3) The 3.2GW Hinkley Point C project alone would increase the inventory by about 80%; the vast majority of which would be in the intensely hot and radioactive spent fuel.

Another way of looking at the impact of radioactive waste produced by new reactors was presented by the Nuclear Decommissioning Authority (NDA) to the West Cumbria Managing Radioactive Waste Safely Partnership (WCMRSP) in August 2010. (4) The presentation showed that while a 10GW new reactor programme would increase the volume of the total waste by only around 10%, the area of space required by the wastes if emplaced in a deep geological repository in various different rock types could be almost as big, if not bigger, than the area of space required by existing wastes.

The NDA's document looked at the repository footprint of a baseline inventory (total waste expected to be created by the existing programme) and compared this with the repository footprint of an upper inventory which would include waste from four new AP1000 reactors and four new EPRs all operating for 60 years. This 10GW new reactor programme would virtually double the footprint of radioactive waste compared with the footprint of existing waste.

	Baseline Inventory	**Upper Inventory**
High strength rock	5.6km^2	9.8km^2
Lower strength rock	10.3km^2	19.5km^2
Evaportite	8.8km^2	18.4km^2

Table 1: Repository Footprints.

But this Upper Inventory only allows for a new reactor programme of 10GW. Currently there are proposals to build almost 16GW of new capacity (Hinkley C 3.2GW; Sizewell C 3.2GW; Wylfa 2.76GW; Oldbury 2.7GW; Moorside 3.6GW). Another presentation (5) to the WCMRSP in August 2010 estimated that the repository footprint for a 16GW new reactor programme could almost triple the repository footprint:-

	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.

The NDA subsequently said: *"These values seem reasonable as indicative figures at the present time, given the uncertainty over the reactor types that will be used".* (6). These figures show the currently proposed new reactor programme would increase the repository footprint by between 120% and 174%.

The 16GW programme does not allow for the possibility of two 1.15GW Hualong One reactors at Bradwell which would add another 2.3GW of capacity.

(1) For example, Dr Peter Bleasdale who went on to become Managing Director of the National Nuclear Laboratory said: "*Already there are significant volumes of historic wastes safely stored, and a programme of new reactors in the UK will only raise waste volumes by up to 10%.*" BBC 13th May 2008 http://news.bbc.co.uk/1/hi/sci/tech/7391044.stm

(2) CoRWM (17th January 2006) Inventory Summary Information , Doc 1531 http://webarchive.nationalarchives.gov.uk/20130503173700/http:/corwm.decc.gov.uk/assets/corwm/pre-nov%202007%20doc%20archive/plenary%20papers/2006/25%20-%2026%20january%202006/1531%20-%20inventory%20summary%20information.pdf

(3) Geological Disposal: An overview of the differences between the 2013 Derived Inventory and the 2010 Derived Inventory, RWM Ltd July 2015 http://www.nda.gov.uk/publication/differences-between-2013-and-2010-derived-inventory/

(4) See pages 5 to 12 of Geological Disposal Inventory presentation to West Cumbria Managing Radioactive Waste Safely Partnership: Issue 2 November 2010 http://www.westcumbriamrws.org.uk/documents/88.2-Inventory_presentation_to_West_Cumbria_MRWS_Partnership_Issue_2.pdf

(5) Higher Level Radioactive Waste: Likely inventory range; the process for altering it; how the community might influence it and understanding the implications of new nuclear build. Presented to West Cumbria Managing Radioactive Waste Safely Partnership, by Pete Roche, 5th August 2010 2nd Version with reactions to NDA responses http://www.nuclearwasteadvisory.co.uk/wp-content/uploads/2011/05/Inventory_presentation_to_WCMRWS_Aug2010.pdf

(6) See pages 13 to 14 of Geological Disposal Inventory presentation to West Cumbria Managing Radioactive Waste Safely Partnership: Issue 2 November 2010

http://www.westcumbriamrws.org.uk/documents/88.2-Inventory_presentation_to_West_Cumbria_MRWS_Partnership_Issue_2.pdf

(7) Geological Disposal: An overview of the differences between the 2013 Derived Inventory and the 2010 Derived Inventory, RWM Ltd July 2015 http://www.nda.gov.uk/publication/differences-between-2013-and-2010-derived-inventory/

Annexe: Derived Inventory

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.

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.

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