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Author:	Technical Review Group
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## 1 Introduction

This report has been prepared by the Technical Review Group (TRG) to inform the Partnership's assessment of a judgement against criterion 4b in its work programme<sup>1</sup>.

Criterion 4b is: whether the Partnership is satisfied with the proposed inventory to be managed in a facility.

The statement in the work programme about 'what we are looking for' in order to be able to make that judgement is: knowledge of what the inventory could be, and the principles that define an acceptable process for how the inventory could be changed, including how the community can influence this.

This report covers:

- Work completed
- Commentary on the issues
- Conclusions and recommendations
- Annexes A and B

Annex A contains extracts from a draft statement from DECC about what the inventory could be. Annex B contains the Ministerial response to the Partnership's proposed principles for defining an acceptable process of inventory change.

## 2 Work completed

There are two inventory tasks in the work programme:

4b(i) Develop understanding of the likely inventory range, the process for altering the inventory and how the community might influence it.

4b(ii) Understand the implications of new nuclear build for the inventory and associated requirements for a GDF. To include facility size, footprint, design and length of time it would need to be open.

The chronology of work undertaken is as follows:

- PSE1 response – there were two inventory related responses. The first was to add task 4b(ii) to the work programme. The second was to ask for a statement from DECC about overseas wastes and the policy of 'substitution' (see Doc 73, p1). This statement has been provided and is re-produced in the footnote<sup>2</sup>.

<sup>1</sup> 'Work Programme for MRWS Partnership 2010/11', Document 13.1

<sup>2</sup> Government policy states that there is a presumption that only UK radioactive waste should be disposed of in this country. For over 30 years, overseas used nuclear fuel has been reprocessed in

- August 2010 Partnership meeting – this heard a presentation from NDA and a ‘critical challenge’ from Pete Roche on the inventory, including new build implications. Subsequent written responses from NDA and Pete Roche identified common ground and narrowed the areas of remaining disagreement to policy issues. The meeting agreed to develop a set of principles to address the issues raised and to meet the work programme tasks (see Doc 93, sections 4.14 and 4.19).
- October 2010 Partnership meeting – this received an update from NDA, addressing inventory questions from the August meeting (Doc 119).
- December 2010 Partnership meeting – this discussed a draft ‘inventory principles’ paper (Docs 97). The meeting agreed a set of principles for taking forward for discussion with DECC (Doc 127, section 6.11).
- In January 2011, preliminary discussions were held with DECC to establish the scope for securing ‘minded to’ agreement from Government in time for inclusion in the consultation document for PSE3.
- 2 February 2011 – a note setting out the outcome of discussion was discussed by the Steering Group, which agreed some amendments to the principles as a basis for further discussion with DECC.
- 10 February 2011 - a note setting out the amended principles was submitted to DECC, along with a request for an ‘inventory statement’ to inform the Partnership’s assessment process.
- March 2011 Partnership meeting – Stuart Haszeldine raised questions about the impact of disposal of spent MOX fuel and plutonium in his review of research on geological disposal.
- 6 April 2011 – a TRG representative met with DECC to review progress. Officials anticipated seeking Ministerial ‘minded to’ agreement to the principles after the Easter recess. The meeting also discussed an early draft of the ‘inventory statement’ requested from Government to inform the Partnership’s assessment process.
- April 2011 Partnership meeting – DECC tabled a basic briefing note on the 2010 UK Radioactive Waste Inventory (Doc 166). The latest inventory is being used to prepare the ‘inventory statement’ referred to above.
- June 2011 – DECC provided the draft inventory statement and a Ministerial response to the inventory principles. Key extracts from the statement are attached as Annex A. The Ministerial response is attached as Annex B.

### **3 Commentary**

The scale and nature of the inventory of radioactive wastes for disposal is of considerable importance because of (a) of the implications for a GDF and (b) wider implications that could impact on West Cumbria.

On (a), the implications of inventory for a GDF include its design, the size of the underground footprint, the period of operation, the developing safety case and, potentially, the number of required GDFs. On (b), some Partnership members challenge whether certain materials (spent fuel and plutonium) should ultimately be disposed of as wastes,

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the UK, under contract at Sellafield, to separate and recover the reusable nuclear materials. In 1986 Government decided to exercise an option contained in reprocessing contracts signed after 1976 for radioactive waste to be returned to its country of origin. Since then it has been Government policy that the wastes resulting from reprocessing should be returned to the country of origin. Some of this waste is returned under a policy called ‘substitution’ whereby additional amounts of high level waste are returned in place of lower activity intermediate and low level waste. This “substituted” high level waste will be radiologically equivalent to the amount of intermediate and low level waste it replaces. This enables earlier return of overseas waste and results in a six-fold reduction in the number of waste shipments around the world.

when they could in principle provide the basis for further reprocessing and fuel manufacture at Sellafield.

Given this range of issues, Partnership members will wish to carefully consider whether the 'what we are looking for' statement will be met ie that they have sufficient "knowledge of what the inventory could be, and the principles that define an acceptable process for how the inventory could be changed, including how the community can influence this."

The first part of this statement – *knowledge of what the inventory could be* – is addressed in the draft inventory statement provided by DECC. The extracts of this statement in Annex A cover the following:

- What might be consigned to a GDF? This explains which categories of wastes and materials could potentially be destined for geological disposal.
- How much could be consigned to a GDF? This explains how waste quantities can change over time, which is illustrated by the differences between 2007 and 2010 inventories (Table 1). It also describes the current (2010) 'baseline' and 'upper' inventories. The 'baseline' inventory reports the volume of wastes and materials potentially destined for geological disposal (Table 2). The 'upper' inventory provides an indication of what is considered to be a realistic higher volume scenario (Table 3). An explanation is also provided of the different assumptions that underpin the 'baseline' and 'upper' inventories. A key assumption difference is that the 'upper' inventory includes radioactive wastes and spent fuel from a new nuclear build programme in the UK.
- How does a change in inventory affect the GDF? This provides a summary of what it is possible to say at this stage about the implications of baseline and upper inventories for GDF design, size, period of operation, safety case, R&D and number of facilities. This summary helps clarify the implications of a new nuclear build programme for a GDF.

The TRG considers that the information in the draft inventory statement should enable Partnership members to take the view that they have sufficient knowledge of what the inventory could be.

The second part of 'what we are looking for' - *the principles that define an acceptable process for how the inventory could be changed, including how the community can influence this* - is addressed in the Ministerial response to the inventory principles proposed by the Partnership. The full list of the principles and the Ministerial response are attached as Annex B.

Points to highlight are:

- In his covering letter, the Minister "warmly welcomes the broad approach" taken in the proposed inventory principles and believes "there is much common ground between us". In particular, the Minister welcomes the Partnership's approach to managing inventory uncertainties and possible changes in future years "through aiming to set principles at this early stage which then govern how the issues are to be tackled as we go forward".
- DECC's "initial more detailed responses" to each principle indicate where there is straightforward agreement, and where there is a more qualified response. Specifically, DECC agrees with Principles 3 (informing a Community Siting Partnership<sup>3</sup> about significant changes to the inventory) and 6 (negotiations about community benefits taking

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<sup>3</sup> The terminology for any post-DtP Partnership will need revising in light of the Partnership's response to the preliminary assessment report on siting (Document 186).

into account significant inventory changes). As outlined below, the responses to Principles 1, 2, 4 and 5 are more qualified (for the full descriptions see Annex B).

- Principle 1 – *Government should make clear its commitment to agreeing by the end of Stage 5 (surface investigations) what the inventory will be.* DECC does not provide this specific commitment, but explains that it will provide up-to-date information on the inventory at the end of Stage 5, “so that any Community Siting Partnership can provide informed advice to local Decision Making Bodies on whether to move forward or to exercise their right of withdrawal at the end of surface investigation.” It adds that even at that point there will be some uncertainty about the waste that will require geological disposal.
- Principle 2 – *Following any DtP, Government will enter into negotiation with a CSP to develop a mutually acceptable process for how the inventory would be changed (after Stage 5) and how host communities and the DMBs can influence this.* DECC states that “the Government would expect to develop a process for dealing with such changes” and that “this process might reach decisions based on pre-agreed principles”. DECC states that “these principles might include, for example, the circumstances under which decision making bodies may feel the impacts of any change to the inventory to be unacceptable ...”.
- Principles 4 and 5 – *Provision of inventory statements prior to decision making at the end of stages 3, 4 and 5, describing baseline and upper inventories, and a high-level summary of the implications for GDF design, size, period of operation, safety case, R&D and number of facilities.* DECC has provided a draft inventory statement for Stage 3, and states that it will “also produce inventory statements for any Community Siting Partnership during stages 4 and 5, unless an alternative approach is agreed.” However, DECC points out that with regard to provision of a summary of implications, it has concerns about the extent to which a single inventory statement will provide the most appropriate means to provide timely and potentially detailed information. It adds that “flexibility should be retained ... to ensure participating communities receive appropriate and clear information.”

TRG agrees with the Minister that there is much common ground between the Partnership’s proposed inventory principles and the Government’s response. It also considers that the Government’s qualifications relating to Principles 1, 2, 4 and 5 are understandable at this stage of the process. As such, TRG considers that satisfactory progress has been made towards agreeing the principles that define an acceptable process for how the inventory could be changed, including how the community can influence this.

Additional points to note about inventory issues are:

- Scope of inventory – the well established approach to the scope of the inventory is to specify the types of radioactive wastes and their volumes. Critics argue that the inventory should also specify the radionuclide and chemical characteristics of the wastes, as these are necessary to enable risk assessment (NWAA Issues Register p4-5). The Government/NDA response would be likely to be that radionuclide and chemical characteristics are considered in other design, R&D and safety case documentation, and their inclusion would make the inventory unwieldy.
- Proposed Inventory Principles were not discussed in PSE2 – although the inventory principles have been informed by wide-ranging discussion within the Partnership (including the exchanges between NDA and Pete Roche), TRG notes that they have not yet been exposed to wider stakeholder scrutiny in PSE. This will come in PSE3.

- The work programme criterion was drafted early in the Partnership's programme and implies that it would be possible to know what the inventory *will be* at the time of a decision about participation. It is now clear that it is only possible at this stage in the process to know what the inventory *could be*. The 'what we are looking for' statement recognises this, and should be taken as a more appropriate benchmark for reaching judgements at this stage in the process.

## **6 Conclusions and Recommendations**

For the reasons above, TRG recommends that the 'what we are looking for' statement be used as the appropriate benchmark for making a judgement at this stage in the process.

The TRG then considers that:

- the information in the draft inventory statement should enable Partnership members to take the view that they have sufficient knowledge of what the inventory could be; and
- satisfactory progress has been made towards agreeing the principles that define an acceptable process for how the inventory could be changed, including how the community can influence this.

Overall, therefore, TRG recommends that the Partnership agrees that it has received what it is looking for on the inventory at this stage in the process.

## ANNEX A: EXTRACT FROM 'THE 2010 ESTIMATE OF RADIOACTIVE WASTES FOR GEOLOGICAL DISPOSAL', DRAFT JUNE 2011, DECC/NDA

### What might be consigned to a Geological Disposal Facility?

Geological disposal is the long-term disposal route for **higher activity radioactive waste (HAW)**. HAW includes waste from the following categories:

- **High Level Waste (HLW)** – waste in which the temperature may rise significantly as a result of its radioactivity, so this factor has to be taken into account in the design of storage or disposal facilities. HLW arises in the UK primarily as a highly radioactive liquid, which is a by-product from the reprocessing of spent nuclear fuel. HLW is made 'passively safe' by converting the liquid HLW into solid form using a treatment process called 'vitrification'.
- **Intermediate Level Waste (ILW)** – has lower levels of radioactivity than HLW and does not generate sufficient heat for this to be taken into account in the design of storage or disposal facilities. ILW arises mainly from the reprocessing of spent fuel and from general operations and maintenance at nuclear sites, and can include metal items such as fuel cladding and reactor components, and sludges from the treatment of radioactive liquid effluents.

As well as HAW, the inventory for geological disposal includes a **small fraction of Low Level Waste (LLW)**, with a concentration of specific radionuclides which means it cannot be disposed along with most other LLW to near surface disposal facilities, and some other radioactive materials not currently classified as waste. These latter include legacy spent fuel and the uranium and plutonium obtained from reprocessing spent fuel. If at some point it is decided that these materials are of no further use and they are classified as waste they will be managed as such in a geological disposal facility.

There are also proposals for new nuclear power stations and any new higher activity waste and spent fuel will also be disposed of in a geological disposal facility. The inclusion of any waste and spent fuel from a new build programme will be taken forward in discussion with host communities as the programme proceeds.

The wastes and materials considered in this report as potentially destined for geological disposal are:

- High Level Waste
- Intermediate Level Waste
- Low Level Waste not suitable for other disposal routes
- Spent Fuel
- Plutonium
- Uranium
- Others

### How much could be consigned to a geological disposal facility?

Waste amounts will change over time. This could be due to changes in planned operations at nuclear sites or if waste management technology or practices alter over time. Changes could be, for example, because of extensions to the lifetime of a nuclear reactor or because of changes in the processes or handling of wastes at individual sites which may result in changes to the number or types of packages of waste. There are also radioactive materials

that may come to be viewed as waste in the future as well as proposals for new nuclear power stations both of which will influence the waste needing to be disposed in a geological disposal facility.

Given the long period over which waste arisings are forecast, changes will continue to occur as the geological disposal facility process moves forward. For this reason the MRWS White Paper recognised that any final agreement with a community on a preferred site for a geological disposal facility would need to address possible changes to the inventory in future years.

### **United Kingdom Radioactive Waste Inventory**

The UK Radioactive Waste Inventory (UKRWI) provides regular updates of the amounts of existing radioactive waste and radioactive materials (not currently classified as waste) in the UK as well as estimating wastes and materials that could arise from the operation and decommissioning of current facilities in the future. It will also include waste from any new nuclear facilities as and when these become operational.

The waste volumes reported in the UKRWI comprise both conditioned and untreated wastes, as well as wastes that are predicted to arise in the future. Untreated waste will require conditioning and packaging for longer term storage and disposal. Wastes that are already conditioned have generally been done so in a form suitable for disposal although there are some wastes that may require further over-packing prior to disposal. The stocks and arisings of spent fuel, plutonium and uranium reported will require packaging (and conditioning where appropriate) prior to disposal.

The UKRWI, although it does not provide a total volume (waste/material plus all final disposal packaging) for geological disposal, does provide a good indicator of actual waste volume prior to disposal packaging. It is useful to show changes in actual waste estimates without being influenced by any changes to final packaging assumptions.

The current, 2010 Inventory of waste and materials (without all final packaging assumptions) potentially for geological disposal is presented in table 1 below and compared to the previous estimate published in 2007.

**Table 1 – Quantities of waste and materials estimated for geological disposal taken from the UK Inventory<sup>4</sup>**

<b>Waste / Material</b>	<b>2007 UK Radioactive Waste Inventory</b>	<b>2010 UK Radioactive Waste Inventory</b>
<b>LLW <sup>1</sup> (m<sup>3</sup>)</b>	12,900	10,700
<b>ILW (m<sup>3</sup>)</b>	236,000	287,000 <sup>2</sup>
<b>HLW (m<sup>3</sup>)</b>	1,090	1,020 <sup>3</sup>
<b>Spent fuel (tU)</b>	6,700	4,150 <sup>4</sup>
<b>Plutonium (tPu)</b>	102	113 <sup>5</sup>
<b>Uranium (tU)</b>	160,000	180,000 <sup>6</sup>

(1) This represents LLW which cannot be disposed of in the Low Level Waste Repository in Cumbria, principally because of the

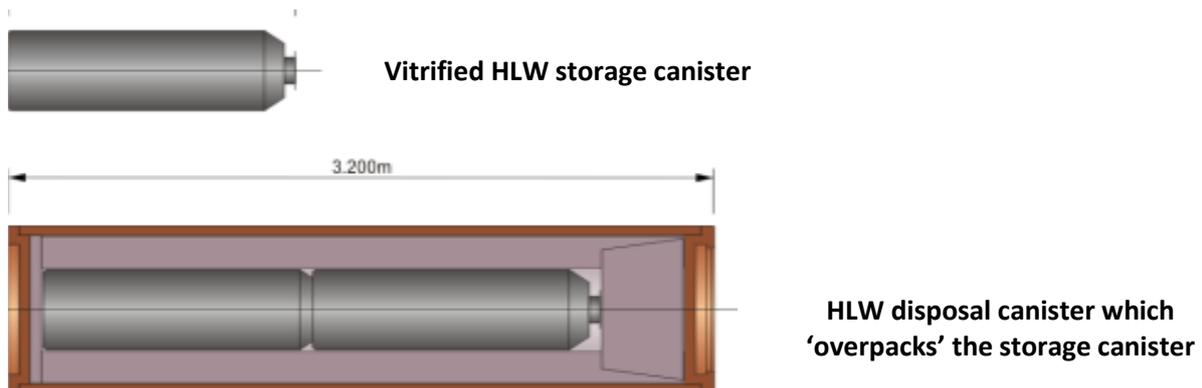
<sup>4</sup> NDA & DECC, *The 2010 UK Radioactive Waste Inventory: Main Report*, February 2011.

concentration of specific radionuclides (i.e. those with very long half-lives), so will need to be disposed of in a geological disposal facility.

- (2) The volume of ILW has increased by about 50,000m<sup>3</sup>. This is principally due to increased estimates of decommissioning wastes forecast to arise at Sellafield.
- (3) The volume of HLW has decreased due to a reduction in the forecast post operational clean out (POCO) arisings.
- (4) The mass of spent fuel has decreased by about 2,500te. This is primarily due to changes in Sellafield's planning assumptions relating to future reprocessing.
- (5) The mass of plutonium has increased by 11te. This is due to changes in Sellafield's planning assumptions relating to future reprocessing.
- (6) The mass of uranium has increased by 20,000te. This is due to changes in Sellafield's planning assumptions relating to future reprocessing and increased arisings from fuel enrichment.

### **Baseline Inventory**

The Baseline Inventory is based on the UKRWI and reports the volume of radioactive waste and materials potentially destined for geological disposal. The volumes are presented in the form of 'packaged volumes' that is the volume of the waste as conditioned and packaged in the final form for disposal. For example, vitrified HLW containers are assumed to be packaged into robust disposal canisters as shown below:



Packaging assumptions have not yet been optimised and for this reason not every waste stream in the 2007 baseline inventory was shown as a 'packaged for disposal' volume (see footnote 2 in the table below). Whilst current packaging assumptions may change, in the 2010 Baseline Inventory it is considered prudent to report all waste types as 'packaged for disposal'. The updated 2010 Baseline inventory is presented in table 2 alongside previous volumes as estimated in 2007.

**Table 2 - Baseline Inventory volumes of waste and materials estimated for geological disposal including all final packaging assumptions**

Waste / Material	2007 Baseline Inventory	2010 Baseline Inventory
LLW (m <sup>3</sup> )	16,600	13,800
ILW (m <sup>3</sup> )	364,000	490,000 <sup>1</sup>
HLW (m <sup>3</sup> )	1,420	6,910 <sup>2</sup>
Spent fuel (m <sup>3</sup> )	11,200	6,440 <sup>3</sup>
Plutonium (m <sup>3</sup> )	3,300	7,820 <sup>4</sup>
Uranium (m <sup>3</sup> )	80,000	106,000 <sup>5</sup>
<b>Total (m<sup>3</sup>)</b>	<b>477,000</b>	<b>631,000</b>

- (1) The increase in ILW is due to the increased ILW arisings reported in table 1.
- (2) The 2007 baseline Inventory did not provide HLW as a 'packaged for disposal' volume, rather it showed the volume of packages in storage at Sellafield. If the 2010 HLW estimate did not take into account final disposal canisters, as in the 2007 baseline estimate, the figure would have been 1,330m<sup>3</sup>.
- (3) The decrease in spent fuel packaged volume is mainly due to increased reprocessing assumptions as reported in table 1.
- (4) The 2007 baseline Inventory did not report plutonium as a 'packaged for disposal' volume. The 2010 Baseline estimate does now take into account assumptions about final disposal canisters.
- (5) The increase in uranium is due to the increased arisings reported in table 1.

### **Upper Inventory**

An upper inventory is also calculated to allow the implications of uncertainties (such as changes to handling arrangements on sites, changes to plant operating lifetimes, new nuclear power stations, etc) in the inventories to be explored and to demonstrate that a geological disposal facility can be developed to deal with an upper inventory safely and securely.

This is not intended to be a maximum and does not set out the largest inventory which could be disposed. It is not possible to state a 'maximum' inventory due to uncertainties in future forecast arisings (i.e. the extent of reprocessing as this would lead to a decrease in spent fuel and an increase in other higher activity wastes and materials). At this generic stage the 'maximum capacity' of a geological disposal facility also cannot be determined until details of a specific site are known, when the characteristics of the geological environment (i.e. the natural barrier) have been investigated and when these, in combination with the engineered barrier, have been evaluated through application of the safety case.

The upper inventory provides an indication of what is considered to be a realistic higher volume scenario and table 3 below sets out the 2010 Upper Inventory estimate alongside the 2010 Baseline Inventory.

**Table 3 – Comparison of Baseline and Upper Inventory of waste and materials estimated for geological disposal including all final packaging assumptions**

<b>Waste / Material</b>	<b>2010 Baseline Inventory</b>	<b>Upper Inventory as estimated in 2010</b>
<b>LLW (m<sup>3</sup>)</b>	13,800	150,000
<b>ILW (m<sup>3</sup>)</b>	490,000	786,000
<b>HLW (m<sup>3</sup>)</b>	6,910	12,000
<b>Spent fuel (m<sup>3</sup>)</b>	6,440	22,200
<b>Plutonium (m<sup>3</sup>)</b>	7,820	10,400
<b>Uranium (m<sup>3</sup>)</b>	106,000	183,000
<b>Total (m<sup>3</sup>)</b>	631,000	1,160,000

**Summary of the differences in the assumptions used in the Upper Inventory compared to the Baseline:**

- All AGR stations are assumed to operate for 40 years as opposed to 30 to 35 years in the baseline inventory; similarly Sizewell B PWR is assumed to operate for 60 years as opposed to 40 years;
- The upper inventory includes radioactive wastes and spent fuel from an assumed new nuclear build programme in the UK comprising four AP1000 reactors and four EPR reactors (total generating capacity of 10GWe) each operating for 60 years. This is not intended as a maximum since the eventual installed capacity of a new build programme is not known; for instance energy companies have recently committed to build up to 16GW(e) of new nuclear power stations, although the proposed reactor types have not yet been determined;
- The upper inventory is based on an early decommissioning scenario for Magnox and AGR stations as opposed to the current decommissioning strategy assumed in the baseline. This scenario assumes no 'Care and Maintenance' stage and brings forward final site clearance by between 50 and 75 years and therefore results in increases in estimated waste volumes due to there being less time for radionuclide decay.
- All spent fuel in the baseline inventory and spent fuel arising as a result of extended operations of existing reactors (but not from any new reactors) is assumed to be reprocessed (this includes contracted and un-contracted spent fuel) as opposed to the baseline in which some spent fuel is assumed to be directly disposed. The Upper Inventory therefore includes the higher activity radioactive wastes and materials from the reprocessing of this spent fuel (assumed to be an additional 4,330tU AGR and 1,570tU PWR spent fuel);
- It is assumed in the upper inventory that all non-commercial reactor spent fuel (also referred to as exotic fuel) is directly disposed (assumed to be 440tHM);
- Estimation of spent sealed radioactive sources requiring disposal is increased over the assumption in the baseline.

- Data on volume uncertainties reported in the 2007 UK RWI are taken into account in assigning Upper Inventory waste volumes.
- Assumptions in the upper inventory include the disposal of nominal volumes of excavated waste from historic disposals at Dounreay and the LLWR trenches.
- The upper inventory assumes that uranium and plutonium from UK defence activities are disposed of as wastes.

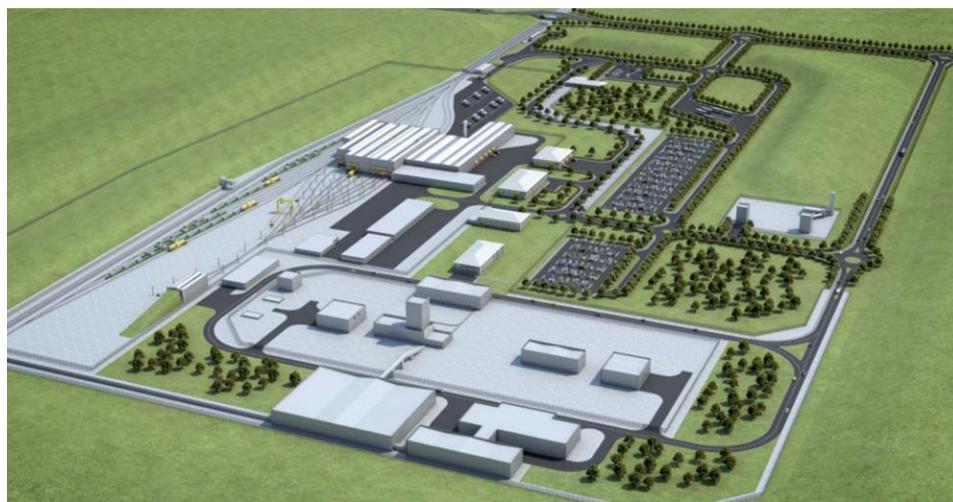
## How does a change in inventory affect the geological disposal facility?

### Potential size and design of Surface and Underground facilities

A geological disposal facility has two major components:

- the surface facility, comprising of buildings to receive and transfer waste underground, workshops, offices, possibly waste packaging facilities etc ; and,
- the underground facility, comprising access tunnels/shafts, the vaults that would hold the waste, any ventilation shafts etc.

The surface facilities for a geological disposal facility are estimated to cover an area of about 1 square kilometre with either the baseline or upper inventory and are not expected to be significantly different in design for the two inventories. This is also unchanged from that estimated previously using the 2007 Baseline Inventory as set out in the generic Disposal System Safety case (DSSC)<sup>5</sup>.



The range of geological settings that could be suitable for hosting the underground part of a geological disposal facility is diverse and until a specific site / geology is identified, the NDA are working with a range of generic host rock types that are considered potentially suitable and which occur in the UK.

The estimated underground area required (footprint) for the 2010 Baseline and Upper Inventories in the generic rock types being considered by NDA, as well as those estimated previously using the 2007 inventory data, are shown in table 4 below. It is worth noting that these estimated footprints are illustrative and would depend on a range of factors, in particular the characteristics of a site and hence the design and layout of the geological disposal facility design selected for that site. The illustrative designs that have been used to estimate footprints also assume that there would be two distinct disposal areas (one for

<sup>5</sup> <http://www.nda.gov.uk/aboutus/geological-disposal/rwmd-work/dssc/>

ILW/LLW and one for HLW/SF), excavated on a single level and separated by an appropriate distance. Once site characteristics are known, it may be possible to design a geological disposal facility that is on multiple levels, hence reducing the overall footprint. The nature of underground facilities are not expected to be significantly different for the two inventories.

**Table 4 - Estimated footprints for geological disposal**

Illustrative Concept Example	Baseline Inventory		Upper Inventory	
	2007	2010	2007	2010
Higher strength rock	6 km <sup>2</sup>	6 km <sup>2</sup>	10 km <sup>2</sup>	9 km <sup>2</sup>
Lower strength sedimentary rock	10 km <sup>2</sup>	9 km <sup>2</sup>	20 km <sup>2</sup>	20 km <sup>2</sup>
Evaporite rock	9 km <sup>2</sup>	9 km <sup>2</sup>	18 km <sup>2</sup>	18 km <sup>2</sup>

The overall change in footprints, due to the changes in waste package numbers between the 2007 and 2010 inventories, can be seen to be minor. The 2010 UKRWI identified an overall increase in the number of waste packages, but no new waste package types were introduced. Although the number of HLW/SF waste packages decreased this is offset by the much larger increase in the number of ILW waste packages.

As with the 2007 inventory the differences between Baseline and Upper Inventory have a more significant effect on the estimated footprint. The 2010 Upper Inventory is estimated, on average for the three different illustrative designs, to approximately double the footprint compared to the 2010 Baseline Inventory.

As set out earlier, the upper inventory is not intended as a maximum as the eventual installed capacity of a new build programme is not known. The upper inventory assumes a new nuclear programme, operating for 60 years, that generates approximately 10GW(e). Government has not set any target for the amount of electricity it expects to be generated by new stations although energy company plans suggest they might build up to 16GW(e) of new nuclear power stations.

Depending on many factors, including assumptions made regarding electricity generation and types of reactor, if a 16GW(e) new build programme was assumed the upper inventory could be estimated to increase by 15,000m<sup>3</sup> for ILW, 12,200m<sup>3</sup> for spent fuel and 33,800m<sup>3</sup> for uranium. The footprint of a geological disposal facility would potentially increase (over the 2010 Baseline Inventory) by a factor of approximately 2.5.

No new technical challenges for the design and construction of a facility would be posed by the change in the number of waste packages for a facility in either the 2010 Baseline Inventory or the 2010 Upper Inventory. There would however be a proportionate increase in the construction and backfill materials required as well as the spoil generated. The overall increase in waste packages would also result in increased infrastructure underground (i.e. inlet cells and associated disposal vaults).

It is assumed that the peak throughput of a facility would remain unchanged from that used for the illustrative designs developed to accommodate the 2007 Baseline Inventory. However, the increase in the number of packages for disposal would change the operating profile with an increased period of operations at a higher rate and therefore the average throughput rate would increase.

### **Operational timescales**

The timescales for operation of a geological disposal facility are currently based on a range of assumptions and at this stage of the programme the operational regime has not been optimised.

For the 2010 Baseline Inventory, the estimated operational period for a geological disposal facility remains unchanged from that estimated for the 2007 Baseline inventory at around 100 years.

It is assumed that the 2010 Upper Inventory is estimated to extend the operational period to around 130 years. That would lead to the extended operation and maintenance of the site infrastructure and a higher utilisation of the waste handling equipment. However, there are likely to be potential opportunities to optimise these timescales as the programme moves forward.

### **Safety case**

The generic DSSC (based on 2007 inventory data), sets out why RWMD has confidence in the safety of a geological disposal facility and that the regulatory requirements for a geological disposal facility could be met in the future once a specific site, geology and facility design has been identified. It draws together detailed information on the scientific and engineering principles supporting geological disposal, setting out at a generic level how a suitable, site-specific safety case might be made in the future<sup>6</sup>.

The generic DSSC also considered an upper inventory in order to demonstrate that a facility can be developed to deal with the upper inventory safely and securely in addition to being confident that the same will be true for a lesser inventory.

The changes to the wastes and materials reported in 2010 Baseline and Upper Inventory when compared to those reported in 2007 are primarily to the volume rather than to the nature and characteristics of the wastes. These changes, both increases and decreases, will be considered in detail in a supporting report, explaining the differences between the inventories summarised in Tables 2 and 3, which is expected to be published by RWMD later in 2011.

An initial analysis of the 2010 update to the Baseline and Upper Inventory has found that the generic DSSC findings would remain unchanged; RWMD continues to believe it will be possible to demonstrate the required level of safety for a range of potential host geological environments. As identified in the generic DSSC, there are several issues important to safety that still need to be resolved. Many of these can only be resolved once research and investigations at the selected site have been completed and this will be addressed through NDA's on-going research and development programme<sup>7</sup>. In particular the increased quantity of carbon-14<sup>8</sup> and depleted uranium<sup>9</sup> in the 2010 Baseline Inventory reinforces the specific research and development work identified for these wastes and materials in the generic DSSC.

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<sup>6</sup> NDA, *Geological Disposal: An overview of the generic Disposal System Safety Case*, NDA Report No NDA/RWMD/010, December 2010.

<sup>7</sup> NDA, R&D Programme Overview: Research and Development needs in the Preparatory Studies Phase, NDA Report NDA/RWMD/073, 2011.

<sup>8</sup> An estimated 15% increase in carbon-14 in ILW at 2150 due mainly to a re-evaluation of the content in irradiated graphite wastes. An important area of NDA's research is to investigate the rate at which methane containing the radionuclide carbon-14 might be produced from the waste, and the potential for this gas to migrate through the surrounding and overlying rock formations.

<sup>9</sup> An estimated 13% increase in depleted uranium masses. This is flagged as an important area of work within the DSSC for further research to explore the possibility and implication of developing a disposal concept specifically for the safe disposal of uranium.

The significance of some of the key issues identified in the generic DSSC would also be reinforced for the 2010 Upper Inventory. In addition to those discussed above the implications of the increase in the number of waste packages for the transport safety case are being considered and will be addressed as part of the iterative development of the disposal system process. Spent fuel from new reactor designs will be hotter and more radioactive than spent fuel from existing UK reactors and therefore could require longer cooling time prior to disposal. Hence, the opportunities for reducing the required cooling time, for example options for spent fuel packaging and configuration in a geological disposal facility, are also being investigated<sup>10</sup>. This analysis of implications of inventory changes for the generic DSSC will be published in a report by RWMD during 2011.

### **Environmental and Sustainability Assessment**

The NDA also published in March 2011 a generic Environmental and Sustainability Assessment based on the 2007 Baseline and Upper Inventory that identifies, characterises and assesses, at a generic level, the likely non-radiological environmental, social and economic effects that may arise from implementing a geological disposal facility<sup>11</sup>.

As with the safety case, an early analysis of the 2010 Baseline and Upper Inventory has found that using the new data would make no material difference to the findings of the generic assessment. Using the 2010 data does result in some differences, such as the volume of rock spoil generated, transport movements and direct employment, However these are relatively small and covered by the uncertainty considered in the generic assessment work.

Updates to the inventory will be taken into account during the next, more detailed stage of environmental and sustainability assessment. This will include the planned Strategic Environmental Assessment during Stage 4 of the MRWS site selection process.

### **Number of Geological Disposal Facilities**

The Government has always been clear that it would be possible to build more than one geological disposal facility and this could be necessary if the geological setting at potential sites was not suitable for a "co-located" GDF (i.e. a GDF containing all higher activity wastes). However, the MRWS White Paper also stated that in principle the UK Government sees no case for having separate facilities if one facility can be developed to provide suitable safe containment for the Baseline Inventory. At this early stage, without a specific site, it is not possible to say using the 2010 Baseline or Upper inventory whether more than one facility might be required. This will be explored through the MRWS process of site selection, through detailed site investigations and through ongoing research and development into disposal concepts.

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<sup>10</sup> NDA, Geological Disposal: *Feasibility studies exploring options for storage, transport and disposal of spent fuel from potential new nuclear power stations*, NDA Report no. NDA/RWMD/060, November 2010.

<sup>11</sup> NDA, Geological Disposal: An overview of generic environmental and sustainability assessment, NDA Report no. NDA/RWMD/072, December 2010.

## ANNEX B: MINISTERIAL RESPONSE TO PROPOSED INVENTORY PRINCIPLES



Charles Hendry MP

Minister of State

Department of Energy & Climate Change  
3 Whitehall Place  
London  
SW1A 2AW

[www.decc.gov.uk](http://www.decc.gov.uk)  
[ps.charles.hendry@decc.gsi.gov.uk](mailto:ps.charles.hendry@decc.gsi.gov.uk)

Our ref: MC2011/04693DM

West Cumbria MRWS Partnership  
Copeland Borough Council  
The Copeland Centre  
Catherine Street  
Whitehaven  
CA28 7SJ

June 2010

Dear Colleagues,

Thank you for the Partnership Principles which you have proposed and which my officials have shown me.

I warmly welcome the broad approach taken, and believe there is much common ground between us.

We all recognize that at this stage there is inevitable uncertainty relating to both the type and volume of waste and materials potentially requiring geological disposal and the capacity of a geological disposal facility itself.

The Managing Radioactive Waste Safely (MRWS) White Paper noted that any final agreement with a community on a preferred site for a geological disposal facility (GDF) would need to address possible changes to the inventory in future years. I therefore welcome your approach managing this uncertainty through aiming to set principles at this early stage which then govern how the issues are to be tackled as we go forward.

I set out the Department's initial more detailed responses to each of the Partnership Principles on the following page. I hope you will find them helpful. My officials stand ready to discuss any points of concern that you may have.

My officials will also work with you on the provision of the inventory statement which you have requested and will continue to work with the Partnership so that you will have the information you need to formulate your recommendation.

Yours sincerely, Charles Hendry

CHARLES HENDRY

**Partnership Principle 1. Government should make clear its commitment to agreeing with a Community Siting Partnership (CSP) what the inventory for disposal in a GDF will be. This agreement will be reached by the end of Stage 5 (surface based investigations). Subsequent significant changes to the inventory would be subject to an agreed inventory change process.**

The Government fully accepts that participating communities will want to understand the potential inventory of waste to be disposed of in a GDF by the end of surface based investigations so as to decide whether to withdraw from the process at that point. The Government reaffirms its commitment to work with the NDA on further refining the expected inventory for the GDF so that any Community Siting Partnership can provide informed advice to local Decision Making Bodies on whether to move forward or to exercise their right of withdrawal at the end of Surface Investigation.

Even at that point there will be some uncertainty about the waste which will require geological disposal over the lengthy operational phase of a facility, but Government recognizes that communities will want to understand how the inventory may potentially change and what the effects of any such change may be on them.

**Partnership Principle 2. Following any decision to participate, Government will enter into negotiation with a Community Siting Partnership to develop a mutually acceptable process for how the inventory for disposal in a GDF would be changed and for how host communities and the Decision Making Bodies (DMBs) can influence this. That process should be defined and agreed as a working draft by the end of Stage 4 (desk-based studies). The negotiation about a mutually acceptable process will agree the circumstances under which local DMBs should have a veto on changes to the inventory.**

Following a decision to participate decision making bodies will be able to withdraw until a late stage in the process and this provides a route for communities to pull out of the process if they feel the impacts of a proposed inventory are unacceptable. Of course, the Government recognizes that communities will want the impacts of any changes to the inventory to be acceptable if a decision to participate is made and this is also reflected in the MRWS White Paper.

The Government would expect to develop a process for dealing with such changes during the desk based studies stage, although it is important to recognize that there is likely to be a considerable period of surface investigation during which the community can continue to withdraw from the process. This process might reach decisions based on pre-agreed principles. These principles may include, for example, the circumstances under which decision making bodies may feel the impacts of any change to the inventory to be unacceptable but should also recognize that estimates of future waste arisings are inherently variable and that geological disposal needs to provide a means to safely dispose of the higher activity radioactive waste in the UK which requires geological disposal.

**Partnership Principle 3. During Stages 4 and 5 (desk-based studies and surface-based investigations), the Government will inform a Community Siting Partnership at the earliest opportunity when significant changes occur to (a) the baseline inventory and (b) the 'upper' inventory, and will clarify the implications for (i) the design of a GDF and surface facilities, (ii) the size of the underground footprint,**

**(iii) the period of operation of the GDF, (iv) the developing GDF safety case, (v) the number of required GDFs and (vi) the use of alternative disposal methods.**

During the desk based studies and surface based investigation stages Government will of course inform participating communities in a timely way when significant changes occur to estimates of the baseline inventory of waste expected to require geological disposal or to estimates of the upper inventory of waste which may be consigned to geological disposal.

When significant changes take place, for example when the UK Radioactive Waste Inventory is updated, Government will inform local communities of any resulting significant changes to (i) the design of a GDF and surface facilities, (ii) the size of the underground footprint, (iii) the period of operation of the GDF, (iv) the developing GDF safety case, (v) the number of required GDFs and (vi) the use of alternative disposal methods.

**Partnership Principle 4. Government will provide an ‘inventory statement’ prior to local decision-making at the end of stages 3, 4 and 5 of the GDF siting process in order to inform a Partnership’s recommendations at that time. The statement will describe the baseline and upper inventories and a high-level summary of the implications for aspects (i) to (vi) as stated in Principle 3.**

Government will provide communities with the information described in response to Principle 3 above and will provide an inventory statement to the West Cumbria MRWS Partnership in the summer of 2011 reflecting the updated 2010 radioactive waste inventory.

We are committed to continuing to engage positively with Community Siting Partnerships to ensure wherever possible they have the information they require to inform recommendations and decision making as part of the MRWS process. We will therefore also produce inventory statements for any Community Siting Partnership during stages 4 and 5, unless an alternative approach is agreed.

However, as officials have previously discussed with the MRWS Partnership that we have concerns about the extent to which a *single* inventory statement document will provide the most appropriate means during stages 4 and 5 to provide timely, and potentially detailed information on all of the areas described under (i) to (iv) and believe flexibility should be retained if a decision to participate is made to ensure participating communities receive appropriate and clear information.

**Partnership Principle 5. Each ‘inventory statement’ should include a high level overview of the main areas of research still to be undertaken to enable development of the GDF safety cases that would be associated with (a) baseline and (b) upper bound inventories.**

The government attaches great importance to work on the GDF being underpinned by necessary research including research to underpin the development of safety cases. While, as described above, we have some concerns about whether inventory statements are the most effective approach we see no problem in providing a high level overview of the main areas of research still to be undertaken to support safety cases associated with baseline and upper bound inventories.

**Partnership Principle 6. Government acknowledges that negotiations about Community Benefits will take account of any significant changes to the inventory.**

Future discussions about the benefits that the communities would receive from hosting a GDF will need to consider the implications of significant changes to the inventory.