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DEPARTMENT OF  
**ENERGY  
& CLIMATE CHANGE**

# Data collection on solid low-level waste from the non-nuclear sector

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# Contents

	<b>Page</b>
<b>Glossary of Terms</b>	<b>4</b>
<b>Executive Summary</b>	<b>5</b>
<b>1. Introduction</b>	<b>6</b>
1.1 Project Description	6
1.2 Project Tasks	6
<b>2. Methodology</b>	<b>8</b>
2.1 Task 1: Data collection methodology	8
2.2 Task 2: Data collection	9
2.3 Task 3 Summary of information on disposal facilities	10
2.4 Task 4 Factors affecting choice of disposal routes	10
2.5 Task 5 Trends in waste arisings	11
2.6 Task 6 Trends in waste management facilities	11
2.7 Task 7 Improvements to data collection	11
<b>3. Results</b>	<b>12</b>
3.1 Waste stream numbers	12
3.2 Volumes and masses	12
3.3 Waste Planning Authorities	13
3.4 Spatially descriptive information	13
3.5 Waste miles	14
3.6 Waste trends	15
3.7 Spatial analysis of trend data	15
3.8 Upscaling of data to provide a national picture	15
3.9 Review of qualitative responses	16
<b>4. Data collection and interpretation – additional issues</b>	<b>19</b>
4.1 Introduction	19
4.2 One-off disposals	19
4.3 Data quality and interpretation	19
4.4 Future waste facilities	20
4.5 Data collection by electronic means	20
4.6 Special considerations for the Oil and Gas Sector.	21
4.7 Special considerations for the Defence Sector.	22
4.8 Northern Ireland	22
4.9 Conclusions	23
4.10 Recommendations	24
<b>5. References</b>	<b>25</b>

## Glossary of Terms

Term	Meaning / Definition
<b>APC</b>	Air Pollution Control
<b>Defra</b>	Department for Environment, Food and Rural Affairs
<b>EA</b>	Environment Agency (of England and Wales)
<b>GIS</b>	Geographical Information Systems
<b>LPA</b>	Local Planning Authority
<b>LLW</b>	Low Level Radioactive Waste
<b>LLWR</b>	Low Level Waste Repository
<b>NDA</b>	Nuclear Decommissioning Authority
<b>NNI</b>	Non-Nuclear Industry
<b>NUTS</b>	Nomenclature of Territorial Units for Statistics
<b>SoLA</b>	Substances of Low Activity (Exemption Order)
<b>SEPA</b>	Scottish Environmental Protection Agency
<b>UKAEA</b>	(Former) United Kingdom Atomic Energy Authority
<b>VLLW</b>	Very Low Level Radioactive Waste
<b>WPA</b>	Waste Planning Authority
<b>Long-lived beta</b>	Radionuclides with $T_{1/2} > 90$ days
<b>Short-lived beta</b>	Radionuclides with $T_{1/2} < 90$ days

## Executive Summary

An on-line survey was conducted of waste arisings in the Low Level Radioactive Waste (LLW) category from premises authorised under the Radioactive Substances Act 1993 in the non-nuclear sector; that is, premises which do not, in addition, hold a licence under the Nuclear Installations Act 1965. The purpose of the survey was to support the development of a national strategy for management of LLW from the non-nuclear sector.

There are 877 facilities in England, Scotland and Wales that hold RSA93 authorisations in the non-nuclear sector. A total of 111 facilities could not be contacted during the survey because contact details were not made available to the contractor. Of the 766 facilities contacted, 35% have responded to the questionnaire. A further 3% of facilities have notified the contractor that they refused to complete the survey.

The survey produced a number of useful indicators for waste types, geographical distribution and transport issues (relating to the 'proximity principle' for waste management). However, care has to be taken in attempting to produce a national picture of waste arisings due to statistical limitations. These statistical limitations, in short, are:

- Low response rate (only approximately a third of the undertakings believed to be producing and disposing of LLW responded to the survey).
- The inability to quality assure (audit by relevant knowledgeable persons) the available data to ensure that it was representative. For instance, are any significant waste producers absent from the survey?

Although current waste disposal quantities may be somewhat higher than in previous years, at least for those undertakings responding to the survey, the quantities appear to have peaked, and in some cases are anticipated to reduce in the coming few years. However, whether this general conclusion can be applied nationally is not clear, due to the low statistical base of the data.

Few undertakings responding to the survey expressed any significant problems with LLW disposal currently. However, the low response rate to the survey means that this finding should be treated cautiously.

# 1. Introduction

## 1.1 Project Description

The Department for Environment, Food and Rural Affairs (Defra) and the Devolved Administrations (Government) published a new policy on the management of Low Level Radioactive Waste (LLW, including VLLW) in March 2007 [Ref. 1]. At the same time, Government gave a commitment to develop a strategy for the management of LLW from the non-nuclear sector. This was in recognition of the fact that this sector appeared to be experiencing difficulties in finding and maintaining routes for the disposal (or other management options) of its waste, and that this sector has a key role to play in the UK economy, in healthcare and in education.

Government has now established a programme to develop such a strategy, and the programme is expected to deliver its output during 2009. The programme is managed by a Programme Board chaired by a senior Defra official, and consists of a number of inter-related projects, the first of which concerns the collection, analysis and presentation of numerical data and other information relating to the non-nuclear sector. This project first is the subject of the current report.

To ensure the strategy is comprehensive and up-to-date, the Government's programme board requires information on:

- How much LLW/VLLW is arising from the non-nuclear sector at present (in terms of its activity, mass, volume, physical form etc.)?
- What disposal (or alternative management) routes are available?
- What is changing (or likely to change) in terms of LLW/VLLW arisings and management facilities?

## 1.2 Project Tasks

The project was carried out under seven tasks, with the objectives outlined below.

- To develop and agree a detailed methodology for how the necessary data and information will be collected, held and displayed.
- To collect sufficient information on radioactive waste arisings from the non-nuclear industry across the whole of the UK, so as to provide an overall view of their nature (i.e. total, short-lived and long-lived activity in Becquerels (Bq), mass and volume, physical characteristics (e.g. density and any hazardous properties) and locations of arisings and disposal.
- To provide spatial and summary descriptive information of existing facilities that are, or could be, used for the disposal of non-nuclear industry waste arisings.

- To identify and discuss the factors which influence the choice of disposal routes by waste producers, and to comment on the extent that the proximity principle applies to the overall pattern of disposals across the UK.
- To assess likely future trends in waste arisings from the non-nuclear industry.
- To assess likely future trends in the availability of waste disposal facilities and specifically to identify what new disposal facilities are planned for municipal, commercial and industrial wastes, and for clinical wastes. Waste disposal facilities in use or planned within NDA facilities for LLW and high volume VLLW should be considered. In the latter case, to determine what scope there might be for disposal of additional non-nuclear industry wastes to these high volume nuclear facilities.
- To identify and assess options for improvements to routine data collection on waste arisings and disposals from the non-nuclear industry, and on the availability of waste disposal routes and facilities across the UK, such that Government will be able to update the national strategy from time to time.

The output of this data collection project will be used, alongside the inputs from parallel and related projects under the Programme, to prepare a nationwide strategy for LLW and VLLW disposals from the non-nuclear industries. In turn, the strategy and its supporting data will be used to inform planning authorities with responsibilities for national, regional and local planning waste strategies who will be required to make appropriate provision for radioactive wastes from the non-nuclear industries within their waste plans.

## 2. Methodology

### 2.1 Task 1: Data collection methodology

Data on solid LLW<sup>1</sup> from the Non-Nuclear Industry (NNI) was collected electronically using an online survey form. It was decided that the electronic format would be the best platform to collect the data due to the simplicity of entering the data; users would be able to adapt the data over time and have the ability to continuously add data through time. It would also reduce the resources that would be required in sending out and processing the returns from a paper-based survey. Furthermore, an electronic online survey form would have the advantage of providing a basis for future routine data collection if such collection is believed to be necessary by Government.

The categories to be included in the survey form were agreed and an initial survey form was created and independently reviewed. The final version of the survey was produced and uploaded onto a live internet site on 15<sup>th</sup> February 2008, and can be found at the following web address:

<http://www.llw.atkinsgeospatial.com/Login.aspx>

The survey required respondents to detail, for current (last full year of data), historical and anticipated future arisings:

- Waste volumes and/or masses
- Waste classification (e.g LLW, VLLW)
- Waste type<sup>2</sup>
- Radionuclides
- Disposal route(s)

Contact details for the all the non-nuclear facilities in England, Scotland and Wales<sup>3</sup> were provided by the Environment Agency (EA) and the Scottish Environment Protection Agency (SEPA). The details were provided for all undertakings currently authorised under the

<sup>1</sup> In this report, unless specifically stated otherwise, LLW includes the subset VLLW.

<sup>2</sup> Waste types are:

Aggregate
Aqueous
Clinical
Metals
Organic Liquid
Soft Waste
Soil
Waste Closed Source
Other

Where 'other' is used for any waste which can not be ascribed to any of the above.

<sup>3</sup> Northern Ireland data is treated separately; government officials from the province indicated that there are few problems in Northern Ireland, and that data collection, if found necessary, would be carried out centrally.



Radioactive Substances Act 1993 for the disposal of solid LLW. User accounts were created for all the facilities.

The survey was set up such that once a user was created an automated email would be sent to the nominated contact of the facility, providing them with the background information to the survey and issuing them with a password and username to login to the survey.

Facilities were reminded throughout the survey period to enter the required information by being sent reminder emails. An article was also inserted in 'The Society for Radiological Protection' newsletter, which was sent to all their members. Other reminder and information initiatives were undertaken, including telephone follow-up and further explanation. The help of the environment agencies was also enlisted to contact some organisations.

Some undertakings, at their request, chose not to complete the online survey, but rather elected to complete hard-copy survey forms. Completed forms were entered into the database of survey returns by the project team.

## 2.2 Task 2: Data collection

The data collection period was extended from the end of April to the end of July to increase the number of returns. The dataset was compiled at the beginning of August and manipulated in a number of ways before the analysis, as described below:

Numerous facilities stated that they had not disposed of any solid LLW recently or historically, and hence their data returns were zero; these were all removed from the dataset.

Only a certain number of facilities had provided waste stream data across all three time scales, historical, current and anticipated. The electronic survey functioned in a way that created data for all three timescales even if the data was not available. Therefore, all waste streams that did not have any data available were removed.

A number of facilities provided waste stream data on aqueous waste that was disposed via drain, sewer or directly into a water course. As the survey only related to solid waste, these waste streams were removed.

Waste was classified using the waste classifications from Government policy (LLW, VLLW High Volume and VLLW Low Volume), and into the following categories: waste type, radionuclide or radionuclide group, disposal method and sector. It is important to note that the number of waste streams does not provide an indication of volume, mass or activity; it is purely a qualitative description of the waste.

One waste stream could be a small or large mass or volume, but would still count as one waste stream. To provide a more quantitative illustration of the waste streams, the total volume and mass of the waste streams in each category was summarised.

The total volume or mass for each category was simply the total of all the waste streams and if a maximum and minimum value was given, the average of the values would be taken. Some estimated masses and volumes could not sensibly be used in this way because the waste producers had indicated only that the mass or volume in question lay in a very wide range of 1 – 9,999.,

To provide an overall view of the waste arisings and disposals from the non-nuclear sector, all waste streams were sorted into Waste Planning Authorities (WPA). The Government's Planning Portal (<http://www.planningportal.gov.uk/>) was used to identify the Local Planning Authority (LPA) for each facility. These LPA were then categorised into WPA using the NUTS (Nomenclature of Territorial Units for Statistics) dataset, which is a hierarchical classification of administration areas. Waste streams in the same WPA were grouped together. The total mass and volume of all the waste streams in each WPA was summed by adding together all the best estimate values and (if only maximum and minimum values were provided) an average of these values was taken. To illustrate the results spatially, the total volume and mass for each WPA was mapped using a Geographical Information System (GIS).

## 2.3 Task 3 Summary of information on disposal facilities

Existing landfill and incinerator facilities in the UK were identified using the names and addresses of the disposal undertaking sites provided by the data returns. A requirement of the survey was for the user to insert the name, address and postcode of the waste disposal site and provide data across three timescales: historical, current/recent and anticipated. Utilising the historical and current/recent waste stream data, the disposal facilities were then categorised into three groups: those only receiving current/recent waste streams; those that have received historical waste streams and are still receiving current/recent waste streams; and facilities that have only received historical waste streams. To illustrate the spatial distribution of disposal facilities in the UK they were mapped using a GIS (Figure 1).

Summary descriptive information for individual waste disposal facilities was summed by collating all the waste streams together to provide an indication of their total volume, mass, activity and the types of waste they accept from the non-nuclear sector. Total volume and mass was summed by adding together all of the best estimate values. If the maximum and minimum values were given, the average of these values was provided.

## 2.4 Task 4 Factors affecting choice of disposal routes

### Questionnaire

To identify the factors which influence the choice of disposal routes by waste producers, and to comment on the extent that the proximity principle applies to the overall pattern of disposals across the UK, facilities that completed the online survey and had provided useful data (that is, not zero returns) – total 210 - were approached via email to answer a questionnaire.

The questions related to whether they had experienced any difficulties in disposing of their waste, whether the LLW policy had affected their decisions on waste management, how they selected their waste management/disposal routes, and if they had any other matters to raise in relation to LLW management.

### Waste Miles

Waste miles refers to the distance that a particular waste stream travels from the place it is generated to the place it is disposed. The waste miles for each individual waste stream were calculated using Google Earth. The postcodes of the facility and disposal site were inserted into Google Earth and the distance between them calculated in miles. The 'ruler' function was used in Google Earth which allows a measurement of the distance between the points in a straight line. Note that this method will provide a measure of 'waste miles' for future comparison, while not being a precise measure of 'road miles'. The waste miles for each WPA were calculated by grouping together all the waste streams and calculating the average.

## 2.5 Task 5 Trends in waste arisings

Trends in waste arising from the non-nuclear sector were assessed by manipulating the data that covered the three time scales of historical, current/recent and anticipated. A second set of data, more limited in application, was based on those returns which set out just current/recent and anticipated waste arisings.

## 2.6 Task 6 Trends in waste management facilities

Two tasks were carried out:

- Letters were sent, under Defra headers, to waste disposal companies, to ask about their commercial intentions with respect to radioactive waste disposals. The main questions were:

*What commercial and/or political issues influence your company's decisions to take radioactive waste from the non-nuclear sector? Do you foresee any major changes in what may influence future decisions to take these wastes?*

*Have you experienced any problems with your authorisations?*

*Do you have any plans to revoke your authorisations? And if so, what are your main reasons?*

*In the case of incinerators which dispose of residues, do you routinely assay the residues, or do you have any one-off assay values which would help us to characterise this particular solid waste (some of which might be in the VLLW category)?*

- An outline of project requirements was sent to the Nuclear Decommissioning Authority (NDA) to explore their intentions with respect to radioactive wastes from the non-nuclear sector.

## 2.7 Task 7 Improvements to data collection

To identify the options for improvements to routine data collection on waste arisings and disposals from the non-nuclear industry, the issues that have occurred throughout the project have been highlighted and assessed.

## 3. Results

### 3.1 Waste stream numbers

The survey required information on annual arisings for ‘historical’, ‘current/recent’, and ‘anticipated’ waste streams. Table 1 and Figure 1 illustrate the total number of current/recent waste streams in the dataset, which are broken down by waste classification, waste type, radionuclide or radionuclide group, disposal method and sector.

The number of waste streams does not provide an indication of volume, mass or activity; it is purely a qualitative description of the waste. However, it does indicate how individual waste streams, from particular undertakings, have been classified by the undertakings in question.

Some 40% of the waste streams have been classified as VLLW (low volume). The waste stream survey returns show that the research and clinical sectors predominate, generating clinical wastes. As expected, the principal radionuclides are those associated with medicine and medical research – tritium, C-14 and the short-lived beta emitters (such as P-32 and S-35). 58% of these waste streams are destined for disposal by incineration – an expected finding, bearing in mind the nature of the waste and its source.

### 3.2 Volumes and masses

To provide a more quantitative illustration of the waste streams, the total volume and mass of the waste streams in each category were summed and graphically displayed. The total volume of waste streams in each category is illustrated in Figure 2, and the total mass of waste streams is illustrated in Figure 3.

In terms of volume, VLLW (low volume) category waste, the medical sector and the incineration disposal route again predominate. In terms of mass, the situation is the same, except that landfill is the predominant route. This indicates the significant, and expected, higher density of waste destined for landfill.

The medical sector is by far the largest disposer of waste in terms of volume but when compared with mass appears to be one of the smallest. This apparent anomaly is caused by the fact that respondents could report data either as mass or volume, and most chose to use volume. The break down of mass and volume for the same categories are unlikely to correlate directly. This is caused by the constraints within the survey. Survey users were only required to provide information on at least one of either volume or mass (but there is the ability to provide data on both). The majority of users have only provided information on volume or mass; there was a small number of organisations that provided information on both. For these reasons, a correlation of mass and volume data to provide density data would lead to erroneous results.

Table 2 presents the information in a different way. In this case, rather than presenting the number of waste streams, it sets out the total number of organisations that have responded by providing information on current/recent waste streams. If an organisation has a number of current/recent LLW waste streams that are disposed to landfill, this will only be recorded as one for that particular organisation. The table shows that 172 organisations have described a total of

254 waste streams. Of these, approximately equal numbers stated that they disposed of VLLW and LLW, but there are few instances where an organisation uses both classifications.

### 3.3 Waste Planning Authorities

To provide an overall view of the waste arisings and disposals from the non-nuclear sector, all waste streams were sorted by Waste Planning Authority (WPA). A summary of the information is provided in Table 3. This indicates the total number of current/recent waste streams for each WPA in the various categories.

The table also provides an estimate of the total mass and volume of all the waste streams arising in each WPA as indicated in the survey returns. This was summed by adding together all the best estimate values and (if only maximum and minimum values were provided), an average of these values was taken. Dashed volume and mass values indicates that the facility did not provide this waste stream information in the survey.

Some estimates of mass and volumes provided by facilities that have been removed from the analysis. A full description of the data treatment is provided in Section 4.8.

To interpret the results spatially, the total volume and mass of all the waste streams in a particular WPA were mapped using GIS. All WPAs were categorised into one of four groups depending on the total volume or mass produced. The spatial distribution of volume and mass waste arising in any WPA can be seen in Figures 4 and 5 respectively.

Although the map shading gives some indication of relative arisings for different geographical areas, two caveats are necessary:

- Scotland is treated as one planning authority region; this tends to distort the picture, giving an impression that waste arisings are higher in Scotland. This is not the case.
- The proportion of survey returns (with non-zero data) varies significantly across the country, from 17.6% in the Thames Region to 31.7% in the Midlands. This difference obviously affects the apparent distribution of waste arisings.

### 3.4 Spatially descriptive information

To identify existing facilities that could be used for the disposal of non-nuclear waste arisings the postcodes, names and addresses of the disposal undertaking sites that were provided by facility contacts in the survey were used. This information allowed an identification of the locations that are currently being used or have been used by the facilities in the past to dispose of their waste.

A list of landfill and incinerator sites used by the non-nuclear sector (as reported in the survey)<sup>4</sup> in the UK was collated from the database and spatially illustrated with the use of a GIS. Historical and current/recent waste stream data provided two lists of facilities, which were then

<sup>4</sup> Part of the specification for this task required that all facilities which might be available for LLW management should be identified. In fact, most landfills and incinerators are potentially available; although the intentions of waste management companies were solicited, none came forward to suggest that they were expanding or reducing capacity, or were likely or unlikely to manage LLW on a commercial basis. For this reason, planning authorities, in consideration of their responsibilities to plan for waste management capacity, will need to use local knowledge to ascertain whether capacity is sufficient.

categorised into three groups: facilities only receiving current/recent waste streams; facilities that have received historical waste streams and are still receiving current/recent waste streams; and facilities that have only received historical waste streams.

The first list concerns disposal facilities that have only been receiving current/recent waste streams. This potentially indicates new disposal sites that have recently been accepting waste; these are highlighted green. The second group of disposal facilities are those that have been accepting both current/recent and historical waste streams. This indicates that they have been accepting radioactive waste for a number of years and are still accepting the waste; these are highlighted yellow. The final group concerns those disposal facilities that have, according to the survey, only accepted historical waste streams. This indicates that the sites may have now closed or no longer accept radioactive waste; these are highlighted red.

The spatial distribution of incinerator sites is illustrated in Figure 6 and the spatial distribution of landfill sites in Figure 7.

To provide summary descriptive information for each individual disposal site, all the waste streams that were associated with each site were collated and their values added together. This provided an indication of their total volumes, masses, activities and the types of waste that were accepted by the disposal undertaking facilities from the non-nuclear sector. Summary information for all the incinerator and landfill disposal facilities in the UK is presented in Tables 4 and 5 respectively. The facilities were classified into the three categories described above.

Secondary waste streams, including incinerator ash and Air Pollution Control (APC) waste types, have all been removed from the analysis for separate treatment. All these waste types are indicated in Table 6.

There are no pronounced trends in this data; that is, no obvious and statistically significant increases or reductions in waste management capacity.

### 3.5 Waste miles

The 'waste miles' of a particular waste stream refers to the distance from where the waste is generated to the disposal site where it is disposed. The waste miles for both landfill and incinerator waste streams were calculated using Google Earth.

To provide an indication of the average distance waste is transported to be disposed of for each WPA, similar waste streams were collated and an average of the waste miles was taken. The average distance for each WPA for both incinerator and landfill sites can be seen in Tables 7 and 8 respectively.

All WPAs were then grouped into one of four categories, based on the average number of waste miles, and colour coded accordingly. A spatial interpretation of the data for each WPA was illustrated using GIS. Average waste miles for incinerator sites are illustrated in Figure 8, and for landfill sites in Figure 9.

This analysis provides a yardstick by which the application of the proximity principle could be measured over time.

### 3.6 Waste trends

Data from the survey were used to analyse the future trends in waste arising from the non-nuclear sector. Waste streams were only included in this analysis if data was available for historical, current/recent and anticipated arisings (53 waste streams), or for historical and current/recent data (128 waste streams). Table 9 provides a further breakdown of these numbers into LLW/VLLW, and into the sectors concerned. Table 10 provides a further breakdown according to radionuclide type.

The statistically significant conclusions from this analysis are:

- Overall waste volumes and masses have been steady, but are expected to fall. However, there is an indication that although volumes and masses may fall, activities will not.
- For the radionuclides C-14 and H-3, there is an indication of a continuing rise in activity, projected into the future.

The remaining trend information is included for illustration purposes, and is not likely to be statistically significant...

### 3.7 Spatial analysis of trend data

To provide a spatial indication of the anticipated increase and decrease in waste in all the WPAs, Table 11 was compiled. This illustrates those areas that are anticipating a rise in radioactive waste (green), will remain as at present (orange) or are anticipating a decrease (red). GIS was used to spatially illustrate the trend analysis of volume and mass for each WPA, which can be seen in Figures 11 and 12 respectively.

Overall and on average, the graphs show no significant anticipated change over present.

### 3.8 Upscaling of data to provide a national picture

Care needs to be taken when attempting to scale the data to generate a national picture. The statistics are not robust for four reasons:

- Contact problems mean that a significant number of organisations have not been contacted. It is not known whether these organisations are in a particular class, and would therefore skew the statistics.
- A key requirement for the data collection task was to elicit, from the Environment Agency and SEPA, an indication of whether any major (high volume, mass or activity) waste streams were not included in the data returns. The databases were consequently sorted into lists for each EA region, and sent to the regulators for comment. Of the eight England and Wales regions plus Scotland, only two E&W regions have participated. Of these two, one has provided a response which appears to indicate that some major waste producers were, in fact, absent from the list of responses, but full details were not forthcoming on the timescale of this project; the other has provided a partial response which indicated that no major waste producers were absent. Therefore, it is not known whether all significant waste producers have completed their returns.

- There was an apparent disjoint between survey responders who provided volume data and those who provided mass data. Few respondents provided both.
- Most importantly, the very low return of data (approximately one third of those polled responded) means that the values are extremely susceptible to bias in terms of major/minor waste producers absent and major/minor waste producers present in the survey.

For the above reasons, statistical advice to the project was to the effect that national upscaling should not be attempted, and would provide a picture which could be misleading.

### 3.9 Review of qualitative responses

Facilities that completed the survey and provided waste stream data returns were contacted and asked four questions relating to whether they have experienced any difficulties in disposing of their waste, whether the LLW policy had affected their decisions on waste management, how they selected their waste routes, and if they had any other matter to raise in relation to LLW management. A total of 185 facilities were contacted and 32 responses were received. These responses were then supplemented by interchanges facilitated by non-nuclear liaison groups in the UK.

A summary of the responses for each question is provided below. These responses are, for the most part, reported almost verbatim. The arguments behind the lists of difficulties are not always clear. Further dialogue with those who provided these responses would be required to elicit additional information.

***“Have you experienced any difficulties in disposing of waste - for instance, any change in practices within waste disposal companies, or problems with setting up contracts etc? If you have had any difficulties, has this adversely affected your business, perhaps in terms of increased costs or forced changes of practice?”***

The majority of responses (22) stated they had not experienced any problems in disposing of their waste. Of the remaining responses the following difficulties were identified:

- The disposal of waste is difficult due to the increasing cost of disposal and the difficulties in comparing contractors with regard to price. A detailed submission must be prepared for a quote, which often leads to delays in getting a response.
- Arranging collections and disposal across long distances.
- There appears to be a disconnection between what the EA believes is practicable and the practice of disposal operators.
- There are a limited number of disposal options which is further complicated by the requirement to have each disposal route specified on the authorisation.
- Reluctance on the part of the landfill sites<sup>5</sup> to accept radiological wastes even though they can be disposed of under a relevant exemption order or VLLW authorisation.
- Delays when trying to make the arrangements for the collection of the waste.
- Disposal of some waste via the local authority is not possible on account of their policy of incineration/recycling of waste.

<sup>5</sup> It is unclear how landfill operators would know that they are receiving (unlabelled) VLLW or exempt waste. This comment is therefore not clear.



- Policy conflict internal to the EA regarding the transfer of NORM ongoing for three years (2002-05) resulting in costs to the company in trying to obtain permission for one route before another was agreed upon.

In summary, although there appears to be a perception that waste routes are not as numerous as hitherto, the main problems appear to be practical, concerning the setting up of contracts and obtaining relevant permits from the environmental regulators.

***“Has Government LLW policy (the 2007 policy) affected your decisions on waste management - for instance, the statement of the proximity principle, application of the waste hierarchy etc?”***

The Government LLW policy has not affected most facilities, but has been welcomed by some respondents. Other responses include:

- The slowness with which SEPA is allowing us to modify our authorisations so that we can implement the policy.
- Trying to send LLW sealed sources for recycling.
- Could be affected if incinerator residues (ash/lime) are subject to high volume VLLW controls.

***“How did you select your waste routes? What were the main drivers in this selection?”***

- Practicality and economics.
- The recognition of a risk-based approach to disposal.
- Availability and costs.
- Environmental impacts and costs.
- The maximum length of time allowed storing waste on site to allow us to dispose of waste as non-radioactive waste.
- Waste consortium selected the route as radioactive waste is within contract for other hospital waste.
- Relationship with the contractor and practicalities.
- Availability of incinerators for organic solvent LLW.
- Have own incinerator for disposal.
- Only produce the occasional Low Volume VLLW so use Local Authority waste services.
- Cost and performance of operator.
- Cost and distance.
- Logic and cost effective.
- Main driver was to have a flexible process in place.
- Trust with the operator was the major driver, cost irrelevant.
- Selected by type and activity.
- Cost, availability and ensuring appropriate responsible disposal.
- Risk assessment and consultation with radiation protection advisor.
- Cost and ease of operation but also wanted a local solution.
- Guidance from RPA and waste advisor.
- Inter-departmental transfers to persons who are better equipped to deal with the waste.
- Routes are selected on the basis of waste type, cost, and environmental considerations. The lack of local disposal facilities means that our carbon footprint is high.
- Reliability and proximity.

- Nature of the waste willingness of the contractor to take the waste, cost, the service provided by the contractor, best practical mean policy of the university.
- Route was affected by who would accept the waste.
- Safety, convenience and cost.
- Decay stored for simplicity.

In summary, costs and availability appear to predominate the decisions. There are some indications from the responses that new government policy is being noted (references to 'risk' for example) but other indications that waste routes are used because of history (contracts in place) rather than because any new assessments, based on the government policy criteria, have been carried out.

***“Is there any other matter with respect to LLW management which you would like to be highlighted and addressed in the development of the strategy?”***

- Routes are closing as expected but there is a need from medical research and R&D in education for some routes to be maintained.
- Encouragement of disposal facilities not to exclude waste from the groups that they take. SEPA's approach to declaring radioactive waste results in us sending our waste to England to be disposed by an authorised incinerator.
- Decay storage<sup>6</sup> is a very useful management technique for short-lived isotopes. Provided storage areas are adequate and secure there should be consideration of longer authorised periods prior to disposal as VLLW.
- No major increase in cost or restrictions on contractors removing waste from sites. Small users in the non-nuclear sector should not be governed by the same regulations as the nuclear sector.
- One user was advised to refuse freedom of information request about radioactive waste they produce on the grounds of national security, the basis of which that a terrorist could use the information to work out what we stored on the premises.
- Increase in the number of disposal facilities and allow disposal by any approved route without specifying particular organisations in the authorisation
- The lack of alpha VLLW routes means that low levels of contaminated wastes need to be sent as LLW which is both very costly and results in the needless filling in of a valuable resource (i.e. LLWR at Drigg).
- The strategy needs to clearly state that you can re-categorise waste at the time of transfer/disposal. You may have started with some LLW that you have put down for a period of decay storage. After this time when it comes to disposing of the waste, it may now be VLLW or even SOLA. Clear statements need to be made and the differences between English and Scottish interpretations of RSA93 eliminated.
- Proportionate and consistent regulation across England/Wales and Scotland.

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<sup>6</sup> Decay storage is not a disposal option, but a waste management practice whereby certain short-lived radionuclides are stored to reduce activity pending disposal.

## 4. Data collection and interpretation – additional issues

### 4.1 Introduction

Reference to the project objectives (Section 1 above) shows that a number of additional initiatives and considerations need to be made prior to developing conclusions for the data collection work. These additional issues are set out in this section.

### 4.2 One-off disposals

The survey was intended to collect and present information on routine disposals, such that trends and possible difficulties could be identified and analysed. However, a number of undertakings provided information on one-off disposals, which have not been included in the trend data. For the purpose of completeness, these data are presented in Table 12. The nature of one-off disposals is such that, in a survey of this type, trend information is extremely problematical. Furthermore, although the survey returns indicate masses of no more than a tonne or so, some one-off disposals (for instance from land remediation projects) are known anecdotally to be much higher than this. The predominant route for one-off disposals is to the LLWR, or via UKAEA to the LLWR.

### 4.3 Data quality and interpretation

Numbers of responses in the three categories current, past, and future are presented by sector in Tables 13 and 14. The purpose is to see which sectors have adequate coverage from a statistical point of view, and which do not.

There are 877 facilities in England, Scotland and Wales that hold RSA93 authorisations in the non-nuclear sector. Although all facilities in Scotland were contacted and asked to take part, contact details for England and Wales, as provided by the Environment Agency, were not comprehensive or correct in all details. Follow-up research was necessary in order to extend the survey to a reasonable number. Despite this follow-up work, a total of 111 facilities have not been contacted during this survey. Of the 766 facilities contacted, 35% have responded to the questionnaire. A further 3% of facilities have notified Atkins that they refused to complete the survey.

Examples of some specific problems encountered during the collection and analysis work were:

- Some respondents sent blank returns. Waste streams entered into the database that did not contain any data were removed from the analysis - it not being clear whether they were reporting nil waste. Where possible, these nil returns were followed up.
- Some respondents stated that they no longer dispose of LLW/VLLW, or their authorisation had been revoked.
- Aqueous waste streams disposed of (e.g., to drains/sewer/sea/river) were removed from the analysis.

- All the waste streams that have provided information on secondary waste have been removed from the analysis for separate treatment.
- Some respondents stated that their waste streams were VLLW (high volume), but after further analysis, this classification was misinterpreted. Therefore, these waste streams were moved into the VLLW (LV) category and the summary tables have been adjusted to accommodate for this.
- More than one respondent has provided a volume in the range of 1-999999. This was distorting the data, and so the range of data has been removed from the analysis.
- There was reporting of some waste streams that were released to air; these have also been removed from the analysis.

#### 4.4 Future waste facilities

The following points summarise the responses and correspondence in relation to the future capacity for non-nuclear LLW disposal facilities.

- One response has been received from a large waste management company in the incinerator business indicating that the current capacity will be maintained, with no intention of reducing capacity.
- Other waste management companies are believed (but not confirmed) from evidence external to the survey to be interested in developing facilities, possibly under NDA contracts, for LLW disposals, mainly in the VLLW category. Facilities have also been identified specifically for oil and gas NORM wastes.
- Although there is only one UK incinerator currently authorised for alpha disposal, there is no technical, safety or environmental reason why the environmental regulators will not authorise applications for an alpha component at other incinerators.
- NDA are currently considering new incinerator capacity, and this may be made available for wastes arising in the non-nuclear sector.

#### 4.5 Data collection by electronic means

A project objective was:

*“To identify and assess options for improvements to routine data collection on waste arisings and disposals from the non-nuclear industry, and on the availability of waste disposal routes and facilities across the UK, such that Government will be able to update the national strategy from time to time”.*

The following notes are pertinent to this question:

- Certain users of the survey were averse to completing the electronic survey and requested a hard paper copy to complete, of which 36 copies were completed.

- Other users have stated that they would have preferred to have been contacted through written communication before receiving the email with the login details. The sole form of initial contact throughout this exercise has been through electronic emails such as the introductory email and, for those that had not completed the survey, reminder emails.
- Users have stated that they supplied this information to their regulatory authority<sup>7</sup> and questioned why they had to complete the process twice. They claimed that the data should be retrieved from them.
- There have been a small number of users that have emailed, and one anonymous call, refusing to complete the survey as it was not made compulsory or a legal requirement. It is believed that the real number will be more significant, as other users will probably share the same view but have not informed the contractors.
- There have been a number of contacts that have left the company to which their details are assigned, or are on extended leave/maternity. E-mails have not always been forwarded to the relevant persons within these organisations. This is a matter for the contact arrangements database set out in the above section.
- One shortcoming has been identified with the on-line survey form; an inability to deal with one-off disposals.

The above matters will be developed further in the recommendations section. Although some are associated with the mechanics of data collection, far more are concerned with legal enforceability and the availability of correct contact information.

## 4.6 Special considerations for the Oil and Gas Sector

The Oil and Gas sector are a special consideration for this work. Issues relating to the management of LLW from the sector – oilfield shale with enhanced concentrations of Naturally Occurring Radioactive Material (NORM) – have been dealt with extensively in other reports (Refs. ). Furthermore, it is difficult to establish the total volumes and activities of waste in this category. Hence, the values which have been derived historically are a highly-uncertain indication of future values. Their inclusion in this survey would have had the effect of significantly distorting the statistical analysis.

A summary of the position for this industry is as follows.

- Some onshore disposal facility capacity is essential for non-exempt NORM that cannot be disposed of elsewhere (e.g. at present, onshore arisings from decommissioning).
- LLWR capacity for oil and gas NORM wastes is uncertain as it is constrained by radium and thorium activity limits, plus the current capacity limits might be fully taken up by other wastes.

<sup>7</sup> Routine annual reports are made to the environmental regulators for the purposes of maintaining the national Pollution Inventory. However, use of the Pollution Inventory as a substitute for this survey is not appropriate because:

- The Pollution Inventory reporting depends on a de minimus value. Many important waste streams, particularly in the VLLW category, would have been missed.
- The Pollution Inventory requires only details of activity, not volume or mass. Additionally, there is no readily accessible spatial analysis of the inventory data.

- Public resistance to new radioactive waste disposal sites is in evidence, although oil and gas NORM has the perceptual advantage of being “natural”.
- Several landfill operators have interest or plans but are reluctant to invest without some guarantee of revenue.
- Exempt NORM waste may continue to go to conventional landfills and this is an important route e.g. for occasional large volumes of terminal wastes.
- Special precautions burial is a diminishing practice. With the exception of one site in Lancashire, the survey indicated no landfills currently engaged in this practice.
- There are no sites that receive non-exempt LLW in Scotland, few in England and Wales and limited interest from waste contractors..
- Non-exempt NORM waste is not covered by the Waste Framework Directive waste, and in the absence of special precautions burial requires a RSA authorised disposal facility.

#### 4.7 Special considerations for the Defence Sector

Exchanges with MoD at the start of this project were to the effect that MoD issues should not be included in the routine data collection work; data would be collected independently by them. Due to staff changes and other priorities, this work was not done on a timescale suitable for inclusion in this survey, although some qualitative views were expressed and included in this report.

#### 4.8 Northern Ireland

Data from Northern Ireland was not included in the survey. The small volumes involved did not, according to NI regulators, present a problem at the moment. One local incinerator is available for C-14 wastes arising from the clinical sector. One landfill which formerly received radioactive waste under the ‘controlled burial’ arrangements no longer does so. All other wastes in the LLW are exported to the mainland for incineration or landfill. Although, without further evidence, this appears to contradict the proximity principle, commercial organisations will only enter the market in Northern Ireland if there is sufficient business. From the limited quantity of data available, this appears to be unlikely.

## 5. Conclusions & Recommendations

### 5.1 Conclusions

This project was established as part of a programme to produce a strategy for the management of Low Level Radioactive Waste (LLW) including its sub-set, Very Low Level Radioactive Waste (VLLW). Although the figures presented in this report will assist the production of the strategy, it is possible, bearing in mind the widespread publicity for the survey through professional associations and liaison groups that the dearth of response to the survey leads to a conclusion that many undertakings which produce LLW and VLLW do not perceive an immediate problem with disposal. This conclusion is supported by the qualitative findings set out in Section 3.8 above. This conclusion also concurs with the conclusions of an earlier pilot study (Ref. 2). However, the opposite conclusion could be drawn – that the lack of response conceals a number of problems in this area.

Notwithstanding the above, this report does present useful information according to Waste Planning Authority area. Although not amenable to local or national upscaling, because of the low and non-representative statistical base of the data, the figures provide an indication of the nature of arisings in these areas. The figures will indicate to local waste planners the fact that they have a responsibility to manage radioactive wastes in the LLW and VLLW categories.

With the possible exception of an anticipated increase in C-14 and tritium waste in the future, there are no statistically significant anticipated increases in waste which will require disposal during the next few years. Although some current categories are showing higher quantities than in previous years, the quantities appear to have peaked, with anticipated quantities either as today or lower.

The survey has suggested that, so far as respondents were concerned, no landfill is currently disposing of radioactive waste from the non-nuclear sector under the 'controlled burial' arrangements, (although one respondent to the survey erroneously claimed to be using such arrangements).

With the exception of 'controlled burial', there is no evidence from the survey that landfill and incinerator operators are reducing capacity for LLW management. There is some evidence that this capacity will increase. This is supported by additional evidence that NDA facilities may enter the market for non-nuclear LLW. However, this statement needs to be qualified and put into the context of pressure to reduce land filling of wastes generally.

Although the High Volume VLLW category was established by Government policy in early 2007, its use is causing some confusion; a number of undertakings are using this classification where it is not appropriate, while others (e.g. disposers of incinerator ash) are not using the classification. This may be a consequence of the (as yet) lack of Environment Agency guidance on the subject, but the situation appears to be clearer to undertakings in Scotland.

Data in this report can be used to establish a 'waste miles' indicator for the purpose of future comparisons.

Although electronic data collection may be the most efficient method for future data collection, some issues (based on the experience of the current exercise) need to be addressed. The key issues are:

- Is routine data collection necessary
- Although the SEPA contact database is comprehensive and up-to-date, the Environment Agency database is far from this position.
- Legal enforcement will be necessary if sufficient data of sufficient quantity is to be collected to enable comprehensive data manipulation and the application of statistical methods. This would be straightforward to introduce, but a good case will have to be made to ensure that the additional effort required by users is warranted.
- Quality assurance of data – in particular to ascertain its representativeness – will be essential if any statistical treatment of future data is intended.
- Some lessons learned during the course of this project (e.g. the treatment of one-off disposals) need to be incorporated into any updated on-line survey form.

## 5.2 Recommendations

Selected data and analysis from this report can and should be used to inform the production of a national Low Level Radioactive Waste Strategy for the non-nuclear sector. However, care needs to be taken in the statistical treatment of this data; it is not amenable, by reason of its non-representative nature, to detailed statistical analysis. Rather, the results can be used as indicative of waste types, geographical distribution and 'waste miles'.

There appear to be few problems, as notified during this survey, anticipated by the non-nuclear sector regarding LLW management, at least over a period of years, according to the outcome of this survey. For this reason, the non-nuclear strategy should concentrate on a longer time period – perhaps decades – as should any future data collection initiative of this type.



## 6. References

[1] Government Policy on the Management of Low Level Radioactive Waste, 2007.

[2] Galson Sciences Ltd. Pilot study to assess volumes and disposal routes for solid radioactive wastes from non-nuclear industries, 2006.

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