Nuclear Free Local Authorities
RADIOACTIVE WASTE POLICY
Briefing on the Government Review

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OVERVIEW OF RADIOACTIVE WASTE STORAGE REVIEWS

Executive Summary

This report has been developed for the Nuclear Free Local Authorities (NFLA) by the NFLA Scotland Policy Adviser, Pete Roche, in conjunction with the NFLA Secretary. It provides an overview of the following:

- The Committee on Radioactive Waste Management's report to the Government on the interim storage of radioactive waste until a national radioactive waste repository is built.
- The Nuclear Decommissioning Authority's report on how it will manage radioactive waste on the sites that it operates.

The report outlines the current radioactive storage arrangements, and comments on the general lack of urgency in developing medium and long-term waste storage strategies.

The report outlines a continuing concern of the NFLA – the safety of the High Level Waste tanks on the Sellafield site. The radioactive waste contained in these tanks are the most dangerous in the UK and deep concerns remain over the safety regime for this facility – particularly after an alarming incident on the 1st April 2009 (*see Section 10*). *The NFLA believe that as a priority urgent work is required to develop replacement tanks due to continuing concerns over corrosion.*

The report also notes major security concerns over a terrorist attack on the High Level Waste tanks. One report suggests an area from Glasgow to Liverpool would require evacuation in the event of a major rupture of these tanks, while the Norwegian Radiation Protection Agency have noted that the west coast of Norway would only be 9 hours away from significant radioactive contamination in the event of the tanks exploding.

The report notes official concerns from the Nuclear Safety Advisory Committee that there has been 'significant slippage' in programmes dealing with the storage and management of radioactive waste, and what progress there is remains slow.

Recommendations:

- **The NFLA Secretariat raises these concerns with CoRWM and the NDA through direct correspondence and stakeholder workshops**
- **NFLA highlight concerns to the UK Government**
- **NFLA members highlight these concerns through their Waste Management Committees**

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1. CORWM and Radioactive Waste Storage Reviews

Following a Committee on Radioactive Waste Management (CoRWM) recommendation in July 2006 that there should be a "robust programme" of interim radioactive waste storage, both CoRWM and the Nuclear Decommissioning Authority reported in March 2009 on their respective reviews of waste storage.

A sense of urgency appears to be lacking across both reports. As long ago as 2002 (and earlier) concerns have been expressed about the unsatisfactory amount of radioactive waste which has been properly conditioned and packaged; and poorly characterized, physically and chemically degraded historic waste held in old deteriorating facilities.

In particular, concern has been expressed for over a decade about the condition of high level liquid waste stored in tanks at Sellafield. An accident or terrorist attack here could, for example, require the evacuation of the area between Liverpool and Glasgow and cause up to 2 million deaths. A recent failure in the cooling system of these tanks has again highlighted the urgent need to deal with this problem.

It is noteworthy that the number of annual transports of nuclear waste to a geological dumping facility is estimated to be ten times the current number of spent fuel transports to Sellafield.

2. Background to the Reviews

The Committee on Radioactive Waste Management (CoRWM) recommended in July 2006 that:-

"A robust programme of interim storage must play an integral part in the long-term management [of radioactive waste]. The uncertainties surrounding the implementation of geological disposal, including social and ethical concerns, lead CoRWM to recommend a continued commitment to the safe and secure management of wastes that is robust against the risk of delay or failure in the repository programme. Due regard should be paid to:

i. reviewing and ensuring security, particularly against terrorist attacks;
ii. ensuring the longevity of the stores themselves;
iii. prompt immobilization of waste leading to passively safe waste forms;
iv. minimizing the need for repacking of the wastes;
v. the implications for transport of wastes". (1)

The Government's response stated that: "…*the [Nuclear Decommissioning Authority] NDA is reviewing its interim storage needs and it will now be required to take account of this recommendation by CoRWM in conducting the review."* (2)

On 25th June 2007, the Scottish Government withdrew its support for deep geological 'disposal', but it continues to support long-term interim storage and an on-going programme of R&D.(3) This has an important bearing on the interim storage of waste across the UK.

The NDA published its review of storage regimes for intermediate and high level waste across the UK on both NDA and non-NDA sites on 31st March 2009. (4) Spent fuels and other nuclear materials which have not been declared as waste are not covered. A separate review is proposed to address these. The NDA held two stakeholder workshops on current storage arrangements.

CoRWM also made recommendations to Government in March 2009 on interim storage of higher activity wastes. Their review **did** include spent fuels, plutonium and uranium. (5) The report considers waste conditioning and packaging, waste storage, and waste transport, but

it does not cover the issue of spent fuel from new reactors. This will be dealt with in a later report.

Definitions

Higher Activity Waste includes high-level waste (HLW) (both highly active liquid waste and vitrified waste i.e. solidified in glass blocks); intermediate-level waste (ILW) and even low-level waste (LLW) which is unsuitable for near-surface 'disposal' or dumping.

Spent fuel and nuclear materials: Only about one sixth of the world's spent fuel is reprocessed, (6) so in those countries which do not reprocess, spent fuel is considered to be high-level waste. In the UK, spent fuel, even when it is not expected to be reprocessed, is generally not classified as a waste, because at some point in the future, 'useful' material - plutonium and unused uranium - might be extracted from it. Similarly plutonium and uranium products, some of which have no foreseeable future use, have still not been declared a waste.

Waste 'disposal': CoRWM describes 'disposal' as emplacing waste in a facility without the intention of retrieving it. The Nuclear Free Local Authorities (NFLAs) has always preferred to describe this as dumping, since the dictionary definition of disposal is "the act or means of getting rid of something". So-called radioactive waste 'disposal' involves the eventual dilution and dispersion of radionuclides throughout the environment, so this is a misnomer. Putting nuclear waste in a so-called geological 'disposal' facility (GDF) or a near-surface 'disposal' site like the one at Drigg near Sellafield, does not 'get rid' of the waste at all, it merely dilutes and disperses it around the environment. This briefing uses the term geological 'dump' facility (GDF). This goes to the heart of the fundamental difference between an environmental approach and the nuclear industry approach. Supporters of deep 'disposal' argue it is this generation's responsibility to 'get rid' of waste we have created and not leave it for future generations to deal with. An environmental approach argues that, since it is impossible to 'get rid' of this dangerous waste, we have a responsibility to give future generations a choice in how to deal with it, rather than leaving a radioactive waste dump which will contaminate the environment at a poorly predictable rate.

Storage: CoRWM's report defines storage as placing the wastes or other materials in a facility with the intention of retrieving them at a later date.

3. NDA report

The NDA says its priority is to deal with high hazard, high environmental risk facilities (the majority of which are at Sellafield and Dounreay) ensuring wastes are removed from ageing facilities at the earliest safe opportunity. Raw wastes in historical facilities often carry the greatest level of environmental risk because of the limitations in the design of the facilities and their reliance on active systems to maintain their safety.

In principle, it says, the '100 years or more' interim storage objective may be attainable. New waste stores are designed to align with the timeline for the GDF. But with appropriate maintenance and refurbishment could meet this objective. In any case, there should be periodic safety case reviews throughout their operational life ensuring any necessary and timely improvements are made.

A number of existing packaged waste stores have shorter notional design lives and are likely to require relatively more extensive in-service refurbishment to achieve the 100 years or more objective. It is possible that in some cases it would be better to transfer wastes into another more modern store. Further work is needed to assess what would need to be done

to extend the lives of individual stores and investigate whether replacement stores might be needed.

On security, the NDA highlights the fact that nuclear licensed sites are required to produce an approved Site Security Plan. These allow judgments to be made with regard to the malicious capabilities that could be deployed against the site or transporters, and against which security measures should provide protection.

The NDA says it continues to support the Scottish Government in the development of its detailed statement of policy of long term storage for higher activity wastes.

4. CoRWM's Report on Interim Radioactive Waste Storage

CoRWM's view is that interim storage of waste has two roles:

- as an essential precursor to geological 'disposal' (or such other long-term management method as may be decided on for wastes in Scotland);
- as a fallback in the event of a delay in implementing geological 'disposal', or even a failure to implement it.

CoRWM's review concludes there is a need for better co-ordination across the UK nuclear industry organisations, both civil and defence. Whilst CoRWM believes current plans for storage of higher activity wastes are adequate, the present UK approach to storage lacks robustness: it is fragmented and too few sites have contingency plans. A more strategic approach is required.

CoRWM also emphasized the continuing importance of public and stakeholder engagement (PSE) and the need for co-ordination between the NDA and other waste producers on carrying out that engagement without creating stakeholder fatigue. Although a lot of technical information is available, it may not be in the most appropriate form to engender public discussion. There is also a need for more information on security of storage facilities and transport arrangements. CoRWM says there is a need to give the public insights into security issues, without compromising security. In deciding what information should be made available, account should be taken of existing and proposed practices in countries with similar security needs to the UK and a strong freedom of information culture (e.g. the USA).

5. Current Storage Arrangements

Although some legacy waste storage facilities were purpose built, most were not originally intended for long-term use. Examples of legacy waste facilities are the Magnox Fuel Cladding Silo and the Pile Fuel Cladding Silo at Sellafield, the Dounreay ILW Wet Silo, the Hunterston solid active waste building, the Harwell mortuary holes, and the Trawsfynydd reactor vault. Some of these facilities are nearly 50 years old.

Other legacy waste facilities were constructed for operational holding of materials prior to reprocessing. Examples of these legacy waste facilities are the First Magnox Pond and the Pile Fuel Storage Pond at Sellafield and the Dounreay Fast Reactor (DFR) and Prototype Fast Reactor (PFR) fuel ponds at Dounreay.

The wastes in these legacy facilities are not in a form or condition suitable for long-term storage or ultimate 'disposal'. It is necessary to retrieve the wastes, condition and package them and place them in new purpose-built stores. CoRWM says retrieval of most of these legacy wastes will be difficult and the problems for both the implementers and the regulators should not be underestimated. Before any work can proceed, a robust safety case is necessary and the uncertainties in the legacy wastes' properties and inventories make achieving this difficult. It may be difficult actually to move and manipulate the wastes.

The waste producers and the regulators have identified the facilities that require the earliest attention. For these, retrieval of the wastes is necessary in the near future to reduce the risks presented to the local people and environment by the facilities and their contents. The NDA uses a prioritization process to decide on funding and action. This process has confirmed that the Sellafield Legacy Ponds and Silos are the highest priority.

6. Current NDA Plans

Over the next two decades NDA sites will be carrying out retrieval and treatment programmes for historical and operational wastes arising on existing facilities. By 2040, when the NDA anticipates a GDF could be available, the vast majority of these wastes should be in a packaged form, stored in modern interim storage facilities and ready for 'disposal'.

7. Proportion of waste conditioned "unsatisfactory"

Whilst CoRWM makes some sensible recommendations about co-ordination, its report does not appear to reflect the urgency of the situation – an urgency which has been borne out by events since its report was published.

In June 2002 a joint report by the Nuclear Safety Advisory Committee (NuSAC) and the Radioactive Waste Management Advisory Committee (RWMAC) said it was "unsatisfactory" that by April 1998 only 12% of existing[1] ILW had been conditioned. (7) The committees were particularly concerned about poorly characterized, physically and chemically degraded historic waste held in old facilities subject to deterioration.

The Observer reporting on Nirex's submission (8) to the two committees concluded that:

"…*almost 90 per cent of Britain's hazardous nuclear waste stockpile is so badly stored it could explode or leak with devastating results at any time*". (9)

It said that ILW with the equivalent volume of 725 double-decker buses is being stored in a dangerous state.

CoRWM now says that less than 10% (in terms of volume) of the total predicted UK arisings of ILW have been conditioned to date. Similarly the NDA says about 8% of the total ILW inventory had been recovered, conditioned, packaged and placed into interim storage by 31st March 2008. There appears to have been very little progress since the NuSAC/RWMAC report which used figures from April 1998, more than a decade ago.

In 2002 Nirex reported to NuSAC and RWMAC on particularly challenging waste which would be difficult to immobilise; contains particularly hazardous materials, which might, for example, explode on contact with air; or materials with enhanced radionuclide mobility, which might leak easily. The NDA rightly says its priority is to deal with high hazard, high environmental risk facilities (the majority of which are at Sellafield and Dounreay) ensuring that the wastes are removed from ageing facilities at the earliest safe opportunity.

The public will want assurances that the recent focus on the GDF is not distracting attention from getting legacy waste into passively safe storage which has a design life of at least 100 years. The NDA says that:

"*Sellafield and other holders of historical wastes are working closely with RWMD* [The Radioactive Waste Management Division of the NDA] *to achieve improved passivity of these*

[1] As opposed to a percentage of the total volume of ILW expected to arise from current nuclear programmes.

wastes by conditioning into a form suitable for interim storage and ultimate geological disposal'.

However, the numbers above indicate that progress over the last decade has been painfully slow. The NDA's Radioactive Waste Management Division (formerly Nirex) has told CoRWM that the industry has focused on the most difficult types of ILW first, hence the apparently slow rate of progress.

8. Significant Slippage

In July 2008 NuSAC warned that programmes to deal with radioactive waste from decommissioning at Sellafield and other old nuclear plants had experienced significant slippage. (10) The slippages were caused by poor performances of nuclear plants, delays in developing waste processing and budget restrictions. "*There remains a lack of confidence that the high hazards are being tackled to a robust programme*." NuSAC went on to say that there was evidence that hazard reduction at some sites was continuing at a slower rate than was expected when the NDA was set up, yet this had not been fully justified.

NuSAC was shut down in October 2008. Some former members privately suspect this was because its criticisms were too forthright and could have hampered plans for new reactors. (11)

9. High-Level Waste (HLW)

In a report for the NFLA in June 1998, the Institute for Resource and Security Studies reported that liquid high level waste, which is stored in 21 stainless steel tanks at Sellafield, must be constantly cooled and ventilated, because the waste is so radioactive it generates its own heat. (12) It is important that the cooling system in the high level waste tanks is kept running constantly – otherwise the liquid in the tanks could get so hot it boils. If this happened then radioactivity would escape and contaminate the surroundings. The Nuclear Installations Inspectorate (NII) has stated that the consequences of prolonged cooling failure could be 'very severe'. (13) The timings involved are very short. Cooling failure would lead to boiling after 12 hours, and to the tank drying out after three days.

In 1998 the Sellafield tanks contained around 2,100 kilograms (kg) of Caesium-137 compared with the 30 kg released during the Chernobyl accident.

There is a wide range in the age of the HLW tanks or Highly Active Liquor Storage Tanks (HASTs). The volume of highly radioactive liquor which can be stored is controlled by a legally binding specification issued by the (NII). Vitrification – turning the HLW liquid into glass blocks - achieves significant hazard reduction. However, problems with the Highly Active Liquor Evaporation and Storage (HALES) facility have resulted in lower than anticipated vitrification throughput.

Luckily because of reduced fuel reprocessing throughputs due to breakdowns at the two reprocessing plants, new liquid HLW arisings have been significantly reduced. Sellafield Ltd has started the design and construction of a fourth evaporator and has also provided scope for a further evaporator and replacement HLW tanks within the Lifetime Plan (LTP).

The Institute for Resource and Security Studies submitted evidence to the House of Commons Defence Select Committee in January 2002, following 9/11, about the terrorist threat represented by the HLW tanks, which suggesting the quantity of liquid waste had increased to 2,400 kg. (14). This led to a report by the Parliamentary Office of Science and Technology which looked at various estimates of the impact of a terrorist attack on the

Sellafield HLW tanks. Estimates vary – but some commentators have reported that such an attack may require the evacuation of an area between Glasgow and Liverpool. (15)

On 1st April 2007 there were 1,730m^3 of HLW – only 37% of which had been conditioned and packaged. A further 300m^3 are expected to be produced before the reprocessing plants at Sellafield complete their current contracts.

A 2001 European Parliament Scientific and Technological Options Assessment (STOA) report looked at the number of possible fatalities from an atmospheric release of 50% of the liquid in the tanks (3.5 million TBq of caesium-137). It calculates that this could result in a 'collective dose' over the affected population of 47 million person Sieverts, which would cause around 2 million fatalities. (16)

In July 2008 the NII reported that some cooling components in the high level waste tanks have suffered from corrosion. A number of cooling coils had failed causing a breakthrough of radioactivity into the cooling water circuits which can lead to a radioactive release. The NII says replacement tanks should be pursued with the "utmost urgency". (17)

In September 2008, the NII wrote to the NDA to express "*surprise and concern*" about recent funding decisions which delayed the construction of new evaporators and new HLW tanks. (18)

In October 2008, the NII told The Whitehaven News: "*Further evaporator capacity at Sellafield is essential for the longer term safe management of highly active liquor.*" The newspaper reported that both the NII and the Environment Agency have expressed concern that "funding shortfalls" for the operation of Sellafield could undermine regulatory standards. (19) Sellafield currently has three evaporators used to concentrate highly active liquors prior to storage and vitrification but these have not been working well, so one and possibly two new evaporators are required.

10. Accident involving Sellafield High Level Waste Tank

Although the time it would take for radioactivity to start escaping is short, it has been argued that the probability of a failure in the cooling system is extremely low. For example the NII argue that the probability of a failure continuing for 24 hours is less than one in one million years – and the possibility of 3 day failure (that would lead to the tanks drying out) is less than one in a 100 million years.

However a cooling failure did, in fact occur on 1st April 2009. (20) The Sellafield Site Newsletter '*Sellafield News*' indicates the problem was so serious that the Site Emergency Control Centre arrangements had to be called on. (21) Efforts to re-instate the cooling water supply were directed first at the three tanks with the highest heat loading. Cooling was restored to the first of these after 75 minutes and to all three tanks after 3 hours. Reporting on the incident, Sellafield's in-house Newsletter states that cooling was restored to all tanks within 8 hours. Cumbrians Opposed to a Radioactive Environment commented that this was perilously close to the timescale of 10.5 hours catered for in the Sellafield emergency plan.

Recent research by the Norwegian Radiation Protection Authority (NRPA) considers the effects of a hypothetical critical accident at the Sellafield HLW tanks. The research identified that, if prevailing northeasterly winds occurred, Norway could have radioactive materials hitting its coastline just 9 hours after an accident (22). The NRPA looked at scenarios involving an atmospheric release of between 0.1 – 10 % of the total Caesium-137 inventory contained in the tanks. It found that Norway could receive up to 50 times the contamination experienced after Chernobyl.

11. Other issues raised by the CoRWM report

a) Centralised Storage

The NDA has looked at whether, instead of each nuclear site having its own storage facilities, some ILW should be stored in larger facilities on a few sites. This work only covered the NDA sites, but it appears there is limited scope for consolidation of storage arrangements. The timing of waste arisings, the complexity of transport arrangements, communities' concerns at accepting waste from non-local sites and lack of flexibility are factors leading to this preliminary conclusion. At present, there are no plans in the UK for any large central or regional stores.

b) Security

In its 2006 report, CoRWM noted that security specialists who attended a CoRWM workshop unanimously agreed a statement that:

"…..greater attention should be given to the current management of radioactive waste held in the UK in the context of its vulnerability to potential terrorist attacks. We are not aware of any UK Government programme that is addressing this issue with adequate detail or priority, and consider it unacceptable for some vulnerable waste forms, such as spent fuel, to remain in their current condition and mode of storage."

CoRWM says its understanding of the approach taken to ensure security and how this is regulated, combined with discussions with OCNS, give assurance that due regard is being given to reviewing and ensuring security, particularly against terrorist attack. However the public need to be reassured and have confidence in security arrangements. This reassurance and confidence would be bolstered by the provision of more information about how security is ensured, how it is reviewed and how it is regulated.

c) Transport

Implementation of geological dumping would entail the transport of over 200,000 packages of higher activity waste from existing nuclear sites to the GDF. NDA estimates the number of annual movements involved could be ten times the number of movements of spent fuel to Sellafield. It has work in hand on potential transport modes and scheduling, in preparation for discussions with communities that express an interest in hosting a GDF. There can be no guarantee that a waste package designed for transport now will be suitable after decades in store. Not only could the package deteriorate but also regulations may change.

d) Public and Stakeholder Engagement

CoRWM emphasises the continuing importance of public and stakeholder engagement (PSE). More information should be made publicly available about current storage arrangements for higher activity wastes and the issues involved in planning for the future. There is a particular need for waste producers to provide information to, and hold discussions with, the Local Authorities that have granted, or will be asked to grant, planning permission for stores.

e) Magnox Spent Fuel

About 5,000 tonnes of Magnox fuel is due to be reprocessed before the March 2016 planned closure date of the Magnox reprocessing plant. But there can be no guarantee it will last that long. The NDA is therefore reviewing alternative options including encapsulation in a suitable matrix; reprocessing through THORP and dry storage followed by direct disposal. The THORP option has been virtually dropped because modifications would be too expensive. Both the other options require further research.

f) AGR Spent fuel

There are two tranches of AGR fuel, one which was loaded into reactors prior to the restructuring of British Energy (*i.e.* prior to midnight on 14 January 2005), and one loaded afterwards. These are known as historic and new AGR spent fuel. Basically 75% of the historic AGR spent fuel is contracted for reprocessing and what happens to the remaining 25% - whether it is stored or reprocessed - is left up to the NDA's discretion. The new AGR fuel becomes the property of the NDA when it arrives at Sellafield, so it is for the NDA to decide what to do with it. The NDA is looking into dry storage at Sellafield.

g) Sizewell B Spent Fuel

PWR spent fuel is currently stored in ponds at Sizewell B and is the responsibility of British Energy. There are plans to begin dry storage in 2015.

h) Dounreay Spent Fuel

The preferred strategy for the Dounreay Fast Reactor (DFR) spent fuel is to reprocess it in the Magnox reprocessing plant, so it will require transportation to Sellafield.

i) Submarine Spent Fuel

The fuel from nuclear-powered submarines is currently stored in ponds at Sellafield, where there is sufficient capacity for the current class of submarines and their replacements. It might be difficult to reprocess because of its high uranium enrichment and its physical form. As far as CoRWM is aware, there have been no substantial studies of options for the long-term management of UK submarine fuel, but the MoD regards it as an asset rather than a waste.

12. UK Plutonium Stockpiles

Radioactive Waste Briefing No. 18 dealt with plutonium management options:
http://www.nuclearpolicy.info/docs/radwaste/RWB18.pdf

The NDA submitted its "Credible Options" paper on plutonium to the Government in January 2009, and expects to receive a response in the first half of this year.

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