Submission on Scotland's Higher Activity Radioactive Waste Policy.

Supplementary Assessment of Policy Alternatives[1]

Submission from Nuclear Waste Advisory Associates[2]

October 2010

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[1] http://www.scotland.gov.uk/Resource/Doc/324119/0104295.pdf
[2] http://www.nuclearwasteadvisory.co.uk

1.0 Executive Summary

1.1This document is a response to the Scottish Government's Annex to the Environmental Report for its proposed Higher Activity Radioactive Waste Policy which provides a supplementary assessment of policy alternatives.[3] This additional consultation on the proposed Higher Activity Radioactive Waste Policy is being carried out because several respondents to the consultation [4] earlier in 2010 asked for a fuller comparison of the draft policy with the alternative of deep geological disposal.

1.2 NWAA agrees with the Scottish Government policy of not supporting deep geological disposal of radioactive waste but believes the case against is much stronger than is set out in the Supplementary Assessment document.

1.3 NWAA published a list of 101 outstanding scientific and technical issues in March 2010 relating to the production of a robust safety case for the Deep Geological Disposal of radioactive waste, known as the NWAA Issues Register.

1.4 A more recent scientific review of geological disposal of high-level radioactive waste, prepared for Greenpeace International in September 2010, has examined the scientific literature and identified a number of phenomena which could compromise containment barriers in a deep geological disposal facility, and a number of scenarios in which a significant release of radioactivity from a deep repository could occur with serious implications for the health and safety of future generations.

1.5 Given these two recent reports we do not agree with the Scottish Government's contention that the existing regulatory regime is sufficient to ensure that "*long term leaking and pollution affecting water and soil*" from a deep disposal facility can be expected to be "*negligible or neutral*". [5] Nor do we believe it is possible to claim that "*[r]isks to the general population arising from exposure to radionuclides would not be significant from a deep geological disposal facility, as long as applicable regulatory regimes are followed*." [6]

1.6 We are concerned that the Scottish Government may be seeking to justify its policy of opposing deep geological disposal partly on the basis that a large proportion of Scottish waste is graphite waste which in the Scottish Government's view might be better to be disposed of in near surface facilities. The NWAA view is that due to the high mobility and long half-life of carbon-14, it is unlikely to be possible to make an adequate safety case for the near surface disposal of waste graphite. Furthermore, we are concerned that the proposal to move radioactive graphite wastes into disposal facilities, despite the fact that there is adequate storage capacity available for these wastes, may be due to a wish to import wastes to Hunterston from elsewhere in Scotland.

1.7 Pressure from the Nuclear Decommissioning Authority to keep carbon-14 and graphite waste out of a deep geological disposal facility for reasons connected to the volume of the waste and the associated cost and radioactive contamination that would arise from its disposal, should not be taken as a reason to pursue the near surface disposal option.

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[3] Scotland's Higher Activity Radioactive Waste Policy, Strategic Environmental Assessment, Annex to the Environmental Report: Supplementary Assessment of Policy Alternatives, Scottish Government, September 2010. http://www.scotland.gov.uk/Resource/Doc/324119/0104295.pdf

[4] The draft Policy is set out in the Consultation Document, which can be viewed at http://www.scotland.gov.uk/HAW-ConDoc
The Supplementary Information can be found at http://www.scotland.gov.uk/HAW-Sup
The SEA Environmental Report that was published alongside the Draft Policy and can be found at http://www.scotland.gov.uk/HAW-ER

[5] see Supplementary Assessment Consultation (ref 3) para 2.2

[6] Supplementary Assessment Consultation (ref 3) para 2.4

2.0 Introduction

2.1 Nuclear Waste Advisory Associates (NWAA) is an independent group with a collective experience in nuclear issues of well over 200 years. We aim to provide information and advice on the risks posed by radioactive waste, and support to decision makers, stakeholders and communities involved in its management. Our membership includes former members of the Committee on Radioactive Waste Management (CoRWM) and several members who worked for environmental organisations during the Public Inquiry into Nirex's proposal to begin excavation work at their proposed deep disposal site in Cumbria.[7]

2.2 NWAA's submission to the main Scottish Higher Activity Radioactive Waste Policy consultation in April 2010 is available here:
http://www.nuclearwasteadvisory.co.uk/uploads/7930NWAAsubmission[final].pdf

2.3 We are happy for this, and our previous response to be made available to the public.

3.0 Problems with Deep Disposal

3.1 The Scottish Government's "*Supplementary Assessment of Policy Alternatives*" looks at alternatives to its draft policy on Higher Activity Radioactive Wastes.[8] Scottish policy is to reject the deep geological disposal of radioactive wastes.

3.2 The consultation document highlights the Committee on Radioactive Waste Management's response [9] to the first consultation, [10] which stated that a fuller comparison of the draft Policy with the deep geological disposal option would increase public confidence in the proposed approach of near surface storage or disposal radioactive waste.

3.3 NWAA explained in its earlier consultation response [11] that one main reason for opposing deep disposal is the uncertainty involved in making a safety case. The nuclear industry and the regulator accept that a deep disposal facility would leak and so release radioactivity to the surface. Key to their argument for disposal is that the rate of such leakage can be accurately predicted – and furthermore that it would be sufficiently slow that the resultant doses would not be of concern. However, the technical evidence base does not support this hypothesis – rather, it is indicated that the rate of leakage is likely to be much greater than expected.

3.4Key to the philosophy of deep disposal is that the waste would at some stage be irretrievably buried, in order to 'remove the burden from future generations' as argued by CoRWM. [12] However, this means that the problem of radionuclides leaking at a faster rate than expected could not be rectified. This would create a significant burden for future generations, rather than 'removing the burden' from them. Given the present evidence base, which indicates that a high degree of repository leakage is likely, it would be far better to leave future generations the option of managing the waste in the best way they see fit.

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[7] See http://www.nuclearwasteadvisory.co.uk/default.asp
[8] See ref 3
[9] Response from the Committee on Radioactive Waste Management to the Scottish Government Consultation on Scotland's Higher Activity Radioactive Waste Policy, CORWM Doc No. 2795, 29th March 2009. http://www.corwm.org.uk/Pages/Current%20Publications/2795%20Final%20SG%20HAW%20Consultation%20Response.pdf
[10] See Ref 4
[11] http://www.nuclearwasteadvisory.co.uk/uploads/7930NWAAsubmission[final].pdf
[12] Managing our radioactive waste safely, CoRWM recommendations to Government, July 2006. Para 17 http://www.corwm.org.uk/Pages/Current%20Publications/700%20-%20CoRWM%20July%202006%20Recommendations%20to%20Government.pdf

3.5 In evidence to the House of Commons Energy and Climate Change Committee submitted in January 2010 [13] NWAA highlighted technical problems and uncertainties described by the Environment Agency (EA) of England and Wales, and the European Union Joint Research Centre (EU JRC), associated with the nuclear industry's attempts to quantify the rate of radionuclide leakage from a deep repository. Important considerations included difficulties in calculating the solubility and sorption [14] of radionuclides. In addition the problems associated with gas add further complexity. Although it is extremely important to avoid the release of highly contaminated radioactive gases, it is also imperative that gases are able to escape so that a pressure build up is avoided. The nuclear industry does not seem to have an answer to this conundrum. Problems such as these mean that contamination levels calculated for a deep geological disposal facility could be in error by a factor of ten thousand to one million. This clearly has very significant implications for the risk estimates.

3.6 NWAA has also published a list of 101 outstanding scientific and technical issues relating to the production of a robust safety case for the Deep Geological Disposal of radioactive waste, known as the NWAA Issues Register.[15]

3.7 More recently, in September 2010, Greenpeace International published a scientific review of geological disposal of high-level radioactive waste, entitled "Rock Solid" by Dr Helen Wallace. [16] This examination of the scientific literature identified a number of phenomena which could compromise containment barriers in a deep geological disposal facility, together with number of scenarios in which a significant release of radioactivity from a deep repository could occur with serious implications for the health and safety of future generations.

3.8 NWAA therefore agrees with the Supplementary Assessment that any assessment of deep geological disposal will produce highly uncertain findings.[17] However, we do not agree that the existing regulatory regime is sufficient to ensure that "*long term leaking and pollution affecting water and soil*" can be expected to be "*negligible or neutral*". [18]

3.9 Paragraph 2.4 of the Supplementary Assessment postulates that: "*Risks to the general population arising from exposure to radionuclides would not be significant from a deep geological disposal facility, as long as applicable regulatory regimes are followed*." This conclusion does not appear to follow on logically from the reference document. [19] This joint HSE, Environment Agency and Scottish Environment Protection Agency (SEPA) document (which has only been issued for comment and trial use) is simply guidance for managing higher activity radioactive wastes on nuclear licensed sites. It points out that:

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[13] House of Commons Energy and Climate Change Committee. The Proposals for national policy statements on energy, Volume II, page 428.
http://www.publications.parliament.uk/pa/cm200910/cmselect/cmenergy/231/231ii.pdf

[14] 'sorption' refers to the retention of radionuclides on solid surfaces – which would serve to prevent leakage to the surface

[15] NWAA Issues Register: Outstanding Scientific and Technical Issues Relating to the Production of a Robust Safety Case for the Deep Geological Disposal of Radioactive Waste, March 2010
http://www.nuclearwasteadvisory.co.uk/uploads/7932NWAA%20ISSUES%20REGISTER%20COMMENTARY%20letterhead.doc

[16] Rock Solid?: A scientific review of geological disposal of high-level radioactive waste, by Dr Helen Wallace, Greenpeace International, September 2010.
http://www.greenpeace.org/raw/content/eu-unit/press-centre/reports/rock-solid-a-scientific-review.pdf

[17] see Supplementary Consultation para 2.1

[18] see Supplementary Consultation para 2.2

[19] Health and Safety Executive, Environment Agency and SEPA (2010) Management of Higher-Activity Waste on Nuclear Licensed Sites, Revised Version.
http://www.hse.gov.uk/nuclear/wastemanage.htm#3b

"It is not possible to provide absolute guarantees of disposability in the absence of a licensed and authorised disposal facility with fully developed and approved WAC.[Waste Acceptance Criteria]" [20]

No country in the world has yet completed an operational geological disposal facility for high level civil radioactive waste. This means that we simply do no t know what dose implications of such a facility would be. As discussed above, the present indications are that the doses from such a facility would be unacceptable.

3.10 Given that it is known that a deep disposal facility would release radioactive contamination to the surface; the proponents of such a facility are required to demonstrate that the resultant dose to people at the surface would be less than 20 micro sieverts [21] per year. [22] It is NWAA's view that the Scottish Government should be arguing that achieving such a dose target is simply not scientifically demonstrable or achievable in practice. It is in the nature of chemical elements and geological and biological systems to behave in a variable and hence unpredictable manner such that they make reliable risk/time calculations into the far future not only difficult but virtually impossible.

3.11 Paragraph 2.5 agrees that "[d]*ispersal of contaminants from disposal sites would take place*" but claims "*this would occur over a very long time-span*". In fact work by Nirex indicated that doses to people living on the surface could exceed safety limits very much more quickly. Carbon-14 from a nuclear disposal facility could escape as radioactive methane gas and carbon dioxide. This would be able to quickly reach people at the surface. Nirex calculated the resultant risk could be as high as 100 times the EA limit as soon as the dump has been closed. [23]

3.12 While NWAA agrees with the Scottish Government policy of not supporting deep geological disposal of radioactive waste because it considers that, at present, it is not a 'reasonable' alternative, we believe the case against deep disposal is much stronger than the Scottish Government sets out in the Supplementary Assessment document under Consultation.

4.0 The graphite conundrum

4.1 Paragraph 2.3 states that the most significant part of the total volume of waste in Scotland is graphite, and the impacts of storage and disposal of graphite is uncertain. It is not entirely clear what conclusion the Scottish Government draws from this. NWAA is concerned that the Scottish Government may be arguing that near surface disposal of graphite waste represents a better alternative for the bulk of Scotland's waste.

4.2 We note that CoRWM questioned the proposal for the near surface disposal of some types of longer-lived Intermediate Level Waste (ILW) such as graphite. [24] The El Cabril facility in Spain identified in the original consultation document [25] treats and disposes of Low Level Waste (LLW) and

[20] para 68

[21] micro = one millionth. A Sievert is a measure of radiation dose. It's units are energy - per unit weight - of exposure ; and it can be thought of in terms of the overall '*punch*' associated with the bombardment.

[22] Geological Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation, Environment Agency, February 2009. Page 47 para 6.3.17 http://publications.environment-agency.gov.uk/pdf/GEHO0209BPJM-e-e.pdf

[23] C-14: How we are addressing the issues, Nirex February 2006, Technical Note No: Number: 498808 See p12 (Fig 1)

[24] Response from the Committee on Radioactive Waste Management to the Scottish Government Consultation on Scotland's Higher Activity Radioactive Waste Policy, CORWM Doc No. 2795, 29th March 2009. http://www.corwm.org.uk/Pages/Current%20Publications/2795%20Final%20SG%20HAW%20Consultation%20Response.pdf

[25] Scotland's Higher Activity Radioactive Waste Policy Consultation 2010 (The Consultation Document) (CD) p21 http://www.scotland.gov.uk/Resource/Doc/298914/0093253.pdf

what, in the UK, would be termed 'short-lived' ILW. Near-surface disposal is used France, the US, Japan and Sweden, but for short-lived and lower toxicity ILW.

4.3 The principal radionuclides contained in waste graphite are Carbon-14 (C-14) which has a half-life of 5,730 years, and chlorine-36 (Cl-36) which has a half-life of 301,000 years. It should, therefore, be classified as long-lived ILW. The term short-lived graphite waste which appears in some Scottish Government documents is incorrect. [26]

4.4 A key concern with graphite waste, according to CoRWM is that:

> "…*it contains significant quantities of the potentially mobile and relatively long-lived radionuclides carbon-14 and chlorine-36*." [27]

Preliminary information from France indicates that the potential migration of chlorine-36 has led to a recommendation that graphite should be disposed of at depths greater than 100 metres. In fact France is reported to be planning a special waste site to accommodate graphite.[28]

4.5 Yim and Caron, in a review of the carbon-14 life cycle from nuclear power state that:

> "*Due to high mobility and long half-life, C-14 is typically one of the inventory limiting nuclides for shallow land disposal facilities for LLW ...**direct disposal of the bulk reactor graphite** in a LLW facility **is unlikely to happen***". [29] (emphasis added)

4.6 In contrast, the Nuclear Decommissioning Authority (NDA) clearly sees a significant incentive to keep graphite waste out of a deep geological disposal facility. The NDA says it is investigating a number of existing, planned or new waste management routes for reactor graphite waste, and this may include near surface disposal. [30]

4.7 The NDA points out that reactor decommissioning currently accounts for 35% by volume of the total waste destined for geological disposal in the UK. The majority of this waste (approximately 30% by volume of the UK total) is graphite from reactor cores.[31] According to the NDA near surface disposal would be an option for the core graphite, after a period of about 85 years of care and maintenance.

4.8 Keeping graphite out of a deep geological disposal facility would avoid the dose from the radioactive carbon in the graphite. (See para 3.11 above) The extent to which the methane and carbon dioxide gas in a deep disposal facility becomes radioactive depends on how much carbon-14 is in the waste and in what chemical form. This will in turn depend largely on how much irradiated graphite is present and the method of treatment prior to disposal. [32] However, keeping this carbon out of the deep

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[26] For example, the overheads used at the Post Consultation workshop in Edinburgth on 1st October 2010

[27] "CoRWM report to Government - on National Research and Development for Interim Storage and Geological Disposal of Higher Activity Radioactive Wastes and Management of Nuclear Materials" Report 2543, October 2009. Paras A.9 and A.10 http://www.corwm.org.uk/Pages/Current%20Publications/2543%20CoRWM%20Report%20on%20RD%20Final%2030%20October%202009.pdf

[28] Decontamination and Decommissioning: Let's Get On With It. Nuclear Engineering International, 13th November 2009 http://www.neimagazine.com/story.asp?storyCode=2054750

[29] M-S Yim & F, Caron. Life cycle and management of carbon-14 from nuclear power generation, Progress in Nuclear Energy 48 (2006) 2-36

[30] NDA Draft Strategy published September 2010 for consultation, page 38 http://www.nda.gov.uk/documents/upload/Draft-Strategy-published-September-2010-for-consultation.pdf

[31] Higher Activity Waste: Summary of Options for Waste Graphite, NDA, September 2010 http://www.nda.gov.uk/documents/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=42248

[32] "CoRWM report to Government - on National Research and Development for Interim Storage and Geological Disposal of Higher Activity Radioactive Wastes and Management of Nuclear Materials"

disposal facility displaces the problem – it does not get rid of it. As referred to in paragraph 4.5 (above) doses from carbon-14 placed in a LLW facility would also be unacceptable.

4.9 It is imperative that pressure to keep graphite out of the deep geological disposal facility proposed for England does not lead to Scotland giving approval to near surface graphite disposal facilities with a safety case that would almost certainly be inadequate.

4.10 Magnox North issued a press release on 18th August 2010 announcing that it is assessing the technical viability and potential siting of a near surface disposal facility several tens of metres below ground for graphite waste at Hunterston A. Early exploratory work was expected to start in September. The feasibility study will assess options for the design and possible on-site locations. [33]

4.11 It is noted that the Solid Active Waste Building at Huntertston A is the subject of a Nuclear Installations Inspectorate (NII) Improvement Notice which originally required the site operator to retrieve and make passively safe the waste stored in the building by the end of 2010. It is a matter of concern that the NII has seen fit to give Magnox North a three year extension to this Improvement Notice to the end of 2013. This means that the company is able to delay dealing with what is clearly a serious problem with the waste in this building, mostly graphite fuel sleeves, while this feasibility study is carried out. [34]

4.12 Furthermore, it is possible that the driver for disposal of these wastes, rather than their retention in storage, is to enable the import of radioactive wastes on to the Hunterston site. Such a proposal would contravene an important principle of environmental best practice in radioactive waste management that waste should be stored on site, and not transported elsewhere.

Report 2543, October 2009. Para A.63
http://www.corwm.org.uk/Pages/Current%20Publications/2543%20CoRWM%20Report%20on%20RD%20Final%2030%20October%202009.pdf

[33] Magnox North Press Release 18th August 2010 http://www.magnoxnorthsites.com/news/2010-08-18/hunterston-a-site-graphite-pathfinder-project-

[34] Addressing CoRWM recommendation 8: NDA Reactor Decommissioning Waste Project and Hunterston feasibility work on near surface disposal of graphite fuel sleeves, NDA/WMSG/P72, Issue 1, NDA 18th February 2010