Response to Environment Agency Consultation on the Waste Implications of the the Proposed 'EPR' and 'AP1000' NewBuild nuclear reactor designs.

The EA 'Generic Design Assessment' – (GDA)

Nuclear Waste Advisory Associates [1]

October 2010

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[1] http://www.nuclearwasteadvisory.co.uk/

1.Background.

Under the new planning legislation (the 2008 Planning Act) only local issues can be raised in the planning process. Matters of any substance have to be dealt with beforehand. This means that this consultation on the 'generic' assessment of the waste implications the planned reactor designs is particularly important.

2. Introduction

The Environment Agency's (EA's) role is to ensure the impact of radioactive wastes on the environment is minimised. [2] These consultation documents [3] supposedly set out a detailed evaluation of how wastes from the proposed new reactors would be handled, yet they fail to properly examine the Nuclear Decommissioning Authority's (NDA) assessments of the disposability of spent fuel from new reactor types. The nuclear industry has yet to provide a credible scientific case for nuclear waste 'disposal' – yet the EA propose postponing this critical issue until some unspecified time in the future.

Technical problems and uncertainties described by the Environment Agency (EA), and others suggest **the development of a safety case for the deep geological disposal of spent fuel from new reactors is far from certain**. A recent EA report, for example, states that:

> *"...there has been relatively little work on the deep geological disposal of HLW/SF in the UK."*[4]

Past experience demonstrates the importance of addressing the risks associated with the creation of radioactive waste before the investment of billions of pounds is committed in constructing the facilities which create them. Waste management itself requires the expenditure of further billions as evidenced by repository cost estimates. Given the acknowledged significant scientific, technical and ethical hurdles to the problem of disposing of nuclear waste, the EA should espouse the Government's February 2003 position indicated in the Energy White Paper that **there are "*important issues of nuclear waste to be resolved*" before new reactors can be built**.[5] Instead of issuing a 'statement of design acceptability (SODA)' while acknowledging the need for further information to support that statement, the EA could and should refuse to issue the 'SODA' until this supporting information is provided. This would send a much more credible and less biased message to stakeholders and would reinforce the EA's claim of impartiality. More importantly, this would ensure that due process was undertaken appropriately and that wastes were not created until it was established that safe waste management was available.

Recent research from Germany confirms there is a correlation between the distance of the home from nuclear power stations and the incidence of childhood cancer.[6] This finding has been accepted by the German government. This phenomenon demands investigation so that the cause can be established. In

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[2] Generic Design Assessment: UK EPR nuclear power plant design by Areva NP SAS and Electricite de France SA; Consultation Document. Environment Agency, June 2010. Executive Summary para 1. https://consult.environment-agency.gov.uk/file/1353658

[3] http://www.epr-reactor.co.uk/scripts/ssmod/publigen/content/templates/show.asp?P=57&L=EN & https://www.ukap1000application.com/index.aspx

[4] Understanding controls on the performance of engineered barrier systems in repositories for high level waste and spent fuel. Environment Agency, September 2010, page 3 http://publications.environment-agency.gov.uk/pdf/SCHO0910BSZE-e-e.pdf

5 Our Energy Future – Creating a low carbon economy, Energy White Paper, DTI, DoT, DEFRA. February 2003, paragraph 1.24 http://www.decc.gov.uk/media/viewfile.ashx?filepath=publications/white_paper_03/file10719.pdf&filetype=4

[6] Epidemiological Study on Childhood Cancer in the Vicinity of Nuclear Power Plants (KiKK Study). http://www.bfs.de/de/bfs/druck/Ufoplan/4334_KIKK_Zusamm.pdf (Go to page 13 for the English version).

the meantime, a precautionary approach should be taken. A precautionary approach would suggest nuclear power should be left out of the future energy mix and any further electricity capacity should be supplied by renewable energy.

Communities that host a new reactor site could be required to play host to spent fuel and radioactive waste into the indefinite future – since there is no known safe method for 'disposing' of it. Furthermore there would be risks associated with waste handling and packaging facilities, which may or may not be located on new reactor sites, and as yet unknown risks along potential transport routes.

In other words these EA consultation documents fail to make a convincing case that those issues which are of concern to the communities in which reactors are planned to be sited: Issues concerning the safety of waste:

- storage
- packaging
- transport, and
- disposal

must be resolved prior to waste creation. Furthermore it must be established that the impact on the environment will be minimised.

The Agency's flimsy *laissez faire* approach to such a catalogue of important and genuine concerns is wholly unacceptable.

3. EA Draft Certificate Postpones Disposal Issue

For both reactor types, the EA propose to issue an interim certificate to state the designs are 'acceptable' – pending the resolution, at some stage, of the disposability issue. [7]

The NDA's so-called "disposability assessments"[8] were relied upon by the Government to reach the conclusion that it was "*satisfied that effective arrangements will exist to manage and dispose of the waste that will be produced from new nuclear power stations.*" [9]

The nuclear vendors, or Requesting Parties (RPs) as they are known, have responded to RWMD's Disposability Assessments. [10] In order to evaluate the waste implications of the proposed NewBuild reactor designs the EA must look in some detail at the NDA's disposability assessments and the RP responses. However, the EA's consideration of this issue in the Consultation Document covers just

[7] For the EPR, see page 141 for the draft certificate and page 144 for 'Schedule Two' which refers to the need to resolve the issue of waste fuel disposability: Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Consultation Document, Environment Agency, June 2010 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1270818651893
For the AP100, see page 145 for the draft certificate and page 147 for 'Schedule Two' which refers to the need to resolve the issue of waste fuel disposability: Generic Design Assessment AP1000 nuclear power plant design by Westinghouse Electric Company LLC, Consultation Document, Environment Agency June 2010. https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276873205732

[8] See http://www.nda.gov.uk/news/disposability-assessment.cfm

[9] Draft National Policy Statement for Nuclear Power Generation (EN-6), DECC, November 2009 Paragraph 3.8.20 http://data.energynpsconsultation.decc.gov.uk/documents/npss/EN-6.pdf

[10] See http://www.epr-reactor.co.uk/scripts/ssmod/publigen/content/templates/Show.asp?P=340&L=EN and https://www.ukap1000application.com/PDFDocs/UN%20REG%20WEC%20000098%20DCP_JNE_000105%20Passive%20Pressurised%20Water/UN%20REG%20WEC%20000098%20DCP_JNE_000105%20Passive%20Pressurised%20Water.pdf

seven out of over 170 pages. [11] The EA's Assessment Reports on the Disposability of ILW and Spent Fuel do look in slightly more detail at the RWMD's Disposability Assessments and the RPs responses, but this hardly amounts to a detailed critique, and covers only around 4 pages of the report (sections 3.2 to 3.3 of the EPR report). [12] Even so the EA indicates that the RPs case has:

(a) failed to show that spent fuel will not degrade to an unacceptable degree after 90 years of storage;
(b) failed to identify a viable conditioning route for each higher activity waste stream;
(c) relies on speculation with regard to the C-14 inventory;
(d) failed to provide a description about how spent fuel will be encapsulated;

The consultation indicates several other technical issues that are not fully resolved. But, in effect, the Agency postpones these outstanding disposability issues to some unspecified time in the future.

Section 3.3 of the EA assessment reports on the disposability of ILW and spent fuel, for example, refers to a number of unspecified issues which the EA has raised with the nuclear industry. Neither the issues, nor the industry response is made available to the public. The Agency states that it recognises these issues will have to be addressed at some unspecified point in the future, but that in general they consider plans for dealing with them are adequate. This very limited provision of information and failure to justify the conclusion that plans for dealing with outstanding issues are adequate, has no place in an open and transparent consultation exercise.

In March 2010 Nuclear Waste Advisory Associates (NWAA) compiled a register of current outstanding issues which remain to be resolved if a technical case for radioactive waste disposal is to be made. Over one hundred issues were identified. [13] The EA is continuing along the road of permitting new reactor construction prior to confirming that disposal is in fact achievable This is despite the fact that it is fully aware that it may not be possible to resolve the outstanding issues. Further research may not produce the required answers or it may identify further serious problems that had not been previously identified. The EA specifically stated in November 2009:

> *"…work may or may not indicate that an acceptable safety case can be made"* [14]

Indeed the fact that the outcome of future research may be that wastes cannot disposed of safely has been referred to extensively by the EA. [15]

The EA states that it expects the RPs

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[11] Pages 91-97 of the Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Consultation Document, Environment Agency, June 2010 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1270818651893 and pages 100-103 of Generic Design Assessment AP1000 nuclear power plant design by Westinghouse Electric Company LLC, Consultation Document, Environment Agency June 2010. https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276873205732

[12] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397

[13] Nuclear Waste Advisory Associates Issues Register, March 2010 http://www.nuclearwasteadvisory.co.uk/uploads/6901NWAA%20ISSUES%20REGISTER%20COMMENTARY%20letterhead.doc

14 E-mail from Clive Williams to Adam Scott CORWM Secretariat & Dr Rachel Western 16th Nov 2009

[15] Environment Agency, Response to Nuclear Decommissioning Authority Consultation on – Radioactive Waste Management Directorate Proposed Research and Development Strategy, November 2008. http://www.environment-agency.gov.uk/static/documents/Research/1976_RWMD_Proposed_RD_strategy.pdf Proposed Research and Development Strategy, NDA RWMD, May 2008 http://www.nda.gov.uk/documents/loader.cfm?url=/commonspot/security/getfile.cfm&pageid=20962

> "*...to identify at least one complete credible route by which the higher activity wastes from a fleet of UK [new reactors] could be safely disposed of and to provide grounds for reasonable confidence that the route(s) could be followed successfully*." [16]

This should be a 'deal-breaker' for new reactors, yet by declaring that it is prepared to give an Interim Statement of Design Acceptability to both reactor designs and postponing this issue to some unspecified time in the future., the **EA is risking authorising the production of yet more nuclear waste for which there is no credible disposal route. This is wholly irresponsible**. It is imperative that this issue is resolved prior to the expenditure of billions of pounds on reactor construction. If the nuclear industry is not required to prove they have a safe disposal route for wastes until after the planned reactors are built, then a powerful financial momentum would be created towards allowing the reactors to operate, and so produce waste fuel for which there was no long term safe management route.

It is difficult to see how such a 'credible route' can be identified at this stage when the NDA's RWMD has yet to publish its draft safety case for the geological disposal facility (GDF), and when there are so many unresolved uncertainties regarding the deep geological disposal of nuclear waste. [17]

4. Radioactive Carbon in ILW – Possible breach of dose limits as soon as GDF opens.

One outstanding problem which has yet to be resolved is the gas problem. It is noteworthy that the recent EA report on Engineered Barrier Systems considered:

> *"...only the groundwater pathway and not other potential pathways, such as the gas pathway ..."*[18]

Work by Nirex has indicated that carbon 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.[19]

There would be a relatively large inventory of radioactive carbon in decommissioning waste. The NDA's Radioactive Waste Management Division (RWMD) says this need not be a significant concern. The EA says these arguments are rather speculative at this stage and will need to be underpinned more convincingly. Yet EA recognises the NDA is unlikely to have more confidence in

[16] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, para 29, section 3.1.3
https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397

[17] See for example "Nuclear Waste Advisory Associates 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" which lists 101 unresolved issues.
http://www.nuclearwasteadvisory.co.uk/uploads/6901NWAA%20ISSUES%20REGISTER%20COMMENTARY%20letterhead.doc

[18] Understanding controls on the performance of engineered barrier systems in repositories for high level waste and spent fuel. Environment Agency, September 2010, para 3.1 page 3 http://publications.environment-agency.gov.uk/pdf/SCHO0910BSZE-e-e.pdf

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

its risk estimates associated with radioactive carbon in repository-generated gases before a site for the GDF has been selected.[20]

5. The Copper Controversy

Another outstanding issue relates to the assumption in the NDA Disposability Assessment that spent fuel assemblies will be packaged in a robust disposal canister for disposal, manufactured from either copper or steel. The EA Assessment Report on the Disposability of ILW and Spent Fuel mentions steel and copper containers only once. This is particularly surprising given the recent controversy over copper containers in Sweden.

It is particularly worth noting that recent research suggests corrosion of copper canisters may prove to be much more of a problem than previously expected. In particular, a Swedish research finding published in Summer (2009) states:

> "*According to a current concept, copper canisters of thickness 0.05 m will be safe for nuclear waste containment for 100,000 years. We show that more than 1m copper thickness might be required for 100,000 years durability.*" [21]

Clearly, if such thicknesses of copper were required to ensure safe long term isolation of canisters, the cost and availability issues alone would render the entire disposal concept unviable.

Yet the NDA EPR 'Disposability' Summary document shows a wall thickness for copper canisters of 5cm. [22] The Main report refers to a copper canister lifetime of over one million years (see page 95).

6. No Realistic Basis to NDA Disposal Risk Calculations

To predict the contamination of the water or gas that could leak from a nuclear disposal facility, the chemical characteristics and surroundings of the radioactive atoms must be known. However, the inventory information set out in the NDA 'Disposability Assessment' reports [23] is limited to information on the 'atom type' (the '*isotopes*') [24] alone, not the characteristics and chemical surrounding of these atoms. The critical importance of this type of information may be appreciated by comparing the solubility of carbon in a diamond and carbon in sugar. In one chemical form the carbon won't dissolve at all, whilst in the other form the carbon is completely soluble.

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[20] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, Section 3.2.3, para 39 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397

[21] "*Water Corrodes Copper*" G. Hultquist et al [July 2009 – (online)] Catal Lett (2009) 132:311–316 Received: 29 June 2009 - Accepted: 19 July 2009 (Published online: 28 July 2009) Springer Science+Business Media, LLC 2009
http://www.mkg.se/uploads/Water_Corrodes_Copper_-_Catalysis_Letters_Oct_2009_-_Hultquist_Szakalos_et_al.pdf

[22] NDA Technical Note no. 11261814 – Summary Geological Disposal Generic Design Assessment: of Disposability Assessment for Wastes and Spent Fuel arising from Operation of the UK EPR, October 2009
http://www.nda.gov.uk/documents/upload/TN-17548-Generic-Design-Assessment-Summary-of-Disposability-Assessment-for-Wastes-and-Spent-Fuel-arising-from-Operation-of-the-EPWR.pdf
See http://www.nda.gov.uk/news/disposability-assessment.cfm

[23] See http://www.nda.gov.uk/news/disposability-assessment.cfm

[24] An 'isotope' is a particular version of an element in which the number of 'protons' (the positive particles at the centre of an atom) remains the same; but the number of 'neutrons' (neutral particles – also at the centre of the atom) varies.

Although there is some mention in the Disposability Assessments of the presence of materials such as concrete and cellulose that would affect the chemical environment, to all intents and purposes, the information required is simply absent. Therefore, it is impossible for the NDA to realistically predict the degree of contamination that would arise arising from leaks from a GDF. This means their risk calculations are highly unlikely to reflect reality.

The EA has set a limit on the risk that may be caused by the burial of radioactive wastes of 10^{-6} yr^{-1} (i.e. one person in a million per year contracting a fatal cancer, a non-fatal cancer or inherited genetic defect as a result of radiation exposure). [25] Such a target of risk is simply not scientifically demonstrable or achievable in theory or practice. It is in the nature of chemical elements and also 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. Thus it is hard to see what information could be used as a basis for the claim that the radiological impact from a repository would not exceed the target.

7. Waste Disposal – Risks too High

Notwithstanding the comments made above, the NDA calculates the dose from the spent fuel arising from 6 new EPR reactors (almost 10GW) would be more than half the 'one in a million' risk allowed by the EA.[26]

As the Agency points out:

> "*...this does not leave a large margin to the regulatory risk guidance level*". [27]

The (November 2009) Draft Nuclear National Policy Statement (NPS)[28] proposed ten reactors sites, each with up to two reactors. There are already proposals for up to 16GW of new reactors.[29] It is understood that when the NPS re-consultation is launched shortly only eight sites will remain on the proposed list. But if two reactors are built on each of these sites, in addition to so-called legacy wastes, there could be wastes from up to 16 new reactors (25GW) which would need to be considered. This raises the prospect that two Geological Disposal Facilities may be required (doubling the collective dose to the UK population), yet we have still to find a site, after more than 30 years of searching, for a single facility.

Rather than discussing these issues, or indicating how the EA will seek assurances that risk targets can be met before approving new reactor designs the EA simply states that:

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[25] Geological Disposal Facilities on Land for Solid Radioactive Wastes: Guidance on Requirements for Authorisation, page 46 para 6.3.10, Environment Agency, February 2009 http://publications.environment-agency.gov.uk/pdf/GEHO0209BPJM-e-e.pdf

[26] Generic Design Assessment: Disposability Assessment for wastes and spent fuel arising from operation of the UK EPR. Part 1 Main Report. NDA, 22nd Jan 2010. para 5.4 page 97.

[27] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, para 40, section 3.2.3 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397

[28] Draft National Policy Statement for Nuclear Power Generation (EN-6), DECC, November 2009 http://data.energynpsconsultation.decc.gov.uk/documents/npss/EN-6.pdf

[29] Presentation made by NDA and DECC to the West Cumbria Managing Radioactive Waste Safely Partnership Meeting, 5th August 2010 – presumed to refer to proposals for two reactors of 1.6GW each at Hinkley, Sizewell, Oldbury, Wylfa and Sellafield.

> "*At the time of disposal it will need to be confirmed by the GDF* [disposal facility] *licensee that the performance of the GDF with its whole inventory will be consistent with our risk guidance level*". [30]

At present it is quite apparent the nuclear industry would not be able to dispose of new build reactor wastes safely. It would be wholly irresponsible to wait until such wastes are created to confirm this. Unless and until the nuclear industry is able to demonstrate that new reactor wastes could be disposed of safely there should be no further steps taken towards the development of new reactors.

The NDA argues that, because it would not be able to use a site for disposal unless it was approved by the regulators then, necessarily, the chosen site would meet regulatory standards. [31] This argument does not follow. It is possible the NDA could select a site, but be unable to meet the necessary standards. There has been a precedent for this in the rejection of the site proposed in the 1990s, partly for generic technical reasons, but partly for site-specific reasons.

In March 2010, the House of Commons Energy and Climate Change Select Committee stated:

> *"…the Government has no choice but to find a solution* [for nuclear wastes], *regardless of a decision on nuclear new build* [and] *waste arising from new nuclear power stations will not pose a significant additional challenge in terms of finding a permanent storage solution."* [32]

This '*King Canute*' argument that because the waste problem exists, the Government must be able to solve it, similarly makes no sense. Clearly, just because radioactive waste exists, it does not necessarily follow that it will be possible to safely dispose of it, and does not justify creating further waste – which would only serve to increase the risk presented.

The EA must make it clear that it rejects both of these arguments. Unless and until it is proven that there is a safe disposal route available for new reactor wastes, the Agency must refuse to authorise their creation.

8. Waste and Pollution Issues must be Resolved Prior to Construction

Given that all doses of radioactivity have an associated risk, it is a legal requirement that facilities which discharge radiation must produce a benefit that offsets the risk. This is the so-called 'Justification' requirement. However, it is essential that the risk/benefit assessment is carried out before the construction costs have been sunk. If the assessment is carried out after the construction costs are spent, then these costs will be ignored, and the evaluation will be distorted in favour of allowing the plant to operate. This is what happened in the case of the plutonium separation plant 'THORP' at Sellafield and also the 'Sellafield plutonium fuel plant [the so-called Sellafield 'Mox' [33] Plant (SMP)].

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[30] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, para 40, section 3.2.3 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397

[31] Paragraph 4.3.1 (page 75) and paragraph 5.4 (page 95) of Generic Design Assessment: Disposability Assessment for Wastes and Spent Fuel arising from the operation of the UK EPR, Part 1 Main Report both use the phrase "…*any selected site necessarily would need to be consistent with meeting regulatory risk target*" or in the latter case "*regulatory guidance values*".

[32] The proposals for national policy statements on energy, Energy and Climate Change Committee, Volume 1, 23rd March 2010. Para 71, page 28 http://www.publications.parliament.uk/pa/cm200910/cmselect/cmenergy/231/231i.pdf

[33] 'MOX' stands for 'mixed oxide' fuel – and refers to nuclear fuel that is made out of plutonium as well as uranium

In 1993, British Nuclear Fuels (BNFL – the predecessor to the NDA) switched on the massive plutonium separation plant 'THORP'. There had been a Public Inquiry into the project nearly twenty years previously in 1977. However, within just a year, the rationale for the plant began to disappear.[34]

Despite this, the case for THORP was not reopened until after its construction was complete, at a cost of £2.3 Billion.[35] In 1992 Her Majesties Inspectorate of Pollution (HMIP – the predecessor to the Environment Agency) held a public consultation on the pollution from the plant [36] and in June 1993, John Gummer (the Secretary of State for the Environment) announced a second round of Public Consultation on THORP. [37]

Both of these consultations were held after the multi-billion pound construction costs had been sunk making any consideration of a decision to moth-ball the plant almost impossible. In fact operation of THORP has been a financial and environmental disaster with a range of equipment failures, accidents including acid spills, pipe leaks and blockages,[38] not to mention the additions THORP has made to the UK's radioactive waste inventory. In April 2005, 22 tons of dissolved fuel and 18,000 of acid leaked from fractured pipe-work over a 9-month period, and resulted in the closure of the plant for three years. [39]

Clearly, quite apart from the pollution created by THORP, the best economic decision would have been not to operate the plant.

In October 1998 the Environment Agency published its proposed decision on the Justification for Sellafield Mixed Oxide fuel fabrication plant. In this document the Agency complained that it:-

> *"...received the application from BNFL* [British Nuclear Fuels Ltd] *in November 1996, when construction of the Mox plant was virtually complete and after the capital cost (£300 million) had been incurred. It is unsatisfactory that the Agency has no powers under RSA 93* [The Radioactive Substances Act 1993] *to require an application to be submitted for a new plant prior to its construction ... The Agency is dissatisfied that it was unable to consider the full economic case for the Mox plant. It is seeking a change in the legislation to prevent a similar situation occurring in future".*[40]

Ten years after the decision to build the Sellafield Mox Plant (SMP) and after five separate public consultations, the Government finally approved operation of the plant in October 2001. However, the comparison of the costs of the plant as compared to the benefit (the 'Justification' comparison) ignored the construction costs on the grounds the money had already been spent.[41] Had these costs

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[34] Wilkie, T. Nothing but trouble in the nuclear pipeline. The Independent, 1st March 1993 http://www.independent.co.uk/news/science/science-nothing-but-trouble-in-the-nuclear-pipeline-sellafields-thorp-plant-may-never-operate-a-victim-of-market-and-political-forces-tom-wilkie-explains-1494931.html

[35] Martin Forwood - International Panel on Fissile Materials - Research Report No. 5 "The Legacy of Reprocessing in the United Kingdom" – July 2008 http://www.fissilematerials.org/ipfm/site_down/rr05.pdf

[36] Crispin Aubrey "THORP – The Whitehall Nightmare" Pub: Jon Carpenter – Oxford (1993) page 70

[37] Crispin Aubrey (1993) page 76

[38] Martin Forwood (2008) page 10

[39] Martin Forwood (2008) page 10

[40] Document Containing the Agency's Proposed Decision on the Justification for the Plutonium Commissioning and Full Operation of the Mixed Oxide Fuel Plant, Environment Agency, October 1998. Executive Summary para 17.

[41] Connor, S. Economic benefits outweigh MoX Plant concerns, Independent, 4th October 2001

been included in the calculation, then the cost/benefit comparison would have shown the plant should not have been built.

SMP has been an economic and technical failure.[42] Designed to manufacture 120 tonnes of Mox fuel every year for overseas customers, the plant had produced just 6.3 tonnes in its first seven years at a cost to the taxpayer of more than £1bn. [43] If the case for building the plant had been open to proper scrutiny before construction started this huge waste of money could have been avoided.

9. The Commercial Requirement for Early Consideration of Waste Issues

The Environment Agency's 'generic' evaluation of new reactor wastes prior to construction is meant to avoid a similar situation re-occurring. The Government says that potential new reactor developers have made clear they want national issues to be dealt with in advance of a public inquiry otherwise they will not consider investing in new nuclear power stations.[44] Similarly, the Environment Agency says a key objective of utility companies is that uncertainties associated with regulatory matters are reduced so they can make well informed commercial decisions. [45] Such 'streamlining' of the planning, assessment and authorisation processes undermines the ability of stakeholders and local communities to undertake appropriate scrutiny and comment on developments which will affect them and countless generations to follow.

10. The 1990s Proposal to begin the Deep Disposal Programme

In the 1990s, 'Nirex' [46] planned to undertake excavation work near the Sellafield site in Cumbria, in preparation for the burial of radioactive waste. A Planning Inquiry was held into the proposal in which the generic scientific arguments against the project were examined at some length. The proposal was rejected by both the Inspectors and also the Secretary of State for the Environment partially on the grounds of the scientific inadequacy of the evidence submitted.

John Gummer, the Secretary of State for the Environment, based his rejection of the 1990s proposal on the evidence of the reports presented to him by the Inquiry Inspector, Mr C S McDonald [47], and also the Technical Assessor, Mr Colin Knipe. [48]

For example, Mr McDonald reported that the chemical containment system that the industry was proposing was:

> "*...new and untried with more experimentation and modelling development indubitably required*" [49]

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[42] McSorley, J. A Staggering Waste of Taxpayers' Money, Independent 7th Apr 2009 http://www.independent.co.uk/opinion/commentators/jean-mcsorley-a-staggering-waste-of-taxpayers-money-1664429.html

[43] CORE Press Release 3rd Apr 2009 http://www.corecumbria.co.uk/newsapp/pressreleases/pressmain.asp?StrNewsID=255

[44] The Energy Challenge, DTI July 2006. para 7.35 http://webarchive.nationalarchives.gov.uk/20091002214411/http://www.berr.gov.uk/files/file31890.pdf

[45] The Environment Agency's Submission to DTI – Pre-licensing Assessments of new nuclear power stations and streamlining the regulatory process. Environment Agency 2006

[46] the 'Nuclear Industry Radioactive waste Executive' (now part of the 'NDA' – the Nuclear Decommissioning Authority)

[47] The report of the Inspector can be found at this this web-site http://westcumbriamrws.org.uk/#/external-docs/4540226211 [Scroll down to 'Inspectors Report']

[48] The Technical Assessor (Colin Knipe's) report can be found at:http://www.jpb.co.uk/nirexinquiry/nirex.htm

[49] C S McDonald (1997) Inspector's Report following 'Nirex RCF' Inquiry, Cumbria County Council, File (APP/H0900/A/94/247019) pp 241-242 - para 6E.70

Overall, the Inspector concluded that the nuclear industry should not be given the go-ahead to begin their planned programme:

> "*...in [their] current state of inadequate knowledge*".[50]

Thus a large amount of public spending was avoided because the project received proper scrutiny prior to the start of construction.

11. Reactor Sites as Waste Sites for almost Two Centuries – Possibly Indefinitely

Once waste fuel is taken out of the planned reactors it may need to be stored at the reactor site until 2200, and possibly longer. There are two reasons for this. Firstly, the waste fuel would be very hot and would need to be stored for nearly 100 years to allow it to cool. Adding the 60 year planned operation of the reactor gives a storage time of 160 years. Although it is generally assumed that it is the need to allow for the cooling that would determine how long a reactor site would have to double as a waste site, the EA state that, even after the fuel has cooled, there may not be a disposal facility available.[51]

New reactors are currently expected to come on stream between around 2020 and 2030 and remain in operation for 60 years, until 2080–90. This means that the final load of fuel might need to be stored until 2180 – 2190. The Government's Fixed Unit Price Consultation suggests that emplacement of legacy waste may not be completed until 2130 in any case, and that is assuming a Geological Disposal Facility opens on schedule in 2040.[52]

The nuclear industry has not provided a credible case for the storage of wastes for the minimum period of the 160 years required. The EA often refers to stores designed to last for "at least 100 years", [53] whereas they should be designed to last at least 160 years. Indeed a failure in the repository programme may require spent fuel to be stored for much longer.

As current planning arrangements stand, there will be no opportunity for communities affected by new reactor build plans to say whether or not they are prepared to also accept long term waste storage. It would simply be imposed upon them. This means that the principle of 'volunteerism' put forward by CoRWM (i) would not have been met.[54] This is of particular concern, as due to the problems associated with disposal set out below, these 'reactor sites' could in fact end up becoming wastes sites, possibly indefinitely.

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50 McDonald (1997) p277 para 8.56

[51] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, para 33 (b), section 3.2.1 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397

[52] Consultation on a Methodology to Determine a Fixed Unit Price for Waste Disposal and Updated Cost Estimates for Nuclear Decommissioning, Waste Management and Waste Disposal, DECC, March 2010 Para 3.2.23 – 3.2.24
http://www.decc.gov.uk/assets/decc/Consultations/nuclearfixedunitprice/1_20100324145948_e_@@_ConsultationonFixedUnitPricemethodologyandupdatedcostestimates.pdf

[53] Generic Design Assessment: UK EPR Nuclear Power Plant Design by Areva NP SAS and Electricite de France SA. Assessment Report Spent Fuel, Environment Agency, June 2009. Para 29 page 10
https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871117935

[54] In its Implementation Report CoRWM indicated that its recommendations must also be applied at least to central and regional long terms stores (and, by implication, to on-site stores) if they are to inspire public confidence (See 'Moving Forward' para. 25 p.10 CoRWM 1703 Feb. 2007
http://www.corwm.org.uk/Pages/Archived%20Publications/Tier%202%20(7)%20-%20Implementation/Tier%203%20-%20Implementation%20advice/1703%20-%20Moving%20Forward%20-%20Report%20on%20implementation.doc)

12. Risks due to Waste Packaging at Reactor Site

The Agency says "*clarification will be needed of how and where the spent fuel will be packaged*".[55] This clarification is required now, not at some unspecified point in the future.

According to the EA it is assumed that waste fuel would be packaged before being sent for disposal. However, no description of how this would be achieved is provided. This is important as the packaging facilities could involve further discharges of radioactivity together with an increase in the risk of accident while waste is transferred around the site. The information supplied by EDF on this issue was supplied too late to be available for this consultation.[56] Although information was supplied by Westinghouse, this adds to uncertainties for communities because it is not clear whether the packaging would be done at the reactor site or at a central facility. [57]

13. Communities Affected by Possible Waste Transport Routes

The EA consultation documents provide very limited information about the possible transportation of wastes to a disposal facility or central store. The Agency's statement below will offer little reassurance to people living on potential transport routes:

> "*The safety of transport operations … have been considered ... One important consideration ... is that increased burn up and irradiation of the fuel will result in an increased concentration of fission products and higher actinides* [the group of chemicals that includes plutonium] *which causes the fuel assemblies to have* ***a higher thermal output and dose rate****."* (Emphasis added) [58]

The Agency does not examine the implications of the potential for higher dose rates from the transport flasks. [59]

14. Incineration of Intermediate Level Waste

EDF assume that certain Intermediate Level Wastes (ILW) can be incinerated leaving no radioactive residue. The EA state that this assumption: "*needs further explanation*" and that the incineration of ILW would be "*novel*". [60] The EA should rule out incineration of these wastes at this stage, as it would almost certainly fail to meet the 'Best Available Technique' requirement. Incineration is liable

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[55] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, Section 3.2.3, para 42 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397.

[56] Generic Design Assessment: UK EPR Nuclear Power Plant Design by Areva NP SAS and Electricite de France SA. Assessment Report Spent Fuel, Environment Agency, June 2009. Section 3.7 para 95 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871117935

[57] Generic Design Assessment: AP1000 Nuclear Power Plant Design by Westinghouse Electric Company LLC Assessment Report Spent Fuel, Environment Agency, June 2009. Section 3.7 para 94 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276873464181

[58] Generic Design Assessment: UK EPR Nuclear Power Plant Design by Areva NP SAS and Electricite de France SA. Assessment Report Spent Fuel, Environment Agency, June 2009. Section 3.7 para 86 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871117935

[59] Generic Design Assessment: UK EPR Nuclear Power Plant Design by Areva NP SAS and Electricite de France SA. Assessment Report Spent Fuel, Environment Agency, June 2009. Section 3.7 para 77 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871117935

[60] Generic Design Assessment UKEPR nuclear power plant design by Areva NP SAS and Electricite de France SA, Assessment Report: Disposability of ILW and Spent Fuel. Environment Agency, June 2010, para 41 section 3.2.3 https://consult.environment-agency.gov.uk/portal/ho/nuclear/gda?pointId=1276871149397

to lead to further discharges of radioactive waste into the environment, whereas storage of waste should be able to avoid this dilution and dispersal.

15. Radioactive Waste Discharges – OSPAR rules out new reactors.

Under an international treaty known as the OSPAR Convention on the Protection of the Marine Environment of the North East Atlantic, the UK Government is committed to:

> "*...progressive and substantial reductions of discharges, emissions and losses of radioactive substances, with the ultimate aim of [achieving] concentrations in the environment near background values for naturally occurring radioactive substances and close to zero for artificial radioactive substances."* [by 2020].

This is set out in the Department for Energy and Climate Change's (DECC's) Guidance on Radioactive Discharges (2009).[61]

The EA's consultation documents mention OSPAR only in connection with annual reporting requirements. [62] The requirement to reduce concentrations in the environment to close to zero by 2020 is simply not referred to. It is difficult to see how this requirement can be met whilst adding to reactor discharge through NewBuild.

Nor does the EA attempt to make the case that by building new reactors, the UK can still meet its OSPAR commitments to ensure that discharges are progressively and substantially reduced. The UK Government argues that because new reactors will be inherently cleaner than the existing fleet of reactors which they will replace then discharges will be reduced.[63] The EA has failed to present this argument so that it can be examined. The logic of this is that when new reactor construction reaches existing reactor capacity of around 10GW it will be stopped. But, as we have seen, 16GWof new capacity has already been suggested by developers, and there are proposals to designate sites which could accommodate up to 25GW (8 sites x 2 reactors x 1.6GW). Will the UK Government stop new reactor development once it exceeds 10GW?

One of the Guiding Principles of the OSPAR Strategy with regard to radioactive substances is the application of "*best available techniques and best environmental practice, including, where appropriate, clean technology*". [64] This requirement for 'Best Available Techniques' (and clean technology) for producing electricity should rule out the possibility of building new electricity generating stations which produce highly dangerous wastes when better alternative ways of generating electricity are available such as renewable energy sources.

The EA claims that both reactor types utilise the best available techniques (BAT) to prevent and minimise the discharge of radiation, but it fails to explain how generating electricity using nuclear energy can be described as best environmental practice or clean technology.

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[61] See para 8, Statutory Guidance to the Environment Agency concerning the regulation of radioactive discharges into the environment, DECC 2009.
http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/nuclear/radioactivity/dischargesofradioactivity/1_20091202160019_e_@@_guidanceearadioactivedischarges.pdf

[62] See for example para 25 Generic Design Assessment: UK EPR nuclear power plant design by Areva NP SAS and Electricite de France SA; Assessment Report, Aqueous Radioactive Waste Disposals and Limits, Environment Agency June 2010 https://consult.environment-agency.gov.uk/file/1349282

[63] Letter from Rene McTaggert at DECC to John Mouat, KIMO Secretariat dated 16th September 2010

[64] See Annex 1 of UK strategy for radioactive discharges 2001 – 2020, DEFRA, July 2002
http://www.scotland.gov.uk/Resource/Doc/46746/0024243.pdf

Conclusions

1. The EA Assessment Reports fail to fully analyse the NDA's Disposability Assessment reports and the Requesting Parties responses. Instead they postpone dealing with outstanding disposability issues to some unspecified time in the future. This is unacceptable.

2. The consultation documents fail to acknowledge other work by the EA which states that it is possible that an acceptable safety case for a GDF cannot be made.

3. At present it is quite apparent the nuclear industry would not be able to dispose of new build reactor wastes safely. It would be wholly irresponsible to wait until such wastes are created to confirm this. Unless and until the nuclear industry are able to demonstrate that new reactor wastes could be disposed of safely there should be no further steps taken towards the development of new reactors.

4. If the nuclear industry is not required to prove it has a safe disposal route for wastes until after the planned reactors are built, then a powerful financial momentum would be created towards allowing the reactors to operate – and so produce waste fuel for which there was no long term safe management route.

5. NewBuild waste fuel requires on-site storage for one hundred years simply to allow it to cool down. Adding on the expected operating life of 60 years means that a NewBuild reactor site could end up as a waste site for at least 160 years. This means communities around new reactors might be expected to host a waste site for almost two centuries. In fact the rector site could possibly be a waste site indefinitely – if, as looks quite likely, it not possible to develop a safe disposal route for the wastes..

6. The EA consultation leaves communities around nuclear sites with far too many uncertainties. As well as not knowing how long waste fuel might be stored on site, or what kind of a store would be used, they do not know whether they will be required to host a packaging facility, with its associated risks, or even an Intermediate Level Waste incinerator. Communities on transport routes do not know when waste may be transported through them. It is possible that a community may be asked to host a centralised storage and packaging facility at some point in the future. No indication is given over whether such a facility would be required, and if so where it would be. This means communities that might be affected by NewBuild wastes are not able to contribute to decisions that would affect them.

7. If a new build programme is much larger than around 6 new reactors (10GW), two sites for Geological Disposal Facilities are likely to be sought – doubling the risk to the UK population.

8. The EA fails to explain how the proposal to approve new gaseous and liquid radioactive waste discharges into the environment from new reactors can possibly be consistent with commitments made by the UK Government to OSPAR to achieve concentrations in the environment of artificial radioactive substances close to zero by 2020.

9. The EA ignores one of the Guiding Principles of the OSPAR Strategy with regard to radioactive substances which is the application of "*best available techniques and best environmental practice, including, where appropriate, clean technology*". In the case of electricity generation clean technology would include the various forms of renewable generation.

Annex: Scientific Problems with Disposal:
False Picture Presented by International Nuclear Officials

In March 2010 Nuclear Waste Advisory Associates listed over 100 outstanding scientific and technical issues with nuclear waste disposal, (see the NWAA Issues Register). (1). NWAA extensively quoted the European Commission Joint Research Centre's (JRC) 2009 report on disposal. (2) However, despite the numerous problems that the JRC reported – the overall conclusion of the report was that the technology of geological disposal has developed well enough for programmes to be implemented. However, the JRC conclusion is based largely on a **description** of ongoing research projects – rather their results and nuclear agency reports, which tend to be collective statements based on views rather than an analysis of scientific literature. Only three papers published in scientific journals are referenced.

Importantly the JRC report falsely claims that it is mainly due to a lack of public acceptance that repository programmes in Germany and the UK have (temporarily) foundered, rather than because of scientific problems that jeopardise safety.

Similarly, the Organisation for Economic Co-operation and Development's (OECD's) Nuclear Energy Agency (NEA) states that *"geological disposal is technically feasible"* and that a *"geological disposal system provides a unique level and duration of protection for high activity, long-lived radioactive waste*. (3) Again these statements are based solely on the collective views of its Radioactive Waste Management Committee, not on an analysis of the existing scientific evidence.

Literature Review by Greenpeace International

A recent Greenpeace International (GPI) literature review (4) of papers in scientific journals provides an overview of the status of research and scientific evidence regarding the long-term underground disposal of highly radioactive wastes. It identifies a number of phenomena that could compromise the containment barriers, potentially leading to significant releases of radioactivity.

Prior to the burial of radioactive wastes in a deep disposal facility, the nuclear industry must demonstrate that the amount of leakage would not be excessive. The waste would be dangerous for hundreds of thousands to millions of years into the future – and on this basis alone the nuclear industry predictions hardly seem credible.

The wastes and the disposal system are expected to behave in an extremely complex manner. Many of the processes involved are poorly understood and many of the assumptions made to predict the rate of leakage are impossible to verify. Unless and until these difficulties can be resolved, the data suggests that it is quite likely that a significant release of radioactivity from a deep burial facility could occur, with serious implications for the health and safety of future generations.

Experience with Lower Level Dumps

A number of low- and intermediate-level radioactive waste disposal sites have operated over the last 50 years. However, many of these supposedly final disposal sites have already caused unexpected environmental contamination. This highlights how difficult it is to predict what would happen to buried wastes, even over short timescales. Examples include the Centre de Stockage de la Manche storage site in France, where water supplies in the aquifer have become contaminated, (4) and also the Asse II salt mine in Germany where safety problems, including the leaking of saline water into the chambers persuaded authorities to retrieve and repackage the waste . (5) Despite the fact that nuclear programmes have been in existence for over half a century there is no dump anywhere in the world for high level wastes.

Brief summary of some of the technical issues that jeopardise dump safety

Corrosion: An argument that is absolutely fundamental to the nuclear industry's assumptions concerning dump safety is that the waste containers would last for an extremely long time – and so hold the radioactivity deep underground. However, experimental data indicates that the mechanisms for corrosion are not fully understood. As a result copper and steel could corrode more quickly than expected and so allow faster than predicted release of radioactivity Three key issues are:

- the role of bacteria,
- the rate of corrosion occurs in the absence of oxygen; and also
- the impact of the intense radiation.

Backfill: The material packed into the space between the wastes and the rock wall is known as 'backfill'. 'Bentonite' clay is most often quoted as the backfill material that would be used and it is meant to play an important role in trapping leaking radioactivity. However, the intense heat coming from the wastes could seriously jeopardise bentonite's ability to act as a radionuclide trap. Chemical and physical disturbance due to corrosion, gas generation and biomineralisation (the process of bacteria producing minerals) could also adversely affect the properties of the bentonite backfill.

Solubility, sorption and transport of radionuclides: Generally speaking the chemical processes that would occur in a deep disposal facility are very poorly understood. Chemical effects, such as the formation of colloids and the role of microbes, could speed up the transport of some of the more radiotoxic elements such as plutonium. Build-up of gas pressure in a repository could damage the barriers and force fast routes for radionuclide escape through crystalline rock fractures or clay rock pores. Radioactive carbon dioxide and methane could also be released – which would have very serious implications for the dose of radioactivity that people received – due to the fact that carbon is a critically important for biological systems.

Bedrock properties and hydrogeology: Unidentified fractures and faults, or poor understanding of how water and gas will flow through faults, could lead to the release of radionuclides much faster than expected. In addition excavation of a repository could create fast routes for radionuclide escape through the part of the rock damaged by the excavation.

Other issues which need to be considered include, human error and human intrusion; future glaciation; and earthquakes.

Conclusion

It is clear there are serious problems with proposals for deep burial of radioactive wastes . The vast majority of funding for RadWaste scrutiny is focussed on the nuclear industry who have a vested interest in minimising the problems. This is particularly the case in the context of plans for the construction of new nuclear reactors – which would necessarily create more wastes.

The regulators are responsible for reviewing safety cases and ultimately for licensing facilities. In the UK in the late 1980s / early 1990s 'Her Majesties Inspectorate of Pollution' (HMIP) the predecessor to the Environment Agency invested heavily in a research programme on disposal safety that was independent of the nuclear industry, producing an extensive series of high quality reports.

However, at the critical moment, when the initiation of the proposed disposal programme was the subject of a Planning Inquiry the HMIP withheld their research. Friends of the Earth submitted the documents and cross-examined the nuclear industry on the basis of their contents

Greenpeace and Cumbria County Council also opposed the 1990s proposal and following the scrutiny carried out at the Inquiry, the proposal was rejected. At the inquiry, the objecting groups had a total budget one hundredth that of the nuclear industry but nevertheless succeeded in demonstrating significant problems with the safety case by referring to the HMIP research plus sufficient alternative expertise.

In 2008 planning law was changed, so that the cross examination of future proposals will not be possible

The Environment Agency needs to establish a way in which independent research can be carried out which is quite separate from nuclear industry directed research.

(1) NWAA Issues Register, Nuclear Waste Advisory Associates, March 2010. http://www.nuclearwasteadvisory.co.uk/uploads/7784NWAA%20ISSUES%20REGISTER%20COMMENTARY%20letterhead.doc

(2) W.E. Falck and K.-F. Nilsson "*Geological Disposal of Radioactive Waste: Moving Towards Implementation*", European Union – Joint Research Centre – Reference Reporthttp://ec.europa.eu/dgs/jrc/downloads/jrc_reference_report_2009_10_geol_disposal.pdf

(3) OECD/NEA, 2008. Moving for*ward with geological disposal of radioactive waste: An NEA RWMC colle*ctive statement. NEA/RWM(2008)5/REV2. http://www.nea.fr/html/rwm/docs/2008/rwm2008-5-rev2.pdf

(4) Wallace, H. Rock Solid? A Scientific Review of Geological Disposal of High Level Radioactive Waste, Greenpeace International, Genewatch UK, September 2010. http://www.greenpeace.org/raw/content/eu-unit/press-centre/reports/rock-solid-a-scientific-review.pdf

(5) ACRO. 2009. Gestion des déchets radioactifs: les leçons du Centre de Stockage de la Manche. Centre sans mémoire, centre sans avenir? Greenpeace France 25th June 2009. http://www.greenpeace.org/raw/content/france/presse/dossiers-documents/rapport-gestion-desdechets-radioactifs.pdf

(6) Asse II. Website on: http://www.endlager-asse.de/cln_094/EN/1_Home/home_node.html