

APPENDIX TO LETTER REG EPR00182N– CRITIQUE OF THE NDA RWMD DISPOSABILITY ASSESSMENT

This appendix presents an EDF/AREVA critique of the RWMD Disposability Assessment reports. The principal issues which arose from the review process are outlined below. We have described the issues and have then briefly noted how these issues are expected to be resolved.

Fuel Burn-up

Information provided to RWMD specified that the maximum burn-up for an EPR fuel assembly would be 65 GWd/tU as a bounding case. RWMD has assumed this value as the burn-up for all fuel-assemblies. However, RWMD also calculated that, based on an assumption of 3600 fuel assemblies over 60 years and a load factor of 93%, the average burn-up would be 48.3 GWd/tU.

This calculated average burn-up was not used in the assessment although some calculations were undertaken on a variant case using a burn-up of 50 GWd/tU. It was also determined that using a value of 48.3 GWd/tU would decrease the amounts of radionuclides of post-closure significance by about 30%.

Using a bounding estimate of the burn-up in the assessment tends to overestimate the heat output of the spent fuel, the radionuclide inventories of waste arisings and the volumes of operational and decommissioning ILW, although the RWMD assessment using these overestimates still concludes that no problems or issues are foreseen for the disposability of the wastes.

More detailed analyses could be undertaken to provide better estimates of the average and maximum burn-up rates. The results of these analyses would support future submissions by operators under the Letter of Compliance (LOC) process. These analyses will also take account of the link between burn-up and fuel management strategies.

Assessment Inventories

For LOC assessments, inventories would typically define both a best-estimate and a bounding case. In this assessment the operational ILW arisings are best-estimates, decommissioning ILW arisings are bounding estimates and spent fuel arisings are bounding estimates. Assessments could be undertaken to provide improved (less restrictive) estimates of both bounding case and best estimates of waste and spent fuel inventories. This will require more detailed modelling of activation in reactor components and bioshield including consideration of issues such as the levels of key contaminants (e.g. chlorine and nitrogen) in certain materials used in the reactor and fuel assemblies. The refined inventory data would support future LOC submissions.

Serious Fuel Clad Failures

The Disposability Assessment assumed that the reactor runs at all times with one failed fuel element leaking actinides and other radioactive contaminants into the primary cooling circuit. The effect of this assumption is that ion exchange resins will contain much greater levels of contamination and the primary cooling circuit, including pipework and pumps, will become highly contaminated. The assumption also leads to the RWMD assessment that there would be around 40 g of fissile material in all operational and decommissioning ILW.

We consider that the RWMD assumption that the EPR routinely operates with one serious cladding failure at all times is extremely pessimistic and leads to a significant overestimate of the level of long lived alpha emitters in both the operational and decommissioning ILW waste streams. The contamination of the primary circuit would also create significant operational issues which would affect maintenance procedures. For reasons of waste minimisation and operational efficiency the EPR would not operate in this way and serious cladding failures will result in the removal and replacement of the faulty fuel assembly.

The Disposability Assessment underestimates the depth of knowledge on cladding integrity. We are undertaking further work to draw together this understanding to inform future assessments. Improved specification of the bounding case for serious clad failure in terms of failure frequency and operational management of failure events will provide better estimates for operational and decommissioning ILW inventories.

Spent Fuel Interim Storage

The assessment of spent fuel disposal is partly based on an assessment of the acceptable heat output to meet the surface temperature requirement for bentonite. RWMD has estimated that it would require approximately 100 years for the heat output of the spent fuel to reduce to an acceptable level. However, this is based upon assumptions concerning the 65 GWd/tU burn-up referred to above and on an assumption that the disposal concept is for four spent fuel assemblies to be placed into each canister. Alternative assumptions will affect these calculations and we note that the Disposability Assessment also says that the cooling period required before emplacement for spent fuel assemblies that have been exposed to a burn-up of 50 GWd/tU is reduced to around 75 years for four assemblies and 56 years if three fuel assemblies are disposed of in a canister.

We currently assume a site occupancy of 100 years, comprising 60 years of operations, followed by a further 40 years of interim storage. Assuming a simple linear generation of spent fuel over time, approximately 33% of the fuel will either meet or be cooler than the requirement at the end of the 100 year site occupancy. Further work will be required to determine the overall proportion of spent fuel that could meet the heat loading criteria assuming mixing of over-cooled with under-cooled fuel in the same container and/or with three elements per canister.

Although further assessment will be required, it would appear that, based on an average burnup, and employing a mix of fuel of different cooling periods and some use of 3 element containers, the overall heat loading criteria could be met within a 100 year site occupancy.

Our own scoping calculations, based on wider international experience, suggest that RWMD numbers could be pessimistic by up to at least 20%. It would have been helpful if RWMD had taken this experience into account to illustrate the potential beneficial impact on reducing cooling periods that alternative/optimised disposal concepts for spent fuel might secure. For example, in the ANDRA concept for disposal in granite, based on a thermal criterion of 90°C at the interface bentonite/canister (100°C with a margin of 10°C for uncertainties), the thermal power of four assemblies at 50 GWd/tU is 1.6kW and assumes emplacement after a cooling period of between 50 and 70 years.

RWMD have recognised that the current GDF concept has not been optimised for the disposal of high burnup fuel and there are a number of areas where improvements to disposability and a reduction in above ground storage times may be able to be achieved. These include:

- A double layered buffer system to reduce overall heat loadings
- Use of prefabricated engineering modules to ensure the bentonite remains dry and stable
- Different emplacement geometries
- Re-evaluation of the temperature criterion

We will continue to work with RWMD to optimise the safety and economic aspects of the GDF spent fuel disposal concept. We are confident that there are many ways to optimise the interim storage period. However, this initial RWMD disposability assessment has confirmed that the spent fuel from the EPR is expected to be disposable.

Supplementary Data

RWMD has supplemented the information supplied to them with its own knowledge and experience, especially relating to wastes arising from the Sizewell B PWR. However, the need for and means of estimating or otherwise defining the supplementary data is not always clear to us, particularly with regard to the conservatism inherent in the methods of deriving the supplementary data.

There was not sufficient information in the draft Disposability Assessment to allow the full implications of the identification and use of supplementary data to be considered in detail. While it is considered unlikely that RWMD will have used supplementary data without justification, it remains possible that the data selection may be inappropriate or that it may be based on a misunderstanding of the UK-EPR.

Operational ILW Reference Case

It will be normal practice to specify the level of shielding that is appropriate to particular waste streams. Knowledge of the waste streams (e.g. by direct monitoring) will enable the specification of waste packages and shielding that will comply with dose limits.

It is suggested by RWMD (Section 4.2.3 of the main report) that the reference case waste packaging concept for operational ILW may exceed acceptable operational doses at the GDF. We consider that the risk of excessive doses from EPR waste packages is similar to the risk associated with packages containing legacy wastes and that the risk would be managed in the same way. We also consider that the RWMD statement does not take due account of the operational procedures that would be put in place. These would ensure that the waste package shielding requirements are appropriately defined and that the emplacement of waste into each container will be monitored and controlled to ensure that no such breaches occur.

(Note, the comments concerning possible breaches of operational dose limits are repeated for the two variant operational ILW waste streams and for the decommissioning ILW wastes. The comments made above will apply equally to these waste streams.)

Operational ILW Packaging – Variant 1

It is noted by RWMD that this variant, while making use of a container type that is compliant with RWMD requirements, does not make efficient use of the available packaging volume. However, we also note that this variant packaging concept would lead to a reduction in the overall packaged waste disposal volume as compared to the reference case.

The packaging concepts will be further developed by potential operators and this will include more detailed assessment and specification of various parameters relevant to waste packaging.

Operational ILW Package – Variant 2

This packaging proposal uses non-standard containers but RWMD expects that the final detailed packaging proposal would be compliant. It should be noted that RWMD has assumed that the waste is to be packaged in Type B cast iron casks used as transport containers to ensure optimum waste loading. It is recognised by RWMD that further development work would be required to confirm the assumption that Type B casks will be used rather than IP-2 casks.

The packaging concepts will be further developed by potential operators and this will include more detailed assessment and specification of various parameters relevant to waste packaging.

Decommissioning ILW

The decommissioning ILW waste stream is larger in both volume and radioactive inventory than the operational ILW waste stream. Given that the Disposability Assessment is based upon a

bounding inventory of decommissioning ILW, we are encouraged by the RWMD conclusions concerning the disposability of the wastes. The definition of the inventory will improve (e.g. as a result of Funded Decommissioning Plan activities) and this will allow the packaging concepts to be specified in greater detail, thereby assisting in future assessments for the LOC process.

The packaging concepts will be further developed and this will include more detailed assessment and specification of various parameters relevant to waste packaging.

Chloride Impurity Assumption

At the current stage of the GDA we are not able to specify in detail the chloride content of the fuel and fuel cladding. RWMD therefore used a conservatively high chloride content with the result that a high estimate for the chlorine-36 content of the spent fuel assemblies was obtained. (The intermediate half life and potential mobility of chlorine-36 means that it is a radionuclide of concern to RWMD in terms of the post-closure performance of the GDF.)

More accurate definition of the upper bounds of the chloride impurities allowed in the fuel and fuel cladding for future assessments, would allow a more accurate determination of the post closure risks associated with spent fuel disposal.

Nitrogen Content of Core Components

As with the chloride content, we were not able at this stage to specify the nitrogen content of the stainless steel to be used in the reactor. RWMD therefore used a stainless steel specification with a relatively high nitrogen concentration, leading to a high estimate of the level of carbon-14, particularly in the decommissioning ILW.

More accurate definition of the upper bounds of the nitrogen content allowed in the stainless steel for future assessments, would allow a more accurate specification of the risks associated with ILW disposal.

CONCLUSIONS

Despite the issues discussed above, which we concur with RWMD can be addressed in the LOC process, we take encouragement from the conclusions of the Disposability Assessment, particularly in the light of the highly conservative nature of the assessment. We welcome the fact that RWMD considers that the spent fuel and ILW wastes should be disposable and that no new issues are expected to arise.