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Subject: **Regulatory Observation Actions for Regulatory Observations RO-AP1000-60 and RO-AP1000-60.A1 – Disposability of spent fuel and ILW.**

Dear Mr. Massey,

Westinghouse has reviewed RO-AP1000-60 and RO-AP1000-60.A1 – Disposability of spent fuel and ILW. Please see our response below.

1. **Introduction:**

RO 60 relates to the case for disposability of spent fuel and Intermediate Level Waste (ILW). It is accompanied by a single action as follows:

"Westinghouse needs to make a case for the disposability of spent fuel and ILW to ensure it can be stored, transported and disposed of."

The following sections outline the Westinghouse response to this RO. Several parts of this response refer to activities and responsibilities which will belong to future licensees of both nuclear power stations and waste repositories. In order to provide a response which is as meaningful and durable as possible, we have asked the Multi Party Agreement (MPA) utility partners to comment on an earlier draft of this document and this submitted response incorporates their comments as appropriate.

It is important to stress that the options presented here by Westinghouse provide credible solutions for the disposability of spent fuel and ILW, all being able to represent Best Available Techniques (BAT). The ultimate accountability will rest with the future operator who may determine in the future that a different solution is more appropriate.

2. **Detailed Response**

The regulators have set out detailed expectations within the RO, and in the following sections Westinghouse will address these.

2.1 Disposability Assessment Critique:

Westinghouse has accepted ownership of the findings of the work carried out by Radioactive Waste Management Directorate (RWMD) on assessing the disposability of ILW and spent fuel. In addition, we have provided a critique under a letter WEC00098, 19 October 2009. In this critique, we provided an overview of the Westinghouse opinion of the work carried out by RWMD which in general was positive. A more detailed breakdown of the opinion follows:

2.1.1 Disposability Assessment scope:

The scope of the work carried out by RWMD has met the expectations of Westinghouse and is in our opinion sufficient to address all issues associated with the disposability of ILW and spent fuel. RWMD has considered the nature and quantities of the waste streams, the relationship with the disposal facility concepts, and safety, environmental and security considerations.

2.1.2 ILW and Spent Fuel Disposal Concepts:

Westinghouse has reviewed the concepts proposed by RWMD for the disposal of ILW and spent fuel and is content that the schemes outlined are broadly responsible, safe and environmentally sound disposal options. They are also compatible with the specification of our declared waste streams. There are some specific issues that will need to be resolved before fuel can be sent to a repository and these are discussed below.

We have provided details of options for packaging radwaste which are in line with RWMD preferences but it should be recognised that utilities may eventually make proposals for different packaging arrangements.

2.1.3 Waste stream assumptions.

Westinghouse has considered the assumed waste stream details in the disposability report which were based on Westinghouse information packs provided to RWMD and we are content that these have been adequately represented. These waste packs contain detailed information on the waste forms, the isotopic make up and quantities.

RWMD has provided an overview of AP1000 design and operation insofar as it is relevant to the results of the disposability assessment and Westinghouse is content that this is adequate for the purpose.

Westinghouse noted the RWMD observation that the list of isotopes provided to RWMD for assessment purposes was not complete. There are other isotopes which need to be considered for long term disposability assessments and the estimation of these is a specialist task. RWMD has carried out the assessment of the quantities of these additional isotopes that need to be included and Westinghouse is content that the appropriate skilled RWMD personnel have carried these calculations out accurately. Thus the extent of isotopic coverage and the quantities derived in the characterisation of these waste forms is complete and fit for purpose.

These isotopic estimations extended to decommissioning materials which will be subjected to neutron activation. Westinghouse was unable to provide concentrations of some trace materials which, when activated, give rise to isotopes which are important considerations for long term disposal. RWMD were able to provide bounding estimates for these and this is an area where as-built material specifications will be provided by future licensees to demonstrate they are within these bounding values. Westinghouse is content with this approach and considers that the risk of exceeding these bounding estimates is low.

Activation levels for the decommissioning materials have been estimated by RWMD using FISPACT-2007. Typical lifetime PWR neutron fluxes at component locations together with spectra appropriate to these locations were used by RWMD. Again, Westinghouse is content that this work has been done in an appropriate manner and we accept the results.

Westinghouse is pleased with the RWMD approach of comparing decommissioning activity estimates with those predicted for Sizewell B. These tie up well and where AP1000 values appear high, this is explained by conservative inputs, eg values of trace element concentrations used in the AP1000 analysis.

There is another area of conservatism which we had asked RWMD to incorporate and that relates to radioactive resin loading. Westinghouse had represented filter waste streams which had been subjected to high coolant activity equivalent to 0.25% fuel failure. This is a bounding assessment which is used as an input to fault analyses. In reality modern PWR fuel is considerably more reliable than that and it is possible that filters and resin activity levels will be low enough for them to be disposed of as LLW. However, for the purposes of conservatism and to bound accident scenarios, we had agreed with RWMD on this approach. This will result in higher estimated volumes of ILW than are actually expected. These high values have been observed and commented on by RWMD in their report but for the time being, Westinghouse is content to use these values as a bounding assessment.

Spent fuel activity levels have been calculated on Westinghouse's behalf by RWMD using the ORIGEN-S code. Estimations of radio-nuclides arising from fuel cladding and other non-uranic components were carried out using an existing PWR fuel datasheet derived from FISPACT-97 calculations. Westinghouse is content that these calculations have been carried out in an appropriate manner.

Westinghouse takes comfort from the RWMD view that both operational and decommissioning wastes are similar to, and exhibit characteristics similar to other UK waste streams which are already covered by letters of compliance. In particular comparisons are made with arisings from Sizewell B and these have confirmed that the AP1000 waste quantities and characteristics are similar. There do not appear to be any omissions from the waste stream information provided by Westinghouse to RWMD other than the minor ones discussed in 2.2.1.7 below.

2.1.4 Packaging Assumptions - ILW

The description and performance of ILW packages described in the disposability report accurately reflect the methodology proposed by Westinghouse, in particular the grouting and packaging of ILW arising from operation and decommissioning.

Westinghouse notes that RWMD are content that the Westinghouse grouting process associated with the waste-form is a well proven process and whilst there will be work to be carried out by the future operator to specify the precise nature of the grout mix and the grouting process, that should be left until later to enable a BAT detailed process to be selected at that time. This is addressed later in Table 1.

The ILW containment packages proposed by Westinghouse are based on RWMD's recommendations on package design and meet the requirements of the RWMD Generic Waste Package Specification. They have already been assessed by RWMD and found to be satisfactory from all operational considerations.

Westinghouse notes that RWMD is broadly content with the operational safety aspects (including criticality) of the ILW packages and although there will be detailed operator work required later to finalise the Letter of Compliance (LoC) there is nothing in the disposability assessment which identifies areas of possible concern. It is expected also that when more realistic evaluations on resin and filter activity are carried out, the operator LoC applications for ILW disposal will be straight forward.

Likewise, Westinghouse notes the RWMD opinion of the relatively small overall additional environmental impact resulting from the new build ILW waste-streams and is happy that these have been correctly evaluated.

Westinghouse notes the positive RWMD assessment of security and environmental issues associated with the post closure and long term storage of ILW (including decommissioning wastes).

There are likely to be detailed questions requiring to be answered in respect of quantities of organic resin. These cannot be resolved at the present time and will be addressed by the operator via the LoC process when quantities and nature of such material to be dispatched as ILW are known following the final BAT assessments.

In respect of the transport of ILW, Westinghouse notes that the only challenge to safe limits is Carbon 14 (quantities and release pathways). This is due to a combination of a very conservative estimation of original as built trace elements in the decommissioned materials and the RWMD calculation method which assumes Carbon 14 can be readily released from thick steel plate, which is extremely conservative. Once manufacturing data becomes available, then more realistic estimations of trace materials will be measured and reported to RWMD via the LoC process. There will also be scope for RWMD to improve the release modelling from the plate material. It is also noted that the very conservative activation calculations, which have been carried out so far, appear to challenge the International Atomic Energy Agency (IAEA) dose rate aspects of the regulations for maximum inventory packages. RWMD (and Westinghouse also) are content that this issue will be resolvable when better data is provided or alternatively will be resolved by administrative control. Thus Westinghouse is content that means can readily be determined that will ensure that worker safety will not be compromised.

2.1.5 Packaging and Disposal Assumptions – Spent Fuel

RWMD has accurately reflected the main features of spent fuel insofar as final disposability is concerned. They have considered that final disposal is via robust disposal canisters, each capable of holding up to 4 assemblies. These are surrounded by shielding and neutron absorbing material. The design concept belongs to RWMD, reflects international intent and Westinghouse finds this acceptable.

The RWMD calculations have indicated that for the limiting irradiation fuel, a cooling period of 100 years would be needed to allow disposal in their generic intended design concept. It would be necessary therefore for Westinghouse to demonstrate that the dry-stored fuel assemblies/rods would remain structurally intact over that period to allow fuel movements to be safely performed. Westinghouse is currently preparing information which will demonstrate this.

Notwithstanding the ability of the fuel to remain intact over this cooling period, Westinghouse believes that there will be ways of demonstrating that this 100 year cooling period can be substantially reduced, and will be working with potential customers, RWMD and regulators to achieve this. Westinghouse considers that the calculation of cooling time is not specific to the AP1000 or specific Westinghouse fuel designs, but reflects the impact of any high burnup nuclear fuel. Thus this is a generic modern fuel issue and is not unique to Westinghouse.

The concept of high burn-up fuel is generally environmentally (as well as economically) beneficial, and so this extended cooling time consideration will be an issue that any future repository operator will need to address to meet industry requirements irrespective of reactor or fuel design. Westinghouse is pleased to note that this possibility to carry out further calculations on heat transfer and temperature tolerance has been recognised by RWMD and it is understood that no further input from Westinghouse is needed.

Westinghouse notes the approach adopted by RWMD in terms of the fuel performance after placing in the repository. Following eventual loss of the waste container integrity, an assumption has been made that an instantaneous fraction of radio-nuclides will be released, followed by longer term leaching. This is consistent with other national disposal approaches, is a conservative approach and is still shown to be acceptable. Further research, if commissioned by RWMD, should provide more details on the leaching of the radionuclides.

Westinghouse considers that assessments of the mechanical and fire retardant performance of the disposal canister to be RWMD's core business and we are pleased to note acceptable performance is reported.

The additional repository storage space required to accommodate spent fuel from a fleet of AP1000s is not excessive, and is not significantly affected by specific reactor or fuel design. Therefore Westinghouse believes that possible national strategies of either extending the proposed legacy waste repository or building a new one would be compatible with the new build proposal.

The transport of spent fuel from site to the repository has been considered in the report and there are no significant issues identified by RWMD. Likewise, there are no issues related to repository post-closure which are unique to the Westinghouse fuel.

Accident analyses and dose considerations associated with storage and transport have been carried out and no significant issues have been identified. Likewise, criticality evaluations have not exposed any weaknesses in the safety of the transport and storage of spent fuel. Westinghouse considers that these are more heavily influenced by the design of the transport and flask facilities rather than the fuel design and we are content that these evaluations have been correctly carried out.

It has been noted that Rod Cluster Control Assemblies (RCCAs) and certain other core components have not been included in the packaging discussions so far. It is expected that they will be disposed of within the spent fuel assemblies and we have asked RWMD to do confirmatory work on this. This is not considered by Westinghouse to be a significant item of work and will be carried out in the short term to ensure visibility of disposal options for all wastes.

2.2 Management of Issues.

Westinghouse notes that there are a number of issues that have been discussed by RWMD in their report, issues that have been raised by Westinghouse in Section 2.1 above, or mentioned directly or implied in our covering letter submitting the RWMD report to JPO. These are addressed below in this response. Detailed issues have also been identified by RWMC in Appendix B of the disposability report, and these are addressed in Table 1 below.

Radioactive Waste Management Cases (RWMCs) for ILW and High Level Waste (HLW) have already been produced and submitted to JPO by Westinghouse. The relevant key points brought out in these RWMCs are as follows:

<u>*ILW RWMC Evidence report (Ref 2).*</u>

The ILW waste will be encapsulated in RWMD compliant 3m^3 waste containers. These will be stored in the on-site environmentally controlled ILW store until a national ILW repository becomes available. This is a well understood and acceptable approach for the immobilisation and storage of ILW.

In the absence of aggressive chemicals and under suitably controlled ambient conditions it is expected that these waste containers will take around 10000 years to corrode through, although the critical thickness is likely to be reached before this timescale (Ref 1). The high pH internal environment within the waste container is expected to limit the general corrosion rate; however there is the potential for some internal surfaces not to be passivated by cement. The ILW waste containers will be filled using an approved and accepted formulation that will be determined by formulation trials (Ref 2).

It is not anticipated that any reactions will occur within the waste package that will result in a detrimental impact on the integrity of the waste package. However there is the possibility that organic Ion Exchange resin can expand within an alkaline environment and thus could cause the conditioning matrix to crack. This effect can be negated by limiting *the amount of resin in each waste package or treating the resin with caustic prior to encapsulation. This understanding will be factored into the final design BAT assessment. It is recognised that due to the potential long (100+ years) storage periods for the waste packages that consideration needs to be given to the content of such records and the form in which they are kept. With regards to the ILW store all packages will be 'fingerprinted' on entry to the store which will allow the waste tracking system within the store to locate and retrieve any waste package within the store. The site licensee will determine how best to maintain and store their data and records to ensure compliance with UK legislation.*

Waste packages will be in RWMD approved containers, conditioned under the approved BAT procedure will be 'fingerprinted' by a HRGS and stored in an environmentally controlled ILW store. Therefore Westinghouse believes that the waste packages will meet the Conditions for Acceptance (CfA) for the national ILW repository, when it becomes available. This will be ensured through the Concept, Interim and Final Letter of Compliance (LoC) stages.

The ILW RWMC evidence report recommends some areas that require further development, during the site specific detailed design stage. These are follows;

- *monitoring regime for the required environmental conditions within ILW store*
- *a programme for demonstrating the continuing compliance of waste stored within the storage limits*
- *ongoing measures to demonstrate that compliance with requirements and standards have been achieved*
- *Specific Data and records management procedures.*

These are future detailed development items and are perceived to be low risk activities.

The ILW RWMC evidence report also areas which require finalisation of processes for treatment and disposal of ILW waste streams. These will be considered as part of the next BAT approach. These are outlined below;

- *consideration of the impact from any detrimental effects due to chemical species that may be present in wastes or might reasonably be expected to form*
- *assessment of long-term performance and degradation of the waste containers*
- *an evaluation of the long-term performance of the waste form*
- *an evaluation of any reactions that may take place between the waste and the conditioning matrix*
- *an assessment of the potential for gas generation from the wastes in the long-term*

- *demonstration that the conditioned wastes will remain within the agreed specification for final disposal throughout the storage period*
- *use of and implications for existing waste disposal routes once the preferred option is selected*

Some of these points will be dealt with by the formulations trials performed during the detailed design however some may require consideration by RWMD. Westinghouse has already provided all the required information requested by the RWMD regarding ILW, to enable the RWMD to perform a disposability assessment for these waste streams.

HLW / Spent Fuel RWMC Evidence Report (Ref 5)

- *Spent fuel once removed from the reactor will be placed in high density racks in the spent fuel cooling pond within the Auxiliary building for up to 18 years. This will allow the spent fuel assemblies to cool, after which they will be placed within an interim storage cask. Due to the high burn-up level of the fuel it is may be necessary to store the spent fuel for a considerable period (RWMC have estimated up to 100 years in dry cask storage if a particular repository design were to be selected) in order to allow it to cool sufficiently to be capable of being placed in the repository. However, Westinghouse expects the repository design to be reconsidered on the basis of current world-wide expectations from spent fuel characteristics.*

The disposal canister proposed by the RWMD (Ref 3) as illustrated in the NDA Disposability Assessment (Ref 4) has not been subjected to detailed design evaluation.

The interim dry storage option being offered by Westinghouse is from Holtec International and is based on the proven Holtec International HI_STORM 100U System that has been in operation for a number of years in the United States. However an AP1000 operator may wish to choose an alternative storage system. This will be assessed during a BAT evaluation prior to committing to the final interim fuel disposal facility design.

Currently it is being proposed by RWMC that the spent fuel is placed in an approved RWMD disposal canister (the temperature on the canister surface should not exceed 100°C (Ref 3)). It will then be re-packaged from the Holtec cask (or alternative) and placed in the RWMD cask at the Geological Disposal Facility (GDF) for final disposal. Westinghouse expect that this repackaging of spent fuel will take place at a central location as outlined in the Nirex Outline Design for a Reference Repository Concept for UK High level Waste / Spent Fuel (Ref 3).

This approach requires the fuel to be placed in Dry Storage for up to an additional 100years after removal from the cooling pond in order to meet the heat transfer and temperature requirements of the RWMD disposal canister. As previously stated Westinghouse believe that this storage period can be significantly reduced and is pleased that RWMD recognise the possibility of further calculations in this area.

Westinghouse is confident that high burnup fuel clad will perform satisfactorily for extended periods of interim dry storage and will demonstrate this (see commitment in Table 1 below).

However various technical issues must be addressed by RWMC in the assessment of the long term performance of the waste package in a geological repository. All components of a waste package may alter with time within the repository environment and therefore both the internal and external environment of the waste package must be well characterised. A demonstrated understanding of factors that might affect long-term service behaviour is required for the characterisation of materials for the waste-package components. These factors include variations such as chemical composition, stress state, microstructure, fabrication or production history and thermodynamic phase equilibria. Westinghouse expects that these issues will be dealt with appropriately by RWMC during the detailed design of the GDF.

Due to the potential long storage periods of the waste packages, consideration needs to be given to the content of records and the form in which they are kept. Management processes such as recording the location of each fuel assembly in the cooling pond, which fuel assembly is placed in which interim storage container and the location of each interim storage container within the HLW store, will be necessary to enable the subsequent management of radioactive substances and facilities. The recording of this information allows the tracking of individual spent fuel assemblies from manufacture to disposal. It will be up to the individual site licensees to determine how best to comply with UK regulations regarding the control of data / documents and which procedures they use in order to demonstrate compliance with these regulations.

The HLW RWMC Evidence report has separately highlighted some areas that Westinghouse believes require further detailed development regarding the Storage/Disposal of Spent Fuel. These are as follows;

- *monitoring regime for the required environmental conditions within HLW Interim Store*
- *a programme for demonstrating the continuing compliance of waste stored within the storage limits*
- *ongoing measures to demonstrate whether compliance with requirements and standards have been achieved*
- *arrangements for QA and records (HLW store)*
- *passive safety (HLW store)*
- *integrity of storage arrangements (HLW store)*
- *arrangements for leak detection (HLW store)*
- *details of ventilation requirements and filtration of airborne releases (HLW store)*
- *environmental monitoring arrangements (HLW store)*
- *how waste will be stored and retrieved (HLW store)*
- *how packages that show evidence of deviating from the specification will be managed (HLW store)*

The above points will be dealt with by the specific site licensee during the detailed design of a HLW store (see commitment in Table 1 below).

The following points are specific to the long term disposal of the waste in a repository and may need to be considered by the GDF licensee or surrogate prior to seeking a GDF site license;

- *consideration of the impact from any detrimental effects due to chemical species that may be present in wastes or might reasonably be expected to form*
- *assessment of long-term performance and degradation of the waste containers*
- *an evaluation of the long-term performance of the waste form*
- *an evaluation of any reactions that may take place between the waste and the conditioning matrix*
- *an assessment of the potential for gas generation from the wastes in the long-term*
- *demonstration that the conditioned wastes will remain within the required specification for final disposal throughout the storage period*
- *use of and implications for existing waste disposal routes once the preferred option is selected*
- *intended specification for the waste package*

The above points will be answered in more detail once a final repository has been developed. Westinghouse has provided the RWMD with all the relevant waste related information to enable future repository assessments to proceed.

The remaining Westinghouse issues are identified below and the way forward is discussed including an overview programme. As the construction dates are not yet determined, all schedule information is given relative to the availability of the plant. The issues raised in our critique (above) are addressed first. The issues raised by RWMD in Appendix B of the Disposability Report are addressed next.

2.2.1 Critique Issues

2.2.1.1 High Estimated Resin Activities

Issue:

These resins are discussed in 2.1.3 above. In order to be conservative and bounding, high coolant source terms have fed into the assessment of resin activation and this has been used in the GDA disposability process to ensure that we could be confident that we could dispose of resins resulting from even the most pessimistic of scenarios. As we get closer to the final design of the encapsulation process, more realistic estimates of filter resin activation will be used. This will have no impact on the design of the storage boxes and drums. Quantities of ILW requiring interim storage and final disposal are expected to reduce substantially.

Action / Timescales:

The encapsulation plant will be operational prior to the second plant outage as it may be decided by the operator to move resins from the resin tanks before the second outage. Thus revised estimates of resin activity will be prepared during Cycle 1 based on early operational experience. The risks associated with this strategy are associated with the manufacture of the encapsulation plant which will need to able to handle the revised activities. Early procurement of plant components will reduce that risk. Since the concept and design of cement encapsulation is well proven, and the contamination levels are expected to decrease substantially, the overall risk of the plant not being functional in time is perceived to be very small.

2.2.1.2 Grout Specification

Issue:

This is discussed in 2.1.4 above. The present grout specification is preliminary and will be reviewed nearer to the procurement time to ensure detailed BAT is applied.

Action / Timescales:

The final specification for the processing plant including the grout mix and operating procedures will be prepared no later than during the first cycle of operation. As this is a proven process, the risks are perceived to be small.

2.2.1.3 Quantities of Organic Resin

Issue:

RWMD noted in 4.3 1 of the disposability report (Ref. 4) that the quantities of organic resin to be handled exceeded expectations. In particular, the concentration in waste packages was in excess of expectations.

Action / Timescales:

The issue of quantities of organic resin will be assessed during construction and will be reported in the Pre-Operation Safety Report (POSR). Waste package concentrations will be assessed prior to commissioning of the encapsulation plant during the second cycle of reactor operation. A full description of resin requirements will be provided and justified at that time. The risk of failure to resolve these issues is considered to be small and encapsulation will be only performed once the LoC process has confirmed acceptable resin fractions.

2.2.1.4 Quantities and release of Carbon 14 from Decommissioning Wastes.

Issue:

This is discussed in 2.1.4 above. The impurities which result in Carbon 14 following neutron irradiation are not specified and RWMD has used an upper bound figure. Also, release mechanisms for Carbon 14 from decommissioning wastes are conservative.

Action / Timescales:

More accurate assessments of the relevant impurity levels of the RPV and core component materials will have been completed prior to fabrication. This will either be via a material specification, or by material measurement. This will take place prior to delivery of components to site during the construction process. Westinghouse believes that this will ensure a satisfactory case for demonstrating safe transport of decommissioning material, but if this is not the case; the licensee will commission further work on retention of carbon 14 in steel. The risks are perceived to be small as the information will start to be compiled before and during fabrication. There will be considerable time prior to decommissioning for the licensee to address any further issues in a BAT manner.

2.2.1.5 Integrity of Irradiated Fuel during Interim Storage

Issue:

This is discussed under 2.1.5 above. There is a requirement to demonstrate that irradiated fuel can be stored dry until it is transferred to the repository. This is to ensure that it can be transferred to the encapsulation container intact and that it performs satisfactorily in the repository.

Action / Timescales:

Westinghouse believes that the requirement for on-site storage will be considerably less than the 100 years estimated by RWMD. Nevertheless, as a precaution, we will demonstrate that the fuel can remain intact for this period. This work will be done during 2010. There is also generic information available overseas which supports the conclusion that Zircaloy clad fuel can be stored dry for long periods without significant deterioration.

The risk associated with this approach is small as Westinghouse will justify spent fuel storage on site for 100 years without loss of integrity. The expectation is that fuel will not require to be stored for that length of time.

2.2.1.6 Extended On-Site Spent Fuel Cooling Times

Issue:

This is discussed in 2.1.5 and the HLW / Spent Fuel RWMC Evidence Report summary above. In order to meet the current perceived criteria for disposal in a repository, RWMD have estimated an on-site required cooling time of up to 100 years for high burn-up (65GWD/Te) fuel. This is a feature of the repository and is independent of fuel design (for example, Areva fuel is subject to the same constraint). It will be necessary to demonstrate also that a repository will be available for spent fuel at the end of operating life after the required cooling period.

Action / Timescales:

Under the GDA process, the Westinghouse is treated as a “surrogate licensee” in the absence of an operator, to enable the plant design and proposed mode of operation to be assessed by the regulators. In that role, Westinghouse has provided all necessary information to support the disposability of spent fuel. This has been assessed by RWMD and found to be acceptable.

The next step is to assess options associated with the availability, design and management of a repository to suit commercially available fuel designs and the national strategy. At present, there is no operator for such a repository and in a similar vein, NDA RWMD are acting as a “repository licensee surrogate”, providing input to government strategy for ILW and HLW management. The vendors (Westinghouse and Areva) have already provided RWMD with all relevant waste related information to enable future repository assessments to proceed. We are therefore not in a position to take the work any further. Any further assessments relating to the justification of the repository design (including licensing input) needs to be the subject of direct dialogue with RWMD. The risks are not within Westinghouse’s or a potential AP1000 licensee’s control.

2.2.1.7 Orphan Wastes

Issue:

This is discussed in 2.1.5 above. Westinghouse has identified potential ILW waste streams for which no disposal route has yet been defined. These include irradiated RCCAs, Burnable Poisons and Thimble Plugs.

Action / Timescales:

Westinghouse has asked RWMD to consider the option (practiced world-wide) of disposing of these within spent fuel assemblies. This work will be completed during 2010. As this is a common practice, the risk associated with such a waste management practice is perceived to be small.

2.3 Appendix B Issues

The responses to Appendix B of the Disposability Assessment Report (Reference 4) are summarised in Table 1 below.

TABLE 1 – RESPONSE TO DISPOSABILITY REPORT - APPENDIX B ISSUES.

ISSUE	RESPONSE	RESPONSIBILITY	TIME FRAME
provide further information on proposals for the management of RCCAs	See 2.2.1.7 above	Westinghouse	December 2010
provide information on procedures used to store waste prior to consignment to the GDF.	Waste storage procedures will be developed to ensure safety, transportability, stock control and ability to retrieve are all in place prior to dispatch of first batch of ILW to the ILW store.	Licensee	Prior to the end of Cycle 2 of first plant operation.
provide estimates for the quantity of organic material in the waste packages;	See 2.2.1.3 above	Licensee	Prior to the end of Cycle 2 of first plant operation.
provide information on the types of resins present in the wastes	This will be evaluated and proposed as a BAT solution to the detailed plant cleanup processes.	Licensee	Prior to the end of Cycle 2 of first plant operation.
provide information on the grade and composition of stainless steel used in an AP1000, taking account of the nitrogen impurities in the steel and provide information on the nature of tritium, C-14 and Ar-39 in activated metals;	See 2.2.1.4 above	WEC (manufacturer) Licensee	Prior to delivery on site of RPV
provide more detailed information on the chemistry of the wastes, including toxic element content;	This information will be evaluated and the way forward will be discussed with RWMD as part of the Interim LoC process.	Licensee	Input to the POSR
confirm that the contents of waste	This information will be evaluated and the way forward will be	Waste operator, (could be Licensee or	Input to the POSR

packages meet the "contents specifications", for example that masses of both deuterium and beryllium in the waste packages are less than 1.8g and that the specific limitations on quantities of graphite, exotic fissile materials, moderating materials and favourable sites for sorption of fissile material will be met;	discussed with RWMD as part of the Interim LoC process.	third party)	
provide information on the form of tritium and carbon-14 in the waste packages to support realistic modelling of their release during transport and operation;	This information will be evaluated and discussed with RWMD as part of the Final LoC process.	Waste operator, (could be Licensee or third party)	Prior to the end of Cycle 2 of first plant operation.
provide further information and justification for the scaling factors used to derive I-129 inventories;	This information will be evaluated and discussed with RWMD as part of the Final LoC process.	Licensee	Prior to the end of Cycle 2 of first plant operation.
provide information on the products that would be generated from waste degradation, for example the rates of volatile amines produced by radiolysis and thermal degradation of anion-exchange	This information will be evaluated and discussed with RWMD as part of the Final LoC process.	Waste operator, (could be Licensee or third party)	Prior to the end of Cycle 2 of first plant operation.

resins.			
demonstrate that grout used for conditioning of waste infiltrates the waste and immobilises particulates successfully, and that wastes are retained in the body of the wasteform, for example confirm that free liquids will not be present in the filters and demonstrate that grout infiltrates the filters, immobilises particulates successfully and minimises voidage;	See 2.2.1.2 above. The grout specification will be built upon operating experience of similar plants close to the required date to ensure a BAT solution is arrived at.	Waste operator, (could be Licensee or third party)	Before end of Cycle 1 of operation of first plant.
develop appropriate waste conditioning process envelopes, demonstrate that the plant operational envelope falls within this, and establish acceptable evolution and performance of the resulting wasteforms, for example develop an appropriate formulation envelope for Organic Primary and Secondary Resins that considers the presence of borate within the	See 2.2.1.2 above. The grout specification and formulation envelope will be built upon operating experience of similar plants to ensure a BAT solution is arrived at.	Licensee	Before end of Cycle 1 of operation of first plant.

wastes;			
consider the use of alternative approaches to grouting waste, such as the use of organic polymers as an alternative to the use of cementitious grouts for conditioning;	See 2.2.1.2 above. The grout specification will be built upon operating experience of similar plants to ensure a BAT solution is arrived at. Alternative approaches will be considered then also.	Licensee	Before end of Cycle 1 of operation of first plant.
demonstrate that the packaging of AP04 steel ILW has appropriately considered the distribution of radioactivity associated with the waste, and that dose rates are not affected by placing steel close to the edge of the packages;	Optimised packing arrangements will be derived from estimated dose rates from decommissioning materials to ensure that optimum self shielding is achieved. This approach will be verified by actual measurements from key dose contributors during the plant dismantling process after the required post operational cooling period has elapsed.	Licensee	Prior to cessation of generation.
provide data on the mass transport, thermal conductivity, and gas generation and pressurisation properties of the wasteforms.	This information will continue to be refined in line with specifying a BAT approach for the final waste-forms closer to the required times. In respect of the operational encapsulated ILW waste, this will be finalised in line with timescales associated with the final specification of the cementation plant. In respect of spent fuel, this will be completed in plenty of time for the movements of spent fuel from the pond to the interim dry store. In respect of the decommissioning waste, this will be done prior to cessation of generation.	Waste operator, (could be Licensee or third party)	Before end of Cycle 1 of operation of first plant. 12 year after commencement of commercial operation 15 year after commence

			ment of commercia l operation
provide results from modelling or test work to better define the damage and the release from waste packages under impact accidents, and the heat loading and the release from the waste packages from fire accidents;	Westinghouse has opted to use the standard RWMD recommended packages. As such, there is significant amount of information on the performance of such containers already in the possession of RWMD. Evaluations of the Westinghouse proposed waste-forms have been carried out by RWMD and the results presented in Tables 20 to 23 of the Disposability Report. There are few un-confirmed issues in these tables which will be resolved through the final LoC route.	Westinghouse Licensee	Complete Before end of Cycle 2 of operation of first plant.
consider the deterioration in the mechanical strength of waste packages owing to storage, and the impact of such deterioration on the accident performance.	Long term mechanical strength requirements are expected to be specified by the operator of the waste repository. In the interim, Westinghouse and licensees will work with RWMD (who currently are the best source of advice on this topic) to determine those requirements and ensure that the package handling procedures, and environmental conditions of the proposed interim store are such that unacceptable degradation does not occur. This will be done prior to the completion of the construction of the interim ILW store.	Licensee	Before end of Cycle 1 of operation of first plant.
build confidence in the expected levels of cladding failure as a result of adoption of Zirlo;	See also 2.2.1.5 above. Zirlo fuel cladding is expected to be at least as reliable as previous Westinghouse fuel products post operation. Westinghouse will demonstrate that this is the case in a technical report to be provided during the GDA process.	Westinghouse	December 2010
provide information on the distribution of burn-up around the average and maximum and on	This information will be provided to RWMD via the licensee based on a representative fuel management scheme. It is not anticipated that this will be	Licensee	Before end of Cycle 1 of operation of first

irradiation history, to support modeling of radionuclide inventories;	required for GDA assessment.		plant.
provide information on the properties of spent fuel following irradiation at high burn-up to support assumptions regarding long-term integrity of spent fuel, including estimation of the Instant Release Fractions;	See Section 2.1.5 above. Westinghouse will perform assessments to demonstrate that high burn-up Zirlo clad fuel will retain its integrity during storage on site. This will provide confidence in the on-site storage capability should the licensee choose to continue to use Westinghouse fuel. Westinghouse will be happy to provide all available manufacturing and fuel cycle information to RWMC through the licensee to support the licensee's long term evaluation of integrity and Instant Release Fraction during the time spent in the repository.	Westinghouse Licensee	December 2010 Continuously during fuel supply contract.
provide information that could be used to evaluate the potential for the spent fuel canister to be subject to significant gas pressurisation under both normal and fire accident conditions.	Westinghouse will be happy to provide all available manufacturing and fuel cycle information to the licensee to support the licensee's long term evaluation of integrity and Instant Release Fraction during the time spent in the repository.	Westinghouse Licensee	Continuously during fuel supply contract. Prior to cessation of generation.

2.4 Letter of Compliance Issues

Westinghouse consider it appropriate to address the Letter of Compliance (LoC) issue as a separate topic in this response as it embraces both good practice and recent regulatory guidance, and is a framework within which the confidence in the final waste-form disposability can be developed. Only ILW is discussed in any detail here as the requirements are more immediate.

An overview of the development of the LoC process is shown in Figure 1 below. This is extracted from RWMC guidance.

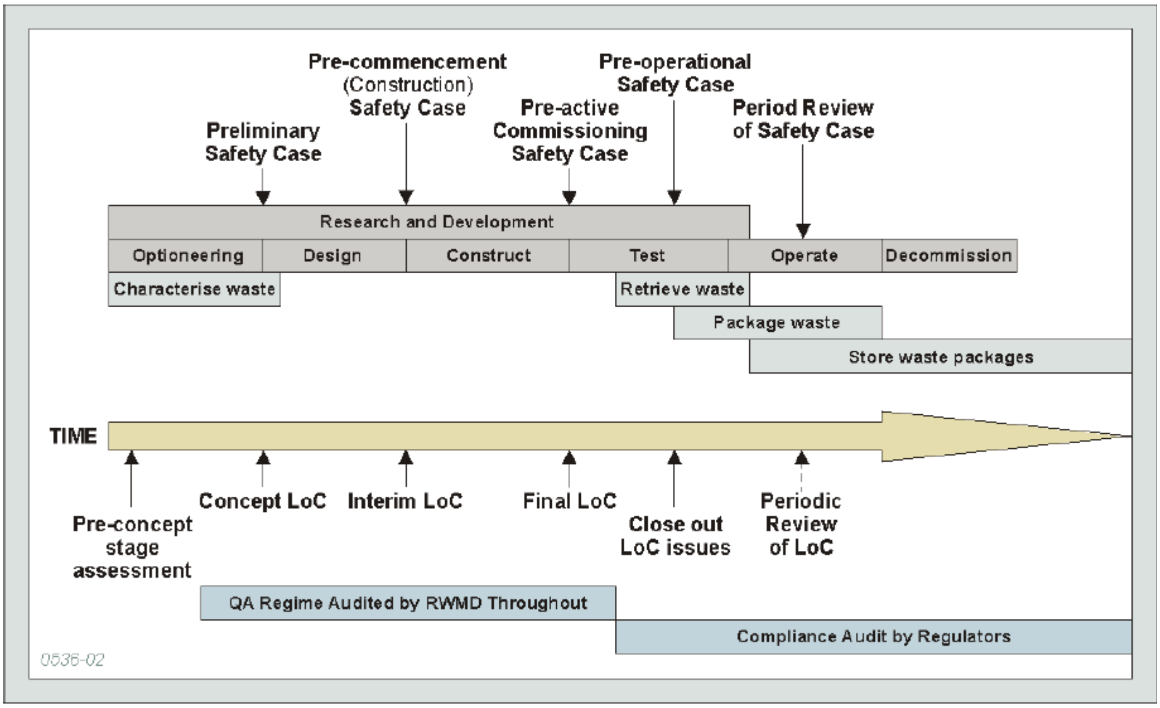

Figure 1: Overview of Letter of Compliance Process.

<u>Concept LoC:</u>

The overall objective of LoC assessment process is to give confidence to all stakeholders that the future management of waste packages has been taken into account as an integral part of their development and manufacture. The level of information prepared for GDA is equivalent to the Concept LoC for both ILW and HAW. This will be developed to reflect any changes in specification which the licensee may introduce as a supporting document for the site PCSR.

Westinghouse takes comfort from the positive conclusion reached by RWMD in relation to the disposability of AP1000 waste-streams. The risks associated with this process are seen to be low as a result of the current RWMD assessment.

<u>Interim LoC:</u>

The interim LoC process for ILW will be completed prior to the final specification of the grouting plant. At this stage, the final BAT detailed assessment will have been completed and justified. The plant procedures will have been completed and the choice of grout finalised. A clear understanding of the waste products, eg resins and filters and their likely contamination levels will have been achieved and waste to grout ratios will have been evaluated and justified. It is important at this stage that there is a high degree of confidence in the acceptability of the product resulting from the proposed plant.

This will be competed by the end of Cycle 1

As the LoC process is evolutional, any significant risks will have been identified during the Concept LoC stage. The overall risks here are therefore seen to be small, and should be manageable with little impact on cost or programme.

The interim LoC for High Active Waste (HAW) will be completed in a timeframe close to the cessation of generation.

Final LoC:

The final confirmatory stages of the ILW LoC process are completed here and this will be achieved before the first batch of grouted material is processed (expected to be during Cycle 2 of operation). The processes to be carried out are shown in Figure 2.

At this stage, it is expected that the LoC process will be complete, however, there may be outstanding exclusions for any unforeseen waste-streams. There may also be conditions imposed on the operation of the processing plant to ensure that the condition of the waste material wholly complies with disposal requirements. Finally, caveats may be imposed on the process.

The final LoC for HAW will be completed in a timeframe after the cessation of generation.

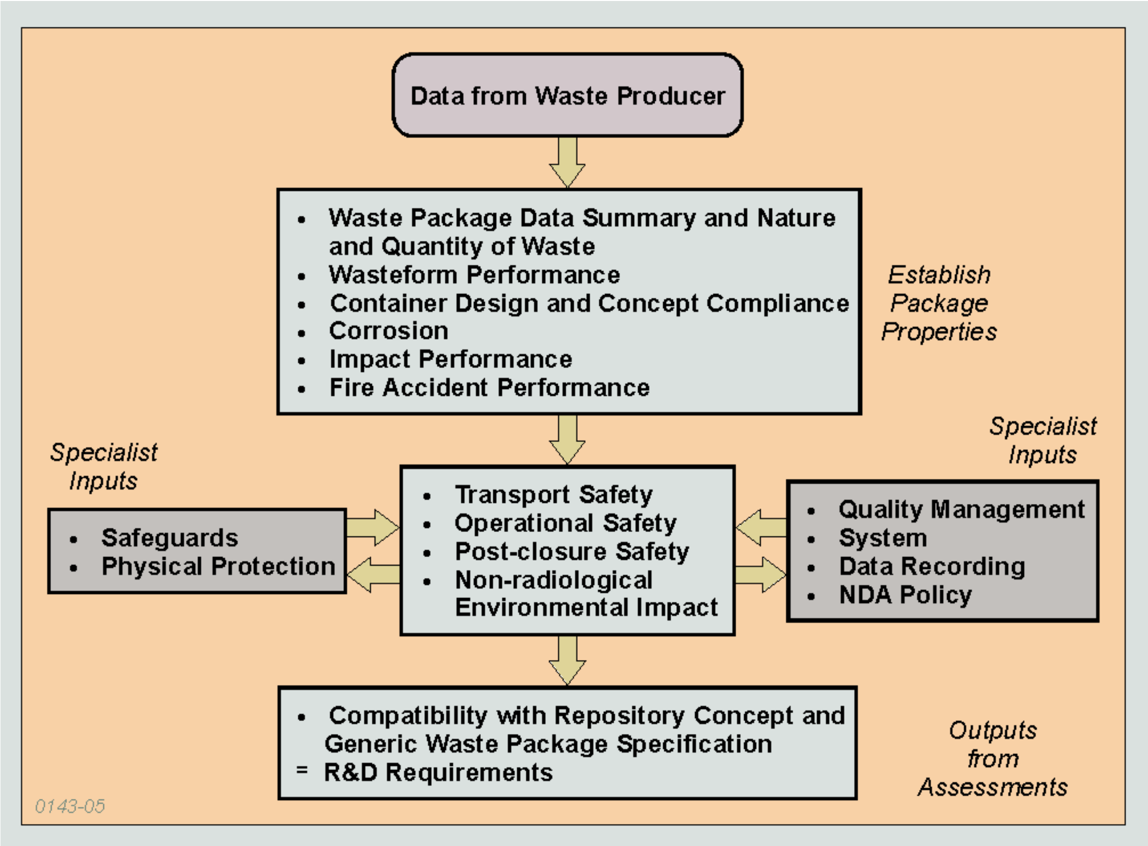

Figure 2: Processes Underpinning Final LoC Stage.

3. Summary

Westinghouse has considered the detailed questions identified in RO60 and has provided a full response above. This response has been reviewed by the utilities who comprise the Multi Party Agreement (MPA) and who will ultimately be responsible as licensees for the work associated with waste management. This RO reflects the Westinghouse understanding of the disposability issue. Some positions may evolve as the utilities assume responsibility for waste storage and waste storage requirements become better known.

A more detailed critique than the one covering the transmittal of the Disposability Report has been provided in this response in 2.1 above as requested by the joint regulators.

Issues identified by Westinghouse from an examination of the Disposability Report have been responded to in the critique, and the method and timing of dealing with them is outlined in 2.2.

Outstanding issues identified by RWMD are summarised in Table 1, together with the proposed resolution. This is presented as an overview plan related to key construction or operational events.

The proposed process for managing the LoC process is outlined in 2.3.

4. References:

1. The Longevity of Intermediate Level Radioactive Waste Packages for Geological disposal: A review. The Environment Agency, Issue 1, August 2008. http://publications.environment-agency.gov.uk/pdf/GEHO0808BOLU-e-e.pdf
2. UKP-GW-GL-055. ILW RWMC Evidence Report, Rev 0
3. Outline Design for a Reference Repository Concept for UK High Level Waste/Spent Fuel September 2005. Number: 502644
4. NXA/10897959, Generic Design Assessment: Disposability Assessment of Wastes and Spent Fuel Arising from the Operation of Westinghouse AP1000 Part 1 Main Report.
5. UKP-GW-GL-056. HLW RWMC Evidence Report, Rev 0

This letter addresses Regulatory Observation Actions RO-AP1000-60 and ROAP1000-60A.1. Should you have any further questions or comments on this submittal, please call me at 412-374-4662

Sincerely,

D.M. Popp
UK Program Manager
WESTINGHOUSE ELECTRIC COMPANY LLC

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