Packaging of Sizewell B Spent Fuel (Pre-Conceptual stage)

Summary of Assessment Report

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Introduction

EdF Energy operates Sizewell B Pressurised Water Reactor (PWR) at Sizewell in Suffolk. Between the commencement of operations in 1995 and April 2010, approximately 1,000 spent fuel assemblies were discharged to the Sizewell B wet storage pond. A further 1,300 spent fuel assemblies can be expected to be generated based on a station operating life of 40 years.

It is known that there is currently insufficient wet storage capacity for the spent fuel arisings anticipated for the power station over its 40 year operating life. Further to this, EdF Energy is seeking to extend the design life of Sizewell B to 60 years, which would result in an anticipated additional 1,200 spent fuel assemblies being generated. This would take the total number of spent fuel assemblies to approximately 3,500 for the lifetime of the power station. EdF Energy is exploring options to address the currently projected shortfall in spent fuel storage capacity at Sizewell B.

EdF Energy has proposed that, following an initial cooling period after discharge, the spent fuel and all associated Non-fuel Core Components (NFCC) would be removed from the wet storage pond for drying and transfer to long term dry storage facilities[1]. EdF Energy has proposed to use a commercial dry storage system developed by Holtec Industries, which uses a Multi-Purpose Canister (MPC) with a series of transport and storage overpacks. Each MPC would have sufficient capacity to hold up to 24 individual PWR fuel assemblies and is hence known as the MPC-24®. The entire inventory of Sizewell B spent fuel (3,500 assemblies) would be stored in approximately 150 MPC-24 canisters. The MPC-24 canisters would be used to dry store the fuel until a Geological Disposal Facility (GDF) becomes available to receive spent nuclear fuel.

EdF Energy has sought advice from RWMD on the disposability of the dried spent fuel from Sizewell B. Two alternative packaging and disposal scenarios have been proposed:

Scenario 1: Interim storage of the spent fuel in the MPC-24 followed by direct disposal of the MPC-24 at a GDF from 2080;

Scenario 2: Interim storage of the spent fuel in the MPC-24 for several decades until a GDF becomes available (again, assumed to be 2080). Transfer of the individual fuel assemblies into smaller high integrity disposal canisters consistent with current RWMD reference case packaging assumptions (equivalent to the KBS-3 concept). Transport and disposal of the canisters to a GDF from 2080.

1 The actual site where the fuel would be interim dry stored has yet to be confirmed.

RWMD has previously supplied formal feedback to EdF Energy on some of the issues associated with Scenario 1, that is, direct disposal of Sizewell B spent fuel using the MPC-24[2]. This Assessment Report builds upon the earlier feedback, providing a full assessment of disposability for both Scenario 1 and Scenario 2. Further to this, the development activities are identified that would be necessary to further develop the proposals with a view to obtaining future RWMD endorsement via the provision of a Letter of Compliance.

The assessment has been carried out through the Letter of Compliance process, whereby RWMD examines the disposability of proposed waste packages by assessment against spent fuel packaging standards and specifications, and the illustrative spent fuel disposal concepts. These concepts have been developed as part of the programme to implement geological disposal for the UK's higher activity wastes. Further information on the Letter of Compliance process is available elsewhere.

Objectives

The objective of this Assessment Report is to provide EdF Energy with:

- Consideration of the implications of extended interim dry storage of the Sizewell B spent fuel on its future disposal in a GDF;
- A summary of the issues associated with transport and direct disposal of spent fuel from Sizewell B packaged in MPC-24 packages (Scenario 1);
- A more detailed disposability assessment for spent Sizewell B fuel repackaged in smaller reference case (KBS-3V type) canisters (Scenario 2); and
- A summary of the activities that would need to be undertaken to take either disposal scenario forwards for future RWMD endorsement.

This Assessment Report builds on previous RWMD advice relating to the transport and disposal of Sizewell B spent fuel using the MPC-24 packages (Scenario 1) and also provides a detailed assessment of disposability for the alternative option, using the reference case (KBS-3V type) disposal canister (Scenario 2). Further to this, a comparison with the assumptions made regarding Sizewell B spent fuel in the RWMD Disposal System Safety Case (DSSC) is provided. This is intended to identify any principal differences that might impact on the generic GDF safety cases and confirm that the conclusions of the DSSC remain valid for Sizewell B spent fuel.

Scope of the Proposals

Consideration has been given to the compatibility of packages containing spent PWR fuel from Sizewell B with the requirements for safe long-term management, including storage, transport, emplacement and extended storage underground, and disposal, as expressed for the Reference HLW/SF Concept[3]. The assessment addresses compatibility with the specification for waste packaging of spent nuclear fuel as expressed in the preliminary Waste Package Specification (WPS)[4]. Further to this, the issues associated with direct disposal of the fuel packaged in the MPC-24 in a range of disposal concepts are highlighted. An essential component of the disposability assessment includes consideration of the evolution of the fuel during interim storage within the MPC-24 dry storage system.

[2] NDA, *Proposed Direct Disposal of Sizewell B Spent Fuel Packaged in Holtec Multi Purpose Canister (MPC-24),* NXA/13433968, November 2010

[3] Nirex, *Outline Design for a Reference Repository Concept for UK High Level Waste/Spent Fuel*, Technical Note 502644, September 2005 (NDA document reference LL/6552289)

[4] Nirex, *The Specification for Waste Packages Containing Vitrified High Level Waste and Spent Nuclear Fuel,* N/124, December 2005

The disposability of the entire lifetime arisings of spent PWR fuel from Sizewell B is considered within this assessment. For the purposes of the assessment, this is assumed to comprise 3,500 individual fuel elements, as has been predicted to arise from an operating period spanning 60 years.

The Sizewell B spent fuel assemblies include additional components that control nuclear reactivity, during operations and shutdown, known as Non-Fuel Core Components (NFCC). These components include neutron absorbing rods and neutron source assemblies that fit within the structure of the fuel assemblies.

Spent fuel assemblies and associated NFCCs are discharged from the core of the Sizewell B reactor to a wet storage pond. The design intent for Sizewell B was that the spent fuel/NFCCs would be long-term stored in the pond pending eventual transfer for disposal. Due to limitations in capacity, EdF Energy has now proposed that each assembly would, following a nominal period of wet storage and cooling, be removed from wet storage for drying and packaging into MPC-24s, each unit containing up to 24 individual fuel assemblies. Each MPC-24 would then be overpacked for transport and storage at an as yet to be defined location. This dry storage arrangement would continue until such time as a GDF becomes available to receive the spent fuel, which is expected to extend to several decades.

EdF Energy has sought feedback on the suitability of the MPC-24 for transport and disposal of the spent fuel and associated NFCC using an appropriate transport and disposal overpack (Scenario 1). This would give rise to approximately 150 packages for consignment to a GDF. The alternatively option would be to retrieve the fuel assemblies and NFCC from each MPC-24 for repackaging into smaller high integrity disposal canisters in multiples of four elements at a time for onward transport and disposal (Scenario 2). This latter approach is consistent with the reference concept for spent fuel disposal developed by RWMD and carried through for quantified assessments within the DSSC, and would give rise to approximately 875 disposal canisters for the projected 3,500 assemblies.

As noted above, the DSSC is based on a high level understanding of the nature and properties of Sizewell B spent fuel, and assuming a packaging approach that is consistent with Scenario 2 (disposal using KBS-3V type canisters). This detailed disposability assessment is based on actual spent fuel data that has been provided by EdF Energy. Therefore, the findings of this assessment have been compared with the generic assessments performed in support of the DSSC to ensure that the conclusions of the DSSC remain valid.

Spent Fuel/HLW Disposal Concepts

It is important to note that the RWMD has not yet selected a final disposal concept for spent fuel since the site for a GDF has not yet been identified and the prevailing geological conditions of such a site will ultimately influence the design of such a facility. This disposability assessment has therefore used illustrative concepts to explore the disposability of both packaging Scenarios proposed by EdF Energy.

A reference spent fuel disposal concept has been developed by RWMD, and has been used as the basis for quantified assessments within the DSSC. This reference concept relies on a series of engineered barriers to control the release of radioactivity and ensure long term safety. This concept is based on the approach being adopted by the Swedish waste management organisation, SKB, for the management of spent nuclear fuel in Sweden.

The first engineered barrier is the PWR fuel itself. The ceramic uranium oxide matrix of the fuel is expected to be stable over long timescales and, provided it is appropriately managed, should not prematurely degrade.

The next barrier is the waste container. Spent fuel being consigned for geological disposal is assumed to be sealed inside a robust disposal canister that is designed to provide containment for many thousands of years. The reference concept developed by NDA RWMD for planning purposes assumes that this canister would be fabricated with an outer shell of copper, although other long-lasting materials are considered potentially suitable. Within the copper shell would exist a cast iron insert that would provide mechanical strength to the overall package whilst also providing location of package contents.

The reference case PWR fuel disposal package comprises four fuel assemblies in a 4.5 m tall copper disposal canister. In a suitable geological environment, these packages would be expected to provide containment of the contents for a period exceeding 100,000 years. The radioactivity within the fuel would decay significantly during this extended period, with only the very long-lived radionuclides remaining.

For the strong crystalline rock geological setting, complete PWR fuel packages are assumed to be deposited in individual vertical holes drilled into the host rock from a series of caverns. Each package would then be surrounded by rings of compacted bentonite clay with a cap of crushed rock and bentonite on top. This engineered barrier would ensure that groundwater would only reach the packages very slowly by diffusion. Radionuclides would also be retained by chemical sorption onto the surface of bentonite particles following eventual failure of the package.

A suitable geological environment would provide the final barrier. This would be selected to provide very long groundwater return times to the surface.

The MPC-24 packages (Scenario 1) are incompatible with the current reference concept described above, primarily on account of their large size. Therefore, consideration has been given to potential alternative disposal concepts that might be appropriate for these packages.

RWMD has previously identified a range of potential alternative geological disposal concepts for spent fuel based on previous work both in the UK and internationally. This identified disposal concepts suitable for various generic geological settings (host rock formations and associated hydrogeological conditions). This effectively provides a catalogue of disposal concepts against which the disposal of the MPC-24 packages has been evaluated.

Potentially suitable disposal concepts for the MPC-24 include tunnels into which the packages may be placed vertically (similar to the reference concept) or horizontally into boreholes. Another potential option that has merit for this type of package is end to end (axial) placement in long tunnels. All potential concepts, would permit either immediate backfilling with bentonite buffer or deferment of this step for a period extending up to hundreds of years. Deferred backfilling allows for maximum flexibility before a decision is made to permanently seal the facility, allowing monitoring and retrieval of the packages at any time if required. For all concept options, the details of an MPC disposal concept are not yet sufficiently developed to allow for quantitative assessments to the same extent as for the reference concept (as per Scenario 2).

Disposal of spent fuel using MPCs offers a number of potential advantages. For example, fewer packages would result in a reduction in the number of transport and handling operations and would also eliminate the risks that would otherwise be associated with re-packaging the aged fuel assemblies into a separate disposal package. In recognition of such advantages, RWMD has commenced additional studies to further explore the technical feasibility of Multi-Purpose Container (MPC) disposal more widely to support future decisions on the development of this management option by nuclear operators[5]. Further work on this matter is expected to be published during 2012.

[5] NDA, *Feasibility Studies Exploring Options for Storage, Transport and Disposal of Spent Fuel from New Nuclear Power Stations*, NDA/RWMD/060, November 2010

Nature of Sizewell B Spent Fuel

A total of 3,500 spent PWR fuel assemblies are expected to arise over a 60 year operating lifetime for Sizewell B. This would give rise to either ~875 reference case disposal canisters or ~150 MPC-24 units. It is noteworthy that the DSSC was based on 2,620 Sizewell B fuel assemblies, giving rise to 655 disposal canisters. However, this was based on an assumed 40 year operating lifetime for the plant.

EdF Energy has indicated that some 1,250 NFCC's could arise based on a 60 year station lifetime. Based on the anticipated arisings of spent fuel and NFCCs, it is expected that one in every three fuel elements would carry a NFCC item and hence for Scenario 2, every disposal canister would carry at least one NFCC. MPC-24 units would each contain several NFCCs.

Sizewell B fuel has an initial uranium-235 enrichment of 4.4%. Peak pellet fuel burn-up is currently limited to 56 GWd/tU. Recent fuel developments include the use of enriched Reprocessed Uranium (REPU) fuel alongside enriched natural uranium fuel, though is unclear to what extent REPU fuel will be used in future refuelling cycles. Other potential changes to the future operating regime include longer future cycle lengths, increased peak pellet burn-up to 65 GWd/tU and enrichment up to 5% uranium-235. EdF Energy anticipates that fuel will be discharged with a greater range of burn-ups in the final few cycles towards the end of reactor lifetime. To account for the range of variability, the RWMD assessment assumed average assembly burn-up of 55 GWd/tU and a uniform rate of discharge from the reactor from 1995 to 2055. A variant inventory was also developed for use in the assessments to explore the disposability of spent fuel fabricated from REPU. This is because, unlike fresh uranium, REPU contains the isotope uranium-236, which when irradiated in the reactor core creates the isotope plutonium-238. This is an important consideration since the high specific heat output of plutonium-238 would makes a significant contribution to the heat output of the spent fuel.

Drying, Interim Storage and Packaging of Sizewell B Spent Fuel

In line with existing practice, the spent fuel assemblies would be discharged from the Sizewell B core for an initial cooling period in the adjacent wet storage pond. At a time determined by the conditions for acceptance with the dry storage facility, the inventory of fuel would be retrieved from this wet storage facility for drying using a process known as Forced Helium Drying. The dried fuel assemblies would then be transferred to the MPC-24 for extended interim on-site storage.

Water and air carryover into the dry storage system could adversely affect the condition of the fuel and its cladding over the extended storage period. This is because radiolysis of water would generate gases which have the potential to pressurise the canister internals and lead to rupture of the fuel cladding. Furthermore, any water and air present could also promote corrosion of the fuel cladding or internal features of the MPC-24 (or disposal canister, as applicable). EdF Energy would therefore need to demonstrate that an adequate level of dryness could be achieved, regardless of the starting condition of the fuel[6]. RWMD has yet to define an upper limit on water carryover for packages containing PWR fuel. Such a limit can only be confirmed once a disposal package (or dry storage system) becomes better defined, since this would dictate the tolerable gas pressure/corrosion allowance.

The spent fuel assemblies within the MPC-24 would also need to be kept under a blanket of inert gas, such as helium, at all times. The heat generated by the spent fuel must also be controlled to prevent mechanical failure of the Zircaloy cladding.

[6] It is possible that some spent fuel will arise with imperfect fuel cladding, including pin-holes.

At the end of the interim storage period, it may be necessary to retrieve the fuel from the MPC-24 for packaging into small disposal canisters if it is deemed that the MPC-24 is unsuitable for onward transport and disposal. The MPC-24 has not been developed to be re-opened once sealed. Furthermore, this transfer would be complicated by the potential for adverse reactions between water and the hot Zircaloy cladding. There may also be a requirement for an additional fuel drying cycle, unless the transfer were to be undertaken without water cover within a dry facility.

Transport to a GDF

It would be necessary to transport the packages through the public domain to a GDF. The technical and safety implications of such transport movements have been evaluated for both packaging Scenarios.

The assessment of disposability has identified that it should be feasible to make a transport safety case for the fuel when re-packaged in the reference case disposal canisters (as per Scenario 2).

The MPC-24 and associated HI-STAR transport overpack is too large and too heavy for land transport as a routine operation in the UK. Although large and heavy loads can be carried using Special Order clearances, these are only issued on a case by case basis. Given that the proposals would lead to approximately 150 such transport movements being necessary, there remains a risk that such clearances may not be obtainable for the full inventory. Clarification of the position of the Highways Agency Abnormal Loads Team acting on behalf of the Secretary of State for Transport regarding large and heavy loads would be an essential precursor to the adoption of this system. Sea transport was also considered but it would still be necessary to provide road transport to a suitable dock with the infrastructure for lifting exceptional loads. This would almost certainly necessitate road transport to some degree since such facilities do not exist in the immediate vicinity of the Sizewell B site and the GDF may also not be located near to a suitable port.

For both packaging/transport scenarios, further work would be necessary to show compliance with the IAEA Transport Regulations in respect of demonstrating criticality safety for the packages. It is possible that a case could be made using an evidence based approach on the degree of burn-up of fissile nuclides in the irradiated fuel, or through provision of specific design features within the packages and transport containers. Such features might include neutron poisons in the disposal package or multiple water barriers that eliminate any potential for ingress of water into the transport flask under accident conditions. However, this is based on initial calculations for intact fuel assemblies in a package and further studies are required in this area to explore the consequences of geometric rearrangement as a result of damage to the fuel cladding. It is recommended that a detailed criticality safety assessment is undertaken to support future submissions to explore transport criticality safety in more detail. RWMD also continues to develop the reference case disposal canisters and associated transport flask which will have an important influence on criticality safety.

Handling and Emplacement Operations at a GDF

On arrival at a GDF, the packages would be transferred underground, unloaded from their respective transport container and placed into deposition boreholes (or perhaps tunnels in the case of the MPC-24).

For the reference case packages (Scenario 2), it should be feasible to make a robust operational safety case based on appropriate working practices and using suitable passive protection systems, such as appropriately designed shield walls, to reduce worker exposure at a GDF.

The operational safety aspects associated with the MPC-24 have not been quantified at this time because the disposal concept and associated handling sequences and fault scenarios have not been sufficiently developed. Since the MPC-24 has not been developed to provide containment for timescales covering more than 100 years, there would be a need to provide an enduring disposal overpack for these packages which would lead to additional handling requirements. While it should be feasible to make an operational safety case using appropriate engineering and management controls, the required caverns and access tunnels would be very much larger for the MPC-24. Large excavations may not be feasible in less competent host rocks, for example evaporate (salt) which may provide a further constraint on the disposal of the MPC-24 package.

GDF Post-Closure Safety

Following closure and backfilling of a GDF, the packages would evolve over extended timescales. The RWMD assessment considered the implications on GDF thermal loading, release of radionuclides into the groundwater and gas phases, generation of bulk gas and criticality safety from the disposal of Sizewell B spent fuel.

It is important that the heat output from spent fuel packages does not cause damage to the engineered barriers of a GDF. For this reason, RWMD has developed a temperature limit for the interface between spent fuel canisters and bentonite buffer of 100ºC. This limit has been developed to ensure that the safety functions of the bentonite are not compromised. Computer models have been developed to determine compliance with this limit for specific packaging proposals.

The radiogenic heat emitted by the Sizewell B spent fuel packages is expected to be relatively high at 2080 (the assumed date of emplacement in a GDF). In order to ensure that the heat emitted from reference case packages containing Sizewell B spent fuel (Scenario 2) does not adversely affect the performance of the engineered barriers in a GDF, calculations have shown that the fuel would need to be cooled for a further seventeen years to 2097 before emplacement. The implications are even more pronounced for fuel manufactured from REPU, where the enhanced inventory of plutonium-238 makes a further significant contribution to overall heat output. For REPU fuel, the cooling period for interim surface storage would need to be extended to 2113 to comply with the limit.

Extending the interim dry storage cooling period would have undesirable consequences from the ongoing costs of institutional care and maintenance of on-site facilities. An alternative approach could involve increasing the spacing between adjacent packages within a GDF. However, increasing the space between adjacent packages could significantly increase the overall footprint of a GDF.

A further potential approach to manage the high heat output from spent fuel packages in a GDF would be selective emplacement of hotter packages in between arrays of cooler packages. For example, it might be possible to place a single Sizewell B fuel package at regular intervals between packages containing longer cooled spent fuel, for example Advanced Gas Reactor (AGR) fuel. RWMD has already commenced work to enhance the thermal modelling capability to explore the feasibility of such an approach.

The preceding discussion refers to the reference case package containing four fuel assemblies (Scenario 2). The MPC-24 disposal configuration (Scenario 1) presents an even greater challenge due to the increased thermal output load of each package. For example, an MPC-24 package containing spent REPU fuel would need to be cooled to 2270 if a bentonite backfill type disposal concept were adopted. Clearly, interim storage for such long periods would be unacceptable and alternative disposal concepts would need to be explored if the MPC-24 is pursued. This may be where cavern type disposal concepts could be beneficial, where deferred backfilling could be adopted to allow for cooling requirements.

Detailed modelling of risk in the groundwater and gas pathways was undertaken. The results showed that risk would be acceptable for both packaging scenarios. This result can be attributed to the anticipated long term integrity of the containers, the stability of the uranium oxide fuel matrix and performance of the engineered barriers and hydrogeology in retarding the migration of radionuclides to the biosphere.

Post-closure criticality safety of spent fuel is a generic issue subject to ongoing work by RWMD and it is concluded that disposal of Sizewell B spent fuel in reference case packages should not provide any new challenge in this respect. The disposal of the MPC-24 on the other hand introduces a much greater local concentrations of fissile material and further consideration would need to be given to determine whether this might increase the probability of criticality occurring during the post-closure phase.

Comparison with the DSSC

The principal differences identified between the representation of Sizewell B spent fuel in the DSSC and this disposability assessment are summarised as follows:

- The inclusion of non-fuel core components with the spent fuel in the current assessment and consequent need for the packages to be lengthened by 200 mm;
- The potentially greater volume of spent fuel arisings in the current assessment that would occur if the lifetime of Sizewell B power station is extended by 20 years; and
- The identification that some fuel has been manufactured from REPU.

The disposability assessment has shown that none of these findings would invalidate the conclusions of the DSSC. The additional packages arising from the extended lifetime of the power station may increase both the duration of the operational period by some six years[7] and the overall GDF footprint. While this would affect the operating costs and overall size of a facility, it would not impact on the overall facility safety case. It is also likely that the increased heat output resulting from fuel fabricated from REPU could be managed using one of the approaches suggested above to ensure compliance with thermal limits.

Recommendations for Further Work

A number of recommendations have been made, which EdF Energy may wish to use as guidance to support any future Letter of Compliance submission. The main issues that are generic to both packaging scenarios include:

- Provision of refined radionuclide inventory information, particularly for NFCCs;
- Demonstration that adequate fuel dryness can be achieved for interim dry storage, packaging and disposal;
- Confirmation of the accident performance of the proposed packages; and
- Development of package-specific criticality safety assessments and the definition of a package safe fissile mass.

Some of the recommendations are unique to the MPC-24 disposal package option and therefore only need to be considered further if the decision is taken to further develop that option as the forward disposition strategy for Sizewell B spent fuel. These include provision of detailed design information to support future GDF design studies and a better estimate of package surface dose rates.

[7] GDF operational throughput is currently assumed to be limited to 200 spent fuel packages per year.

Conclusions

Dry storage using the MPC-24 should provide a safe alternative option to wet storage over extended periods, provided that the spent fuel is adequately dried beforehand and that the MPC-24 can provide sufficient cooling throughout the storage period. The internal environment within the MPC-24 would also need to be kept dry and chemically inert.

While the MPC-24 may provide adequate dry storage, onward transport and disposal of these packages would present significant technical challenges. This is predominantly due to the large size and mass of these packages. Overall, it is clear that a strategy based on storage, transport and disposal using the MPC-24 would carry considerable risk, and may not be viable.

It must also be noted that the MPC-24 has been developed as a final disposal solution and has not been designed to be reopened once spent fuel has been sealed inside. In order to make a case for transport, the fuel would have to be transferred to a compatible container, e.g. smaller MPC). EdF Energy would therefore need to devise a means to reverse the filling operation to enable the fuel assemblies to be transferred to an alternative package for transport and disposal. This in itself would present technical difficulties, suggesting that the MPC-24 may not be an optimum dry storage solution.

The RWMD assessment corroborates the findings of the DSSC insofar as it should be feasible to transport and dispose of Sizewell B fuel using the reference case disposal canister in a hard rock geology, subject to confirmation of thermal output management and the development of a criticality safety case. However, such an approach would require that the spent fuel is retrieved from the MPC-24 for repackaging into a disposal canister. This in itself presents a number of potentially significant technical challenges. EdF Energy is commended to take this risk into account when developing its spent fuel storage strategy.

Although the high residual heat output from Sizewell B spent fuel has been identified as a potential issue, RWMD believes that it should be possible to address this by better understanding the GDF thermal constraints, optimising packaging and/or consideration of alternative spent fuel disposal concepts.

This assessment is considered as HIGH priority under the current regulatory prioritisation scheme for the preparation of Radioactive Waste Management Cases (RWMC)[8]. The HIGH priority categorisation signifies that the regulators would be expected to scrutinise any future RWMC that would be prepared to support the case for disposal of the proposed Sizewell B spent fuel packages. This conclusion is drawn due to the risks associated with using the MPC-24 as well as the fact that Sizewell B spent fuel could amount to a significant proportion of the total radionuclide inventory of a GDF.

Owing to the potential issues raised by the proposals to store and package Sizewell B spent fuel, the conclusions from this assessment have been considered by the RWMD Nuclear Safety and Environment Committee (NSEC). This final version of the Assessment Report incorporates the views of the NSEC.

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[8] *The Management of Radioactive Waste on Nuclear Licensed Sites – Part 1: The Regulatory Process*, Guidance from the Health and Safety Executive, the Environment Agency and the Scottish Environment Protection Agency to nuclear licensees, February 2010