Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

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BMK - Department V/11 (Plant-related Environmental Protection, Environmental Assessment & Air Pollution Control)
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E-mail replies should be sent to the above e-mail address, quoting the reference number

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Reference number: 2022-0.364.344

Vienna, 23.05.2022

Proposed nuclear power station Sizewell C

Austria is participating in the EIA procedure for the nuclear power station Sizewell C according to the Espoo Convention.

Due to the existing Coronavirus situation, the United Kingdom and Austria agreed to conduct consultations according to Art. 5 Espoo Convention in a written form. Austria would like to thank the United Kingdom for the answers of the questions listed in the expert statement.

The Federal Ministry for Climate Action commissioned experts to evaluate the answers. Please find enclosed the final statement of the experts. Austria asks the United Kingdom to consider the comments of the public, the authorities and the final expert statement according to Art. 6 Espoo Convention.

We would like kindly to request the United Kingdom to send the final decision pursuant to Art. 6 Espoo Convention.

Austria would like to thank the United Kingdom for the good cooperation.

Enclosure

Yours faithfully,

On behalf of the Federal Minister

Dr. Ursula Platzer-Schneider

[redacted]

umweltbundesamt
ENVIRONMENT AGENCY AUSTRIA

NPP Sizewell C

Environmental Impact Assessment

Final Expert Statement

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

pulswerk
Das Beratungsunternehmen des
Österreichischen Ökologie-Instituts

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NPP SIZEWELL C ENVIRONMENTAL IMPACT ASSESSMENT

Final Expert Statement

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Gabriele Mraz

Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

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Das Beratungsunternehmen des Österreichischen Ökologie-Instituts

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SUMMARY

At the Sizewell site in Suffolk, UK, a new NPP – Sizewell C – is planned. The proposed NPP comprises two UK European Pressurised Reactors (UK EPR™) units with a net electrical output of 1,670 MW per unit.

At the Sizewell site, two Magnox reactors are being decommissioned (Sizewell A), and a PWR is in operation (Sizewell B). Project applicant for Sizewell C is the company NNB Generation Company Ltd (also referred to as SZC Co.).

The UK has notified the application of NNB to Austria according to Art. 4 of the Espoo Convention. A trans-boundary Environmental Impact Assessment is conducted under UK law (infrastructure planning regulations 2017) and the Espoo Convention. The authority in charge is the UK Planning Inspectorate.

The Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology commissioned the Environment Agency Austria to coordinate the assessment of the submitted EIA Documents in the framework of an expert statement (UMWELTBUNDESAMT 2020). In this expert statement, questions and preliminary recommendations were formulated.

In April 2022, the UK side provided answers to these questions in written form. (BEIS 2022, ONR 2022, NBB SZC 2022b) The final expert statement at hand assesses these answers and gives final recommendations.

The objective of the Austrian participation in the Espoo procedure is to give recommendations to minimise or even eliminate possible significant adverse impacts on Austria resulting from the project.

Although an enormous amount of documents has been submitted in the EIA procedure, **the information provided in the EIA documents is not sufficient to assess the significant trans-boundary effects**. For an assessment of trans-boundary impacts, detailed information on severe accident risks is necessary, however, the EIA documents do not contain severe accident calculations.

During consultations, the UK side referred to data which were submitted during the Euratom Art. 37 procedure. However, the accident scenarios which were submitted in the General Data under the Art. 37 procedure to the EC and approved, might not include the most severe.

At this point in time, when renewables have already become cheaper than nuclear energy it is necessary to update the **assessment of alternatives** for every newbuild plant and not to rely on old data. For the Environmental Impact Assessment of a new NPP, it would also be necessary to update the electricity demand to substantiate the decision for new nuclear instead of the deployment of renewables.

Spent fuel and radioactive waste can cause adverse environmental impacts and therefore an EIA for a new NPP needs to assess the nuclear waste management. But no sufficient proof of safe disposal for spent fuel and radioactive waste was provided in the EIA documents and during the written consultations. The interim storage facility for spent fuel is not available yet, and it remains unclear how the spent fuel will be stored if construction is delayed. Also no information is provided on the timetable for the geological final repository for spent fuel and high level waste.

Before embarking on the use of the KBS-V3 method with copper canisters for the final repository, prove should be provided that copper corrosion will not become a problem in the long term.

Reactor Type

According to the ES, the design of the UK EPR™ units is based on technology used successfully and safely around the world for many years. However, only two units of the EPRTM are in operation: Taishan 1 and 2 (China) since 2018 and 2019, respectively. Two reactors are currently under construction, one each in France (Flamanville 3, FL3) and the U.K. (Hinkley Point C1).

The project OL3 was and the project FL3 is many years behind the initial schedule. The length of the construction period and the numerous difficulties which occurred at OL3 and FL3 demonstrate the complexity of the EPR design. It is to be expected similar problems will also arise in the construction of Sizewell C. The reference design for the UK EPR™ is Flamanville 3 (FL3). However, the deviations from the reference design are not explained.

In June 2021, the loss of tightness of the fuel rods at the Taishan No. 1 reactor in China was detected, which was due to mechanical wear in the lower part of the rod. In addition, during the inspections of the assemblies and inside the vessel, a local phenomenon resulting from impact of the hydraulic load was detected. According to EDF, the ongoing investigation could impact other EPR projects. (EDF 2022)

The EPR was conceived as a reactor with an improved capability to withstand various types of threats and events while reducing the consequences of severe accidents. Nonetheless, its design basis needs to be re-examined in the light of the Fukushima accident. Regarding Station Black Out (SBO), additional measures are necessary, but the actual design problems remain. The relatively high thermal power of the EPR, for example, reduces the time for the operator to react efficiently during accident sequences to avoid a severe accident.

On December 13, 2012, the Office for Nuclear Regulation (ONR) has issued a Design Acceptance Confirmation (DAC) for the UK EPR™ design. During GDA process, however, ONR has identified several "findings" that are important to safety and still need to be resolved (Assessment Findings).

If the ex-vessel cooling of the molten core functions as planned, this new feature will have the potential to reduce the probability of large releases in case of a severe accident. However, the ONR´s assessment emphasised uncertainties regarding the functionality of the Core Melt Stabilisation System; in several Assessment Findings the need for further examination of nearly all important safety issues is addressed. According to ONR (2022), only 11 out of the 26 Assessment Findings have so far been closed for the UK EPR™.

Taking into account all the facts, it is questionable if the proposed safety design and features guarantee preserving containment integrity, both in the long-term or in the short term. At this time, it cannot be proven beyond doubt that severe accidents with high releases cannot occur.

Accident Analysis

With regard to possible accidents, reference is made to the Generic Design Assessment (GDA). The Environmental Statement (ES) stated that a detailed assessment of safety, security and environmental risks associated with the UK EPR™ design has been undertaken as part of the GDA process. However, this assessment was completed almost ten years ago. Since this evaluation, the state of the art in science and technology has seen further development, which has been incorporated in new international and European regulations and guidelines.

According to EDF/AREVA, the UK EPR™ is a Generation 3+ reactor; its safety approach at the design level is based on an improved concept of defence in depth. EDF/AREVA claim that the plant's safety concept meets advanced regulatory requirements so that, on the one hand, accident situations resulting in a core melt that would subsequently lead to large early releases are practically eliminated and, on the other hand, the consequences of low pressure core melt sequences that would require protective measures for the public are very limited both in area and time. The claimed "practical elimination" of a large early release is not sufficiently demonstrated by the UK EPR™ PSA. In the specific PSA of the UK EPR™ many factors have been left out because they have been considered out of scope, or not addressed appropriately (for example, Common Cause Failure (CCF) internal and external hazards, failure of the containment).

Generally, PSA results should only be understood as rough indicators of risk. All PSA results are beset with considerable uncertainties, and there are factors contributing to NPP hazards which cannot be included in the PSA. Therefore, the probability of occurrence as calculated by a PSA should not be taken as an absolute value but as an indicative number only. Hence, it is problematic in practice to reliably demonstrate the fulfilment of a probabilistic goal by PSA.

It is important to note that a 2019 published WENRA report provides a common understanding of the approach to demonstrate the avoidance of early releases and large releases by using the notion of practical elimination. (WENRA 2019) According to WENRA (2019), demonstrating practical elimination via "extreme unlikeliness with a high degree of confidence" has to be based on the two pillars of deterministic and probabilistic considerations. For the deterministic part of the demonstration, practical elimination should be primarily based on design provisions, supported by operational provisions.

But this guidance was not applied for the safety case of the UK EPR™. Furthermore, it becomes clear that the concept of practical elimination for late containment failure was not applied. Thus, the installation of a containment filtered venting system, which is included in the design of the Finish EPR (OL3) has not been planned yet.

All in all, it is recommended to re-evaluate the analysis of severe accidents using the WENRA (2019) guidance to ensure that the concept of practical elimination of severe accidents is used according to the current state of the art.

Site-specific factors (in particular possible danger of flooding, climate change effects) could endanger Sizewell C. Flooding can have catastrophic consequences for a nuclear power plant. The EIA documents explained that a detailed assessment of site-specific nuclear safety risks would be undertaken as part of the nuclear site licensing regime. Regarding the safety of the UK EPR™ reactors, the authorities accepted that with those regulatory processes in place the EIA does not need to present a detailed assessment of nuclear safety risks.

For ensuring compliance with the safety goals of new nuclear power plants consisting in the requirement that accidents leading to early or large releases have to be practically eliminated, a comprehensive Probabilistic Safety Analysis (Extended PSA) would be required, which takes into consideration all relevant internal and external events and possible accident causes. It is important to note that site-specific factors (such as hazards of seismic or tsunami events, climate change impacts) that could endanger the plant are not discussed appropriately in the Environmental Statement.

According to SCARR (2022) the low-lying marshlands that surround the proposed Sizewell C could certainly be affected by a climate change scenario that fails to limit global warming to 1.5 degrees. Furthermore, there is no plausible mechanism that could justify the assumption for the maintenance and preservation of the unconsolidated Dunwich bank over the next two 100-year episodes of coastal processes. This loss could result in significant shoreline erosion around Sizewell C. Thus, a conservative approach should address the loss of major sections of the marshlands whether from depletion of the Sizewell-Dunwich banks or climate change sea level rise of anything above 1.5°C.

All in all, a conservative worst-case release scenario should have been included in the EIA. A source term, for example for an early containment failure or containment bypass scenario, should have been analysed as part of the EIA – in particular because of the results of the analysis of trans-boundary effects of a potential severe accident at the Sizewell NPP site indicate that significant transboundary effects cannot be excluded.

Accidents with involvement of third parties

Terrorist attacks and acts of sabotage can have significant impacts on nuclear facilities and cause severe accidents – also on the planned Sizewell C reactors.

Although the EIA process for reasons of confidentiality cannot discuss precautions against sabotage and terror attacks in detail in public, the necessary legal requirements should be set out in the EIA documents.

Information regarding the issue of terror attacks would be of interest to the Austrian side, considering the large consequences of potential attacks.

Both BEIS (2022) and ONR (2022) stated that the UK EPR™ design can withstand a crash of commercial aircraft. However, it is not explained what type of aircraft is being considered.

Military action against nuclear installations represents another danger that deserves special attention in the current global situation. Thus, at least the crash of a military jet should be considered.

Trans-boundary impacts

The results of the analysis of trans-boundary effects of a potential severe accident at the Sizewell NPP site indicate that significant trans-boundary effects on Central Europe (including Austria) cannot be excluded. The results also indicate the need for intervention measures in Austria. Such measures include agricultural countermeasures, but also iodine prophylaxis for risk groups.

Moreover, the results emphasise the importance of a serious evaluation and discussion of the severe accident scenarios for Sizewell C in the framework of the trans-boundary EIA.

The information the EIA procedure provided so far does not allow a meaningful assessment of the effects that conceivable accidents at Sizewell C could have on Austrian territory. The analysis of a severe accident scenario would close this gap and allow for a discussion of the possible impacts on Austria.

ZUSAMMENFASSUNG

Am Standort Sizewell in Suffolk im Vereinigten Königreich ist ein neues KKW in Planung – Sizewell C. Das geplante KKW besteht aus zwei Reaktoren des Typs UK European Pressurised Reactors (UK EPR™) mit einer Nettostromleistung von 1.670 MW pro Block.

Am Standort Sizewell befinden sich zwei Magnox-Reaktoren in Dekommissionierung (Sizewell A) und ein Druckwasserreaktor (Sizewell B) in Betrieb. Die Projektwerberin für Sizewell C ist das Unternehmen NNB Generation Company Ltd (auch als SZC Co. bezeichnet).

Das Vereinigte Königreich hat Österreich den Antrag von NNB gemäß Art. 4 der Espoo-Konvention notifiziert. Eine grenzüberschreitende Umweltverträglichkeitsprüfung wird gemäß britischem Gesetz (Infrastrukturplanungsverordnung 2017) und der Espoo-Konvention durchgeführt. Die zuständige Behörde ist das UK Planning Inspectorate.

Das Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie beauftragte das Umweltbundesamt, ein Fachgutachten zu den übermittelten Dokumenten zu koordinieren (UMWELTBUNDESAMT 2020). Darin wurden Fragen und vorläufige Empfehlungen formuliert.

Im April 2022 übermittelte die britische Seite die Antworten auf diese Fragen in schriftlicher Form. (BEIS 2022, ONR 2022, NBB SZC 2022b) Das vorliegende Abschließende Fachgutachten evaluiert die Beantwortung und formuliert abschließende Empfehlungen.

Das Ziel der österreichischen Beteiligung im Espoo-Verfahren ist die Ausarbeitung von Empfehlungen, die mögliche signifikant nachteilige Auswirkungen des Projekts auf Österreich minimieren oder eliminieren sollen.

Obwohl eine enorme Dokumentenmenge für das UVP-Verfahren übermittelt wurde, **sind die für die UVP zur Verfügung gestellten Informationen nicht ausreichend, um signifikante grenzüberschreitende Auswirkungen beurteilen zu können.** Für eine Bewertung der grenzüberschreitenden Auswirkungen sind detaillierte Informationen über die Risiken von schweren Unfällen notwendig, doch sind in den UVP-Unterlagen Berechnungen zu schweren Unfällen nicht enthalten.

Während der Konsultationen mit Österreich verwiesen die Expert:innen des Vereinigten Königreichs auf die Angaben, die im Rahmen des Verfahrens nach Art. 37 des Euratomvertrags übermittelt wurden. Allerdings dürften die Unfallszenarien, die in den „General Data" übermittelt und von der Europäischen Kommission akzeptierten wurden, nicht die schwersten Unfälle umfassen.

Angesichts der Tatsache, dass erneuerbare Energien mittlerweile kostengünstiger sind als Kernenergie, ist es notwendig, die **Alternativenprüfung** bei jedem Neubau aktualisiert durchzuführen und nicht alte Daten heranzuziehen. Für die UVP eines neuen KKW wäre es notwendig, den Strombedarf zu aktualisieren, um die Entscheidung für ein neues KKW statt für erneuerbare Energien zu begründen.

Abgebrannte Brennstäbe und radioaktiver Abfall können negative Umweltauswirkungen haben und daher ist es notwendig, dass eine UVP für ein neues KKW deren Entsorgung prüft. Doch weder die UVP-Unterlagen noch die schriftlichen Antworten aus der Konsultation enthielten einen ausreichenden Entsorgungsnachweis für die abgebrannten Brennstäbe und radioaktiven Abfälle. Die Zwischenlagerkapazitäten für abgebrannten Brennelemente stehen noch nicht zur Verfügung und es ist weiterhin unklar, wie die abgebrannten Brennelemente gelagert werden, wenn sich die Errichtung verzögern wird. Der Zeitplan für das geologische Tiefenendlager für abgebrannte Brennelemente und hochaktive Abfälle fehlt ebenso.

Bevor es möglich ist, sich für die KBS-V3 Methode mit Kupferbehältern als die Lösung für das Endlager zu entscheiden, sollte der Nachweis erbracht werden, dass die Kupferkorrosion kein längerfristiges Problem darstellt.

Reaktortyp

Laut der Umwelterklärung basiert das Design der UK EPR™ Blöcke auf einer Technologie, die weltweit erfolgreich ist und sicher über viele Jahre zum Einsatz kommt. Doch sind nur zwei Reaktorblöcke des EPR™ in Betrieb: Taishan 1 und 2 (China) seit 2018 bzw. 2019. Zwei Reaktoren sind zurzeit in Bau, je einer in Frankreich (Flamanville 3, FL3) und im Vereinigten Königreich (Hinkley Point C1).

Das Projekt OL3 war und FL3 ist Jahre gegenüber dem ursprünglichen Plan in Verzug. Die Dauer der Bauzeit und viele Schwierigkeiten zeugen von der hohen Komplexität des EPR-Designs. Ähnlich Probleme sind somit auch bei der Errichtung von Sizewell C zu erwarten. Das Referenzdesign für den UK EPR™ ist Flamanville 3 (FL3). Auf die Abweichungen vom Referenzdesign wurde jedoch nicht eingegangen.

Im Juni 2021 wurde ein Dichtheitsverlust der Brennstäbe im Reaktor Taishan 1 in China entdeckt, der auf mechanische Abnutzung im unteren Brennstabbereich zurückgeführt wurde. Zusätzlich wurde bei der Inspektion der Brennelemente und des Reaktordruckbehälters ein lokales Phänomen festgestellt, welches durch die hydraulische Belastung entstanden war. Informationen von EDF zufolge könnten die laufenden Untersuchungen auch Konsequenzen für die anderen EPR-Projekte haben (EDF 2022).

Das Design des EPR wurde ausgelegt, um eine verbesserte Widerstandsfähigkeit gegenüber verschiedenen Arten von Gefährdungen und Ereignissen zu erreichen und gleichzeitig die Folgen schwerer Unfälle reduzieren zu können. Dennoch ist es notwendig, das Design im Lichte des Fukushima-Unfalls neu zu bewerten. Betreffend Station Black Out (SBO) sind Nachrüstmaßnahmen nötig und geplant, die wesentlichen Designprobleme bleiben jedoch bestehen. So reduziert etwa die relative hohe thermische Leistung des EPR die Zeitdauer für die

Betriebsmannschaft, effektiv bei Unfallsequenzen einzugreifen und schwere Unfälle zu verhindern.

Am 13. Dezember 2012 veröffentlichte die Nuklearaufsicht, das Office for Nuclear Regulation (ONR), die Design Acceptance Confirmation (DAC) für das Design des UK EPR™. Während des Verfahrens zur Generischen Designbewertung (Generic Design Assessment, GDA) gelangte das ONR allerdings noch zu einigen Erkenntnissen (Assessment Findings), die sicherheitsrelevant sind und noch gelöst werden müssen.

Falls die externe Kühlung des Reaktordruckbehälters für den geschmolzenen Kern wie geplant funktionieren sollte, könnte diese neue Einrichtung das Potential haben, die Wahrscheinlichkeit großer Freisetzungen bei schweren Unfällen zu reduzieren. Allerdings hat das ONR die Unsicherheiten betreffend die Funktionalität des Kernschmelzstabilisierungssystems unterstrichen. In mehreren Bewertungsergebnissen wird von ONR die Notwendigkeit für weitere Untersuchungen nahezu aller wichtigen Sicherheitsfunktionen angesprochen. Laut ONR (2022) sind bisher nur 11 von den 26 Bewertungsergebnissen für den UK EPR™ abgeschlossen worden.

Unter Berücksichtigung aller Fakten ist es fraglich, ob der Erhalt der Containment-Integrität durch das geplante Sicherheitsdesign und die Sicherheitseinrichtungen garantiert ist, sowohl kurz – als auch langfristig. Zum jetzigen Zeitpunkt kann nicht vollständig ausgeschlossen werden, dass schwere Unfälle mit hohen Freisetzungen eintreten können.

Unfallanalyse

Betreffend mögliche Unfälle wird auf die Generische Designbewertung (Generic Design Assessment (GDA)) verwiesen. Die Umwelterklärung hält fest, dass eine detaillierte Analyse der Sicherheit, Sicherung und der Umweltrisiken im Zusammenhang mit dem UK EPR™ Design im Rahmen des GDA-Verfahrens durchgeführt wurde. Seit dieser Bewertung kam es allerdings beim Stand von Wissenschaft und Technik zu Weiterentwicklungen. Dies wird von den neuen internationalen und europäischen Regelwerken und Richtlinien reflektiert.

Laut EDF/AREVA handelt es sich beim UK EPR™ um einen Generation 3+ Reaktor. Dessen Sicherheitsansatz auf Designebene beruht auf einem verbesserten gestaffelten Sicherheitskonzept. EDF/AREVA behaupten, dass das Sicherheitskonzept die fortgeschrittenen regulatorischen Anforderungen erfüllt: Dadurch seien Unfallsituationen mit Kernschmelze, die in Folge zu großen frühen Freisetzungen führen würden, praktisch ausgeschlossen und die Folgen von Niederdruck-Kernschmelzsequenzen, die Schutzmaßnahmen für die Öffentlichkeit erfordern würden, zeitlich und örtlich sehr begrenzt. Der behauptete „praktische Ausschluss“ von großen frühen Freisetzungen ist nicht ausreichend durch die probabilistische Sicherheitsbewertung (PSA) für den UK EPR™ nachgewiesen. In der spezifischen PSA für das britische EPR™ wurden viele Faktoren nicht berücksichtigt, weil sie als außerhalb des Anwendungsbereichs liegend angesehen oder nicht angemessen behandelt wurden (z. B. Versagen aus gemeinsamer Ursache (CCF), interne und externe Gefahren, Versagen des Sicherheitsbehälters).

Generell sollten PSA-Ergebnisse nur als grobe Risikoindikatoren verstanden werden. Alle PSA-Ergebnisse sind mit deutlichen Unsicherheiten behaftet und es gibt Faktoren, die zu Gefährdungen für KKW beitragen, allerdings in der PSA nicht betrachtet werden können. Daher sollten die mit einer PSA errechneten Eintrittshäufigkeiten nicht als absoluter Wert, sondern nur als Annäherung betrachtet werden. Deshalb ist es problematisch, in der Praxis die Erreichung eines probabilistischen Ziels mit einer PSA zu belegen.

Es ist wichtig festzuhalten, dass ein 2019 veröffentlichter WENRA-Bericht ein gemeinsames Verständnis zum Ansatz der Nachweisführung für die Vermeidung von frühen und großen Freisetzungen mittels des praktischen Ausschlusses (WENRA 2019) vorlegte. Gemäß WENRA (2019) hat der praktische Ausschluss durch „extreme Unwahrscheinlichkeit mit hoher Vorhersagesicherheit" auf den beiden Säulen deterministischer und probabilistischer Betrachtungen zu erfolgen. Für den deterministischen Nachweis sollte der praktische Ausschluss vor allem auf Design-Vorkehrungen basieren, unterstützt durch Betriebsregeln.

Doch diese Anleitung wurde beim Sicherheitsnachweis für den UK EPR™ nicht angewendet. Ebenso zeigte sich, dass das Konzept des praktischen Ausschlusses eines späten Containmentversagens nicht herangezogen wurde. Somit wurde auch die Installation eines Filtered Venting für das Containment noch nicht geplant, wie es im Design für den EPR (OL3) in Finnland jedoch der Fall war.

Zusammenfassend wird empfohlen die Analyse der schweren Unfälle unter Anwendung der Anleitung von WENRA (2019) erneut durchzuführen, um sicherzustellen, dass das Konzept des praktischen Ausschlusses von schweren Unfällen entsprechend dem Stand der Technik angewendet wird.

Standortspezifische Faktoren (vor allem die möglichen Risken einer Überflutung, Klimawandelauswirkungen) könnten Sizewell C gefährden. Eine Überflutung kann für ein Kernkraftwerk katastrophale Folgen haben. Die UVP-Unterlagen führten an, dass eine detaillierte Bewertung der standortspezifischen Sicherheitsrisiken im Rahmen der atomrechtlichen Bewilligungen durchgeführt werden wird. Betreffend Sicherheit des UK EPR™-Reaktors akzeptierten die Behörden, dass die UVP keine detaillierte Bewertung der nuklearen Risiken aufweisen muss, wenn atomrechtlichen Verfahren zur Anwendung kommen.

Um die Einhaltung der Sicherheitsziele für neue Kernkraftwerke nachzuweisen, wonach Unfälle mit frühen oder hohen Freisetzungen praktisch auszuschließen sind, wäre eine umfassende Probabilistische Sicherheitsanalyse (Extended PSA) nötig, die alle relevanten internen oder externen Ereignisse und möglichen Unfallursachen einbezieht. Festzuhalten ist, dass standortspezifische Faktoren (wie die Gefahr von seismischen Ereignissen oder Tsunamis sowie Klimawandelauswirkungen), die das Kraftwerk gefährden könnten, in der Umwelterklärung nicht ausreichend diskutiert werden.

Laut SCARR (2022) können die tiefliegenden Sumpfgebiete um das geplante KKW Sizewell C sicherlich von einem Klimawandelszenario betroffen sein, welches die Beschränkung der globalen Erwärmung um 1,5 Grad nicht erreicht.

Auch gibt es keinen nachvollziehbaren Mechanismus, der eine Rechtfertigung der Annahme bietet, wonach das unbefestigte Dunwich-Ufer die nächsten zwei 100-Jahresperioden der Küstenentwicklung überstehen werden. Deren Verlust könnte eine bedeutende Küstenerosion bei Sizewell C auslösen. Daher sollte ein konservativer Zugang den Verlust größerer Bereiche des Sumpfgebiets ansprechen, der durch das Verschwinden des Sizewell-Dunwich-Ufers oder den klimawandelbedingt erhöhten Meeresspiegel bei über 1,5°C eintreten könnte.

Prinzipiell sollte ein konservatives Worst-Case Szenario in der UVP dargestellt werden. Ein Quellterm, etwa für ein frühes Containmentversagen oder einen Containment-Bypass sollten in der UVP analysiert werden, vor allem weil die Ergebnisse der Analyse der grenzüberschreitenden Auswirkungen eines schweren Unfalls am Standort Sizewell zeigen, dass signifikante grenzüberschreitende Auswirkungen nicht ausgeschlossen werden können.

Unfälle mit Beteiligung Dritter

Terrorangriffe und Sabotageakte können schwere Auswirkungen auf Nuklearanlagen haben und schwere Unfälle verursachen, natürlich auch bei den geplanten Sizewell C-Reaktoren. Wenn auch im UVP-Verfahren aufgrund der Vertraulichkeit die Vorkehrungen gegen Sabotage und Terrorangriffe nicht im Detail öffentlich besprochen werden können, so sollten die notwendigen rechtlichen Anforderungen in den UVP-Dokumenten skizziert sein.

Aufgrund der enormen Konsequenzen potenzieller Angriffe sind Informationen über die Problematik von Terrorangriffen für Österreich von Interesse.

Sowohl in BEIS (2022) wie auch in ONR (2022) wird festgehalten, dass der UK EPR™ gegen den Aufprall eines Verkehrsflugzeugs ausgelegt ist. Nicht erwähnt wird jedoch, mit welchem Flugzeugtyp gerechnet wurde.

Militärische Angriffe gegen Nuklearanlagen sind eine weitere Gefahr, die angesichts der aktuellen Weltlage besondere Aufmerksamkeit verdient und somit sollte zumindest der Absturz eines Kampffliegers betrachtet werden.

Grenzüberschreitende Auswirkungen

Die Ergebnisse der Analysen zu grenzüberschreitenden Auswirkungen potenzieller schwerer Unfälle am Standort des KKW Sizewell zeigen, dass signifikante grenzüberschreitende Auswirkungen auf Mitteleuropa (auch Österreich) nicht ausgeschlossen werden können. Die Resultate zeigen auch, dass Interventionsmaßnahmen in Österreich nötig werden können. Diese schließen auch landwirtschaftliche Gegenmaßnahmen ein, sowie Iodprophylaxe für Risikogruppen.

Außerdem zeigen die Resultate, wie wichtig eine seriöse Evaluierung und Diskussion der Szenarien schwerer Unfälle im KKW Sizewell C im Rahmen der grenzüberschreitenden UVP ist.

Die Informationen aus dem UVP-Verfahrens ermöglichen keine Bewertung der Auswirkungen, die denkbare Unfälle im KKW Sizewell C auf österreichisches Territorium haben könnten. Die Analyse eines Szenarios für schwere Unfälle würde diese Lücke schließen und eine Diskussion über die möglichen Auswirkungen auf Österreich ermöglichen.

1 INTRODUCTION

At the Sizewell site in Suffolk, UK, a new NPP – Sizewell C – is planned. The proposed NPP comprises two UK European Pressurised Reactors (EPR) units with a net electrical output of 1,670 MW per unit.

At the Sizewell site, two Magnox reactors are being decommissioned (Sizewell A), and a PWR is in operation (Sizewell B). Project applicant for Sizewell C is the company NNB Generation Company Ltd (also referred to as SZC Co. in the Environmental Statement).

The UK has notified the application of NNB to Austria according to Art. 4 of the Espoo Convention. A trans-boundary Environmental Impact Assessment is conducted under UK law (infrastructure planning regulations 2017) and the Espoo Convention. The authority in charge is the UK Planning Inspectorate.

The Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology commissioned the Environment Agency Austria to coordinate the assessment of the submitted EIA Documents in the framework of an expert statement (UMWELTBUNDESAMT 2020). In this expert statement, questions and preliminary recommendations were formulated.

In April 2022, the UK side provided answers to these questions in written form. (BEIS 2022[1], ONR 2022, NBB SZC 2022b) The final expert statement at hand assesses these answers and gives final recommendations.

The objective of the Austrian participation in the Espoo procedure is to give recommendations to minimise or even eliminate possible significant adverse impacts on Austria resulting from the project.

[1] BEIS (2022) includes all answers that are also provided in NBB SZC 2022a.

2 OVERALL AND PROCEDURAL ASPECTS OF THE ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Short summary of the expert statement

Although an enormous amount of documents has been submitted in the EIA procedure, the information provided in the EIA documents was not sufficient to assess the significant trans-boundary effects. For an assessment of trans-boundary impacts, detailed information on severe accident risks would have been necessary, however, the EIA documents lacked severe accident calculations.

At this point in time, when renewables have already become cheaper than nuclear energy it is necessary to update the assessment of alternatives for every newbuild plant and not to rely on old data. For the Environmental Impact Assessment of a new NPP, it would also be necessary to update the electricity demand to substantiate the decision for new nuclear instead of the deployment of renewables.

The following four documents were provided to the Austrian side:

BEIS – DEPARTMENT FOR BUSINESS, ENERGY & INDUSTRIAL STRATEGY (2022): Letter to Dr. Platzer-Schneider, BMK, Ref: EN010012, from 25 April 2022.

NBB SZC (2022a) : The Sizewell C Project. SZC Co.'s Response to the Secretary of State's Request for Further Information dated 18 March 2022. Revision 1.0. https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-010782-SZC%20-%20Main%20Report.pdf (pdf, 70 pages)

ONR (2022) : Sizewell C: Questions from the Government of Austria. Response to the Secretary of State. CM9 Ref. 2022/20680. https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-010763-Office%20for%20Nuclear%20Regulation%20-%208%20April%202022.pdf (pdf, 7 pages)

NBB SZC (2022b): The Sizewell C Project. SZC Co.'s Response to the Secretary of State's Request for Further Information dated 18 March 2022: Appendix 6 – Extract of Article 37 Submission for Sizewell C – Chapter 6. Revision 1.0. https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010012/EN010012-010780-SZC%20-%20Appendix%206.pdf (pdf, 31 pages).

Answers given in NBB SZC (2022a) are identical to BEIS (2022).

2.2 Questions, answers and assessment of the answers

No questions were included in this chapter, but the UK side submitted the following introduction to its answers.

Comment **BEIS (2022):**

5.1 Introduction

5.1.1 This section provides SZC Co.'s response to the questions raised in chapter 8 of the Espoo Convention Response from the Austrian Government of 17 September 2020: EN010012-003106-EN010012 Regulation 32 - Consultation response from Austria.pdf (planninginspectorate.gov.uk).

5.1.2 Since the submission of the Sizewell C Development Consent Order (DCO) application in May 2020, the UK Government has formally submitted a General Data Set in relation to the Sizewell C Project to the European Commission under Article 37 of the Euratom Treaty.

5.1.3 Although the Article 37 process is separate from the Espoo requirements, which the UK meets through its DCO Examination process, it is noted there are strong areas of overlap, particularly in the assessment of transboundary impacts to member states.

5.1.4 In February 2021, a UK delegation, including individuals from the UK Regulators, UK Government and SZC Co. provided evidence which was assessed in an Oral Hearing by a Panel of Member State Experts under Article 37. This included individuals from the Austrian Government (G Mraz - who co-authored the "Sizewell C Environmental Impact Assessment" from the Austrian Government included in the 17 September 2020 response - and C Katzlberger).

5.1.5 On 3 June 2021 the UK received a positive opinion from the European Commission under Article 37 concluding *“that the implementation of the plan for the disposal of radioactive waste in whatever form, arising from the two EPR reactors on the Sizewell C nuclear power station site located in the Suffolk Coast, United Kingdom, both in normal operation and in the event of accidents of the type and associated magnitudes of unplanned release of radioactive effluents, as considered in the General Data, is not liable to result in radioactive contamination, significant from the point of view of health, of the water, soil or airspace of a Member State, in respect of the provisions laid down in the Basic Safety Standards (Directive 2013/59/Euratom).”* - EUR-Lex - 32021A0610(01) - EN - EUR-Lex (partially blackened)

5.1.6 The Article 37 submission and the associated Oral Hearing provided answers to a number of the questions raised by the Austrian Government under Espoo, however for completeness responses are provided below.

Assessment of this comment

The Euratom Article 37 Group of Experts only provides advise to the European Commission (EC), the final opinion is issued by the EC and not the Group of Experts.

The Euratom Article 37 procedure is regulated in Commission Recommendation of 11 October 2010 on the application of Article 37 of the Euratom Treaty (2010/635/Euratom). According to Annex I (6), the General Data should include accidents which were analysed in the safety report and are included in the site related national emergency plan.

However, the accident scenarios which were submitted in the General Data under the Art. 37 procedure to the EC and approved, might not include the most severe.

2.3 Conclusions and final recommendations

Although an enormous amount of documents has been submitted in the EIA procedure, the information provided in the EIA documents was not sufficient to assess the significant trans-boundary effects. For an assessment of trans-boundary impacts, detailed information on severe accident risks would have been necessary, however, the EIA documents lacked severe accident calculations.

At this point in time, when renewables have already become cheaper than nuclear energy it is necessary to update the assessment of alternatives for every newbuild plant and not to rely on older data. For the Environmental Impact Assessment of a new NPP, it would also be necessary to update the electricity demand to substantiate the decision for new nuclear instead of the deployment of renewables.

During the consultations, the UK side referred to data from the procedure under Euratom Art. 37. But the accident scenarios in the Art. 37 procedure might not include the most severe

3 SPENT FUEL AND RADIOACTIVE WASTE

3.1 Short summary of the expert statement

Spent fuel and radioactive waste can cause adverse environmental impacts and therefore an EIA for a new NPP needs to assess the nuclear waste management. But no sufficient proof of safe disposal for spent fuel and radioactive waste was provided in the EIA documents. Interim storage capacities for spent fuel are not available yet, and it has not been made clear if they will be available once Sizewell C will be generating spent fuel. Also no information is provided on the geological final repository for spent fuel and high level waste, neither on the site, the technology or the timetable.

Before the claiming or deciding that the KBS-V3 method will be used for the spent fuel canisters for the final repository prove has to be delivered that copper corrosion will not become a problem in the long-term.

3.2 Questions, answers and assessment of the answers

Question Q8.1-1 *What is the timetable of the planned dry interim storage for spent fuel?*

Written answer by the UK side

(BEIS 2022):

5.2.1 Volume 2, Chapter 7 of the ES (Spent Fuel and Radioactive Waste Management) [APP-192] presents an overview of the proposed arrangements for the management of radioactive wastes and spent fuel arising during operation of Sizewell C.

5.2.2 This sets out (paragraph 7.7.79-7.7.80) [APP-192] that:

"7.7.79 At each UK EPR^{TM} unit at Sizewell C, fuel assemblies removed from the reactor would be cooled underwater in an on-site reactor fuel pool for up to 10 years …

7.7.80 Following this initial storage period in the on-site reactor fuel pool, the spent fuel assemblies would be prepared for transfer to the separate on-site [interim spent fuel store] ISFS, where they would be safely stored until a Geological Disposal Facility is available for transfer, and the spent fuel is suitable for final disposal."

5.2.3 Paragraph 7.7.81 [APP-192] goes on to explain that:

"7.7.81 Therefore the Interim Spent Fuel Store (ISFS) would provide storage for spent fuel from the Sizewell C UK EPR™ reactor units from around 10 years after the start-up of Unit 1 until the spent fuel is transferred off-site for disposal at the Geological Disposal Facility. The ISFS would be designed such that it can store spent fuel for up to 120 [2]years. This would allow interim storage to be maintained until a Geological

[2] Note that the design life is 100 years with capability to extend to 120 years plus if required.

Disposal Facility, or an alternative disposal/management route, has been established and the heat levels within the fuel are at levels that permit its disposal."

5.2.4 As set out in paragraph 7.7.85 [APP-192]:

"The design and operation of the facility would be required to be compliant with the Nuclear Site Licences, and Radioactive Substances Regulations environmental permit with regard to the safety of workers, public and the impact on the environment. The facility would be designed, constructed and operated to comply with the Ionising Radiation Regulations 2017, ensuring doses to workers and the public would be minimised as far as reasonably practicable."

Assessment of the answer

Answers included data on the time the spent fuel will be stored in the spent fuel pools, and the lifetime of the planned interim storage. However, the information concerning the envisaged dates for licensing, construction and start of operation of the interim storage facility was not given.

Question Q8.1-2

What is the status of the geological repository for spent fuel and HLW?

Written answer by the UK side

(BEIS 2022):

5.2.5 As set out in **Table 4.28** (Radiological Considerations) of the **Relevant Representations Report** [REP1-013]:

"UK Government Policy is for the UK's Higher Activity Radioactive Waste (Intermediate Level Waste and High Level Waste) and Spent Fuel to be disposed of via a UK Geological Disposal Facility. The delivery of this facility is managed by Radioactive Waste Management Limited, a subsidiary of the Nuclear Decommissioning Authority."

5.2.6 **Volume 2, Chapter 7** of the **ES** (Spent Fuel and Radioactive Waste Management) [APP-192] paragraph 7.7.91 notes:

"With regard to the availability of a Geological Disposal Facility, Radioactive Waste Management Ltd have published their plans for the scheduling and implementation of the Geological Disposal Facility[3]."

5.2.7 Since the DCO application was submitted, Radioactive Waste Management Ltd. has become part of "Nuclear Waste Services Limited"[4] and three potential sites for the geological disposal facility have been identified, with local working groups set up.

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[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/766643/Implementing_Geological_Disposal_-_Working_with_Communities.pdf

[4] Nuclear Waste Services launches - GOV.UK (www.gov.uk)

Assessment of the answer

The answer above referred to the 2018 document “Implementing Geological Disposal – Working with Communities”, which described the process of searching for a national DGR, but did not contain a timeline.

Question Q8.1-3

How can the safe storage of spent fuel be ensured in case the interim storage and final disposal will not be available in time?

Written answer by the UK side

(BEIS 2022):

5.2.8 As set out in **Volume 2, Chapter 7** of the **ES** (Spent Fuel and Radioactive Waste Management) [APP-192], the UK regulatory permissions regime for nuclear power stations defines precise regulatory requirements and expectations for the management of spent fuel and radioactive waste. Details on the legislation, policy and guidance which apply to ensure safe storage are set out in **section 7.2** Legislation, policy and guidance, with further details on management of spent fuel set out in **section 7.7 d)**.

5.2.9 In line with the UK regulatory requirements, the facility would be subject to periodic safety reviews to ensure the safety case for its operation remains valid and that any shortfalls from the modern standards are identified and addressed.

5.2.10 As set out in **Table 4.28** (Radiological Considerations) of the **Relevant Representations Report** [REP1-013], if the ISFS is required for longer than the currently proposed design life:

"…. Given the relatively simple design of these facilities, they would be capable of extension beyond this period, if necessary, subject to any required refurbishment and or replacement of equipment".

Assessment of the answer

The lifetime of the planned interim storage facility can be extended to 120+ years according to answer on question 8.1-4. The answer furthermore informs that the future interim storage facility might be refurbished and equipment might be replaced if necessary. The question has been answered partially; however, it is not clear how the spent fuel will be stored if construction of the interim storage facility is delayed.

Question Q8.1-4

Is it planned to use copper for the spent fuel canisters, and if yes, how will the copper corrosion problem be solved?

Written answer by the UK side

(BEIS 2022):

5.2.11 For Sizewell C, fuel assemblies removed from the reactor would be cooled underwater in the fuel building fuel pool for around 10 years during operation; and 3 years at end of generation.

5.2.12 The spent fuel would then undergo treatment (drying) and be loaded into a multi-purpose canister (MPC) which will be sealed and is capable of passively cooling the contained spent fuel with no external support. Loaded and sealed MPCs would be transported from the fuel building along the haul route to the Interim Spent Fuel Storage (ISFS) facility, where they would be stored.

5.2.13 The spent fuel would remain here until disposal at the UK Geological Disposal Facility is available. The intended design life for the ISFS facility is for storage of spent fuel for 100 years, but with the potential to extend to 120 years+ after end of generation.

5.2.14 When operational the ISFS facility will contain stored MPCs in HI-Storm containers. Throughout the operational life of this facility, an inspection and monitoring regime is expected to be implemented to ensure that fuel is safely stored (inspection and monitoring is a legal requirement under nuclear site licence condition (LC) 28). Prior to the spent fuel being transferred to the Geological Disposal Facility, the fuel will be required to be repackaged and encapsulated into compliant containers suitable for disposal.

5.2.15 Dry storage of spent fuel has been used widely and previously licensed in the UK and internationally. The MPC and HI-Storm are constructed of a Neutron Absorber, Concrete and Stainless Steel and as such are not copper based. Details of the final disposal container will be confirmed closer to transport to the Geological Disposal Facility and will be subject to regulatory assessment.

Assessment of the answer

The questions has been answered for storing the spent fuel before placing it in a future DGR. In the EIA Report (2020, Vol 2 Chap 7, p. 44) it had been mentioned that the Radioactive Waste Management Ltd disposal concept for High Level Radioactive Waste and spent fuel is based on the Swedish KBS-3V method, which uses copper canisters which their known corrosion problems. The question was also asking if the use of copper is foreseen in the future DGR.

3.3 Conclusions and final recommendations

Spent fuel and radioactive waste can cause adverse environmental impacts and therefore an EIA for a new NPP needs to assess the nuclear waste management. But no sufficient proof of safe disposal for spent fuel and radioactive waste was provided in the EIA documents and during the written consultations. The interim storage facility for spent fuel is not available yet, and it remains unclear where the spent fuel will be stored if its construction is delayed. Also no information is provided on the timetable for the geological final repository for spent fuel and high level waste.

Before embarking on the use of the KBS-V3 method with copper canisters for the final repository, prove should be provided that copper corrosion will not become a problem in the long term.

Final recommendation

FR1: To demonstrate the safe management of nuclear waste and spent fuel from Sizewell C, detailed information on the interim storage and final disposal should be provided; also alternative nuclear waste management solutions in case these facilities will not be operable in time.

4 REACTOR TYPE

4.1 Short summary of the expert statement

The EPR was conceived as a reactor with an improved capability to withstand various types of threats and events while reducing the consequences of serious accidents. Nonetheless, its design basis needs to be re-examined in the light of the Fukushima accident (MAKHIJANI 2012). Regarding Station Black Out (SBO), backfitting measures are necessary and planned, but the actual design problems remain. The relatively high thermal power of the EPR, for example, reduces the time for the operator to react efficiently during accident sequences to avoid a severe accident.

The length of the construction period and the many difficulties of Olkiluoto 3 (OL3) and the Flamanville 3 (FL3) demonstrate the complexity of the EPR design. It is to be expected that problems will also arise in the construction of Sizewell C. It can be assumed that despite the repair of quality deficiencies, some deficiencies will remain.

If the ex-vessel cooling of the molten core is functioning as planned, this new feature would have the potential to reduce the probability of large releases in case of a severe accident. However, the ONR´s assessment emphasised uncertainties regarding the functionality of the Core Melt Stabilisation System; in several Assessment Findings the need for further examination of nearly all important safety issues is addressed. Taking into account all the facts, it is questionable if preserving containment integrity is guaranteed by the proposed safety design and features neither in the long-term nor in the short term.

At the time, it cannot be proven beyond doubt that severe accidents with high releases can be excluded. (UMWELTBUNDESAMT 2020)

4.2 Questions, answers and assessment of the answers

Question Q8.2-1

Which of the Assessment Findings of the ONR´s GDA step 4 Assessment of Severe Accidents for the UK EPR^{TM} have already been solved? How were they solved and if not, when is a solution expected for those?

Written answer by the UK side

BEIS (2022):

5.3.1 SZC Co. has undertaken an impact assessment of all 716 Assessment Findings raised by Office for Nuclear Regulation (ONR) during the EPR Generic Design Assessment (GDA), including the 26 related to Severe Accidents. This assessment was to determine whether the way these were addressed for the Hinkley Point C UK EPR remains applicable for Sizewell C.

5.3.2 The conclusion from this assessment was that no new or additional work was required in relation to Severe Accident Assessment Findings, i.e. that the plan for resolution of the Assessment Findings could be replicated for the Sizewell C project. The solutions to these Assessment Findings are based around changes to the UK EPR design or requirements added to operational or manufacturing documentation. All of these changes are being adopted (replicated) for Sizewell C.

ONR (2022): Of the Assessment Findings we raised during the UK EPR™ Generic Design Assessment (GDA), 26 related to Severe Accidents. For the Hinkley Point C (HPC) project, 11 of these have so far been closed[5]. The evidence submitted by the licensee for closure of these Assessment Findings has generally been of a technically detailed nature; our specialist inspectors have reviewed that evidence and have been content for each to be closed.

The licensee's supporting work for the remaining 15 Assessment Findings is progressing to achieve resolution prior to the allocated project milestones (these are typically late in the project, for instance containment pressure test or start of cold operations) and ONR is content that the HPC licensee is appropriately managing the resolution activities.

For Sizewell C, NNB GenCo (SZC) Ltd has concluded that no new or additional work was required in relation to severe accident Assessment Findings. We are content that the plan and supporting work for the resolution of the Assessment Findings for HPC are applicable to SZC.

Assessment of the answer The question is partly answered. According to BEIS (2022), the solutions to the 26 Assessment Findings related to Severe Accidents are based on changes to the UK EPR™ design or requirements added to operational or manufacturing documentation. According to ONR (2022), 11 of these have so far been closed for the HPC project. The licensee's supporting work for the remaining 15 Assessment Findings is progressing to achieve resolution prior to the allocated project milestones (e. g. containment pressure test). For Sizewell C, NNB has concluded that no new or additional work was required in relation to severe accident Assessment Findings. Neither BEIS (2022) nor ONR (2022) list which Assessment Findings have not yet been solved.

[5] See (partially blackened). The GDAFs closed are: AF-UKEPR-CSA-010; AF-UKEPR-CSA-011; AF-UKEPR-CSA-012; AF-UKEPR-CSA-013; AF-UKEPR-CSA-017; AF-UKEPR-CSA-018; AF-UKEPR-CSA-019; AF-UKEPRCSA-020; AF-UKEPR-CSA-022; AF-UKEPR-CSA-023; AF-UKEPR-CSA-024.

Question Q8.2-1 *Does the UK EPR^{TM} correspond to the EPR in Finland and/or France? If not, where does the design deviate?*

Written answer by the UK side **BEIS (2022):**

5.3.3 The reference design plant for the UK EPR^{TM}, including the design that was subjected to the GDA by the UK nuclear regulators, is the Flamanville 3 plant in France.

5.3.4 As a result of the GDA outcomes, there were a number of modifications made to the UK EPR^{TM} design, relative to the original Flamanville 3 design, taking on board site specific considerations and to bring it into line with UK Regulatory Expectations.

5.3.5 Additionally, improvements made to the Flamanville 3 design throughout its design, construction and commissioning phases have continued to be provided by EDF SA and screened for applicability for the UK EPR^{TM} design.

5.3.6 These have initially been implemented in the Hinkley Point C design and will be replicated for Sizewell C. The design of the UK EPR^{TM} for Hinkley Point C and Sizewell C is described in the Hinkley Point C Pre-Construction Safety Report (PCSR3), which is available on EDF's website.[6]

Assessment of the answer The first question has been answered but not the second question. The response stated that the reference design for the UK EPR^{TM} is Flamanville 3. However, the deviations from the reference design have not been explained.

4.3 Conclusions and final recommendations

The EPR was conceived as a reactor with an improved capability to withstand various types of threats and events while reducing the consequences of severe accidents. Nonetheless, its design basis needs to be re-examined in the light of the Fukushima accident. Regarding Station Black Out (SBO), additional measures are necessary, but the actual design problems remain. The relatively high thermal power of the EPR, for example, reduces the time for the operator to react efficiently during accident sequences to avoid a severe accident.

It is stated that the reference design for the UK EPR^{TM} is Flamanville 3 (FL3). However, the deviations from the reference design are not explained. The length of the construction period and the numerous difficulties which occurred at Olkiluoto 3 (OL3) and FL3 demonstrate the complexity of the EPR design. It is to be expected similar problems will also arise in the construction of Sizewell C.

[6] Gas & Electricity Suppliers for Home & Business | EDF (partially blackened)

In June 2021, the loss of tightness of the fuel rods at the Taishan No. 1 reactor in China was detected, which was due to mechanical wear in the lower part of the rod. In addition, during the inspections of the assemblies and inside the vessel, a local phenomenon resulting from impact of the hydraulic load was detected. According to EDF, the ongoing investigation could impact other EPR projects. (EDF 2022)

If the ex-vessel cooling of the molten core functions as planned, this new feature will have the potential to reduce the probability of large releases in case of a severe accident. However, the ONR´s assessment emphasised uncertainties regarding the functionality of the Core Melt Stabilisation System; in several Assessment Findings the need for further examination of nearly all important safety issues is addressed. According to ONR (2022), only 11 out of the 26 Assessment Findings have so far been closed for the UK EPR^{TM}.

Taking into account all the facts, it is questionable if the proposed safety design and features guarantee preserving containment integrity, both in the long-term or in the short term. At this time, it cannot be proven beyond doubt that severe accidents with high releases can be excluded.

Final recommendation

FR 2: It is recommended that the solution of the problem that occurred at the operating EPR at Taishan NPP be closely followed to avoid the occurrence of the same or similar problem at the EPRs in Sizewell C.

5 ACCIDENT ANALYSIS

5.1 Short summary of the expert statement

With regard to possible accidents, reference is made to the Generic Design Assessment (GDA). The Environmental Statement stated that a detailed assessment of safety, security and environmental risks associated with the UK EPR^{TM} design has been undertaken as part of the GDA process. However, this assessment was concluded eight years ago. Since this evaluation, the state of science and technology has underwent further development. This is reflected in new international and European regulations and guidelines.

In the specific PSA of the UK EPR^{TM}, many factors are not included, because they are out of scope or not addressed appropriately (for example, Common Cause Failure (CCF)).

Generally, PSA results should only be taken as rough indicators of risk. All PSA results are beset with considerable uncertainties, and there are factors contributing to NPP hazards which cannot be included in the PSA.

Therefore, for rare events, the probability of occurrence as calculated by a PSA should not be taken as an absolute value, but as an indicative number only. Hence, it is problematic in practice to reliably demonstrate the fulfilment of a probabilistic goal by PSA.

The claimed "practical elimination" of a large early release is not sufficiently demonstrated by the UK EPR^{TM} PSA yet. To practically exclude the occurrence of severe accidents requires a deep knowledge of the specific situation. It is important to note that a recently published WENRA report provides a common understanding of the approach to demonstrate the avoidance of early releases and large releases by using the notion of practical elimination. (WENRA 2019)

Site-specific factors (in particular possible danger of flooding, climate change effects) could endanger Sizewell C. Flooding can be catastrophic consequences for a nuclear power plant. The EIA documents explain that a detailed assessment of site-specific nuclear safety and security risks would be undertaken as part of the nuclear site licensing regime. The authorities accepted that with this regulatory process in place regarding the safety of the UK EPR^{TM} reactors and the EIA does not need to present a detailed assessment of nuclear safety risks.

All in all, a conservative worst-case release scenario should have been included in the EIA. A source term, for example for an early containment failure or containment bypass scenario, should have been analysed as part of the EIA – in particular because the results of the analysis of trans-boundary effects of a potential severe accident at the Sizewell NPP site indicate that significant trans-boundary effects cannot be excluded. (UMWELTBUNDESAMT 2020)

5.2 Questions, answers and assessment of the answers

Question Q8.3-1

When will be evaluated whether the UK EPR™ meets the safety goal of practical elimination of accident sequences leading to large or early releases of radioactive substances according to the approach of WENRA 2019? What could be the consequences for the Sizewell C Project if SZC Co. fails to meet this important safety objective for European NPPs?

Written answer by the UK side

BEIS (2022):

5.4.1 The UK EPR™ design being built at Hinkley Point C has been assessed against the NNB GenCo Nuclear Safety Design Assessment Principles ("the principles"), developed by NNB GenCo to meet UK and worldwide regulatory requirements. These incorporate advice from ONR, International Atomic Energy Industry (IAEA) standards, Western European Nuclear Regulators Association (WENRA) and other sources where relevant. The current version of the principles references WENRA guidance from 2010.

5.4.2 The Sizewell C design will also be assessed against the principles although, since the design of the nuclear island is identical in both designs, no difference is expected from the assessment. Of note, the principles state:

"Adequate safety measures should be implemented to mitigate severe accidents, including:

Demonstrating that severe accidents which lead to large early releases due to containment failure are practically eliminated;

Demonstrating that the consequences of a degraded core can be mitigated to reach a Severe Accident Safe State indefinitely."

5.4.3 Also:

"The significant phenomena involved in a severe accident shall be identified and analysed. Highly energetic phenomena which have the potential to breach the containment early in the sequence, leading to large early releases, shall be practically eliminated."

5.4.4 The assessment of the UK EPR™ design for Hinkley Point C design against these principles has shown the design to be compliant and all probabilistic targets met, with risks reduced as low as reasonably practicable (ALARP).

5.4.5 The safety case has been assessed by ONR, using their own Safety Assessment Principles, and also judged acceptable against their deterministic and probabilistic criteria for design basis and severe accidents, with risks that are reduced ALARP. Replication will ensure this conclusion is also applicable for Sizewell C.

5.4.6 Both SZC Co. and ONR routinely review new guidance from organisations such as WENRA. The next update to the NNB GenCo Nuclear Safety Design Assessment Principles will take cognisance of any new information in the WENRA 2019 guidance. However, it is considered that the NNB GenCo Nuclear Safety

Design Assessment Principles and ONR Safety Assessment Principles are already very robust standards. The Sizewell C design already meets, and generally exceeds, the expectations in these standards and as such it is unlikely the review against the latest WENRA 2019 guidance will result in an impact to Sizewell C.

ONR (2022): The EPR design considered deterministically the practical elimination of large or early releases caused by high-pressure melt ejection, steam explosion and hydrogen combustion, and as such meets or exceeds the WENRA recommendations.

Our assessments of the safety case for the HPC EPR™ are carried out in accordance with our current Safety Assessment Principles (SAP) and Technical Assessment Guides (TAG). Both our SAPs and TAGs are revised regularly and take account of expectations from WENRA, including the treatment of accidents involving large or early releases of radioactive substances.

The design has continued to evolve, and the safety case is being developed to take account of this. Our assessments thus far, have concluded that the design is acceptable against our deterministic and probabilistic criteria for design basis and severe accidents, with risks reduced as low as reasonably practicable (ALARP). The design of the nuclear island for the SZC plant is identical to that at HPC, so conclusions concerning the very low likelihood of severe accidents, are expected to be the same.

Assessment of the answer The question was answered. Clearly, an evaluation whether the new UK EPR™ design meets the WENRA guidance (2019) will not be conducted.

The UK EPR™ design has been assessed against the NNB GenCo Principles for Nuclear Safety Assessment ("the Principles"), which were developed by NNB GenCo to meet UK and global regulatory requirements. The current version of the Principles refers to the 2010 WENRA guidelines. It is anticipated by NNB GenCo that the review against the latest 2019 WENRA guidance will not have an impact on Sizewell C.

Question Q8.3-2 *Is it planned to review whether the UK EPR™ design meets the recent European safety standards/requirements by WENRA?*

Written answer by the UK side **BEIS (2022):**

5.4.7 See response to 8.3 Q1 above.

ONR (2022): We undertake assessments of the developing EPR designs for HPC and SZC against our current SAPs in conjunction with relevant TAGs. We actively participate in related international activities and routinely review new guidance from international organisations such as WENRA. Whenever we update the SAPs and TAGs, we take into consideration any relevant new information and expectations from WENRA and from other organisations.

Assessment of the answer The question has been answered. It is stated that the UK EPR™ has to meet the current Safety Assessment Principles (SAPs) and Technical Assessment Guides (TAGs). Both documents have not incorporated the WENRA (2019). The next update of the SAPS and TAGs will take the WENRA (2019) into consideration.

Question Q8.3-3 *According to WENRA (2019), all WENRA countries apply the notion of practical elimination to types I and II; some countries also apply it to type III. For which types of scenarios should the concept of practical elimination be applied in the UK?*

Written answer by the UK side **BEIS (2022):**

5.4.8 The NNB GenCo Nuclear Safety Design Assessment Principles specifically outline scenarios equivalent to Types I and II. However, it should be noted that the UK EPR™ design has extensive additional provisions to protect against Severe Accident scenarios, including additional enhancements linked to studies post-Fukushima, such as the ability to use portable pumps and alternative water supplies to provide containment heat removal.

5.4.9 As a result, the UK EPR™ design has been demonstrated to not require the installation of a filtered containment vent system in order to maintain containment integrity in a severe accident, although the design retains the option to back-fit this at a later date. Therefore, while Type III practical elimination is not specifically required by the NNB GenCo Principles, the UK EPR™ design already exceeds what is required by the principles.

ONR (2022): As noted in the NNB GenCo (SZC) Ltd response to this question, their design safety assessment covers scenarios equivalent to Types I and II. In addition, the UK EPR™ design has extensive additional provisions to protect the containment in severe accident scenarios.

Assessment of the answer

The question has been answered. The answer clarified that the NNB GenCo Nuclear Safety Design Assessment Principles for the UK EPR™ specifically outline scenarios equivalent to Types I and II (i. e. scenarios with an initiating event that leads directly to severe fuel damage and early failure of the confinement function and severe accident scenarios with phenomena that induce early failure of the confinement function). (BEIS 2022) Severe accident scenarios that result in late failure of the confinement function (Type III) are not considered for the UK EPR™.

Severe accident scenarios of Type III for the notion of practical elimination are not specifically required by the NNB GenCo Principles. According to BEIS (2022) the UK EPR™ design has extensive additional provisions to protect against Severe Accident scenarios, including additional enhancements linked to studies post-Fukushima, such as the ability to use portable pumps and alternative water supplies to provide containment heat removal. Thus, in the opinion of NNB, the UK EPR™ design has been demonstrated to not require the installation of a filtered containment vent system in order to maintain containment integrity in a severe accident, although the design retains the option to back-fit this at a later date.

Contrary to NNB's opinion, from safety point of view design provisions pose a superior measure compared to portable equipment which the staff would have to activate to prevent late containment failure. This view is also highlighted in the WENRA report (2019) that provides a common understanding of the approach to demonstrate the avoidance of early releases and large releases by using the notion of practical elimination.

According to WENRA (2019), demonstrating practical elimination via “extreme unlikeliness with a high degree of confidence” has to be based on the two pillars of deterministic and probabilistic considerations. For the deterministic part of the demonstration, practical elimination should be primarily based on design provisions, supported by operations provisions. Attention has to be paid to the human factor. The need for human actions should be limited to the extent practicable. The validity of underlying assumptions should be adequately controlled. Uncertainties have to be taken into account; sensitivity studies should cover the whole spectrum of possible conditions. Also, these provisions should withstand events caused by external hazards in a way that demonstration of practical elimination remains valid. For the probabilistic part of the demonstration, practical elimination of a scenario can be considered successful when the target value was achieved.

It is recommended to re-evaluate the analysis of severe accidents using the WENRA (2019) guidance to ensure that the concept of practical elimination of severe accidents is used according to the current state of the art.

Question Q8.3-4 *Which of the Assessment Findings of the ONR´s GDA step 4 assessment of Probabilistic Safety Analysis for the UK EPR™ are solved already? How were they solved and, if no solution has been found yet, when should they be solved?*

Written answer by the UK side

BEIS (2022):

5.4.10 See general comments in relation to severe accidents (8.3 Q1 above).

5.4.11 More specifically, this considers 46 Assessment Findings linked to Probabilistic Safety Analysis (PSA). These findings mainly relate to the need for a plant specific PSA model and for modelling to meet UK regulatory expectations in relation to data and modelling assumptions. Resolution of these Assessment Findings has been agreed with ONR for Hinkley Point C and they are all replicable for Sizewell C. Indeed, a common PSA model has been developed that will be adopted for Sizewell C.

5.4.12 The only areas with regard to PSA that will require work are in relation to some site-specific data elements e.g. the PSA Level 3 model takes account of wind direction, population locations, specific to the site. It is worth noting that, while this will alter the outputs slightly relative to Hinkley Point C, the change will not be significant and will not result in design change. This work is expected as part of the Sizewell C Pre-Construction Safety Report, so in advance of any nuclear safety related construction.

ONR (2022): We agree with NNB GenCo (SZC) Ltd's response to this question. We would add that of the 46 Assessment Findings in this topic area, 26 have been closed for HPC. The evidence submitted by the licensee for closure of these Assessment Findings has generally been of a technically detailed nature; our specialist inspectors have reviewed that evidence and have been content for each to be closed.

Resolution of the outstanding 18 is not expected until much later in the HPC project, typically by the first loading of nuclear fuel. We are satisfied with the rate of closure of the outstanding Assessment Findings related to this topic.

Assessment of the answer The question was answered. 26 out of the outstanding 46 Assessment Findings have been resolved until today. However, without having solved the 18 remaining Assessment Findings, the probabilistic safety analysis (PSA) cannot be considered completed. The current PSA has several important shortcomings: For example, the limited scope of the internal and external hazards evaluated in the PSA and most important the limitation of the PSA 2. Lacking is the UK-EPR specific containment structural analysis which addresses all potential modes of containment failure, including penetration and leakage failures. Until these issues are not solved the practical elimination of severe accidents is not proven.

Question Q8.3-5 *Which recent national and international studies concerning external hazards (flooding risk, seismic hazard, tsunami and climate change) have to be taken into consideration to determine design basis requirements? Which margins against external hazards have to be implemented for the Sizewell C?*

Written answer by the UK side

BEIS (2022):

5.4.13 The Sizewell C site has been subject to full characterisation of all hazards. These characterisation studies have taken full consideration of UK and worldwide best practice and latest available data, have been assessed by ONR and meet all their expectations:

- For the seismic hazard, this has involved a full Probabilistic Seismic Hazard Assessment (PSHA) to modern standards (SSHAC 2+), involving an extensive geotechnical assessment of the site.
- In relation to climate change, latest UK government guidance on climate change (UKCP18 – linked to latest IPCC guidance) has been taken into account for the full life of the station (using maximum credible projections and sensitivities around maximum possible projections).

5.4.14 All natural hazard design bases (including flooding, tsunami and seismic, amongst many others) are conservatively defined in relation to a 1 in 10,000 year return frequency defined at the 84th percentile, in accordance with UK and worldwide best-practice. Beyond design basis studies are performed for levels well beyond these levels and demonstrate the UK EPR design to be robust against beyond design basis hazards.

ONR (2022): Our assessment of the SZC hazard characterisation studies is currently ongoing. Our assessment takes into account UK and international relevant good practice, including our SAPs and External Hazards TAG (NS-TAST-GD-013). SAP EHA.4 outlines our expectation that design basis events should be derived conservatively to take account of data and model uncertainties and that the design basis events are 1 in 10 000 years for natural external hazards and 1 in 100 000 years for man-made external hazards.

We are a sampling organisation and as part of our assessment of NNB GenCo (SZC) Ltd's site licence application we will not assess all the hazard characterisation studies. For some of those assessed, we have identified the need for further work by the licensee post-licensing (if a licence is granted) to enable the hazard characterisation studies to fully meet our expectations. However, we are not currently aware of any external hazards that would preclude the use of the SZC site or impact our decision on granting a nuclear site licence.

Assessment of the answer The first question was answered but only some general information was given to the second question, explaining that studies on the beyond design basis showed that the UK EPR^{TM} design is robust against beyond design basis hazards. However, it is not explained what safety margins are required by ONR.

According to ONR (2022), ONR's assessment of SZC hazard studies is currently ongoing. For some of the hazard characterisation studies assessed, ONR has already stated that if a licence is granted, licensees will need to conduct further analyses after the licence will have been granted; all design bases for natural hazards (including floods, tsunami and earthquakes) are conservatively defined in terms of a 1 in 10,000-year return period.

According to SCARR (2022), the Coastal Process Monitoring and Mitigation Plan (CPMMP) and Soft Coastal Defence feature (SCDF) in their proposed form are not necessarily capable of protecting Sizewell C from submergence of the marshlands. There are two main reasons for shoreline retreat in the bay: climate change effects and the offshore geomorphology.

The IPCC (International Panel for Climate Change) stated: "Sea-level rise under emission scenarios that do not limit warming to 1.5°C will increase the risk of coastal erosion and submergence of coastal land."

The Applicant's 'Expert Geomorphological Assessment' (EGA) presented in the DCO does not address the IPCC's statement of risk. SCARR (2022) asked how this approach fits with the Applicant's response[7] to the above-mentioned question. The low-lying marshlands surrounding the proposed Sizewell C could certainly be affected by a climate change scenario that fails to limit global warming to 1.5 degrees.

Furthermore, there is no plausible mechanism that could justify the assumption for the maintenance and preservation of the unconsolidated Dunwich bank over the next two 100-year episodes of coastal processes, the uncertainties of which can only be increased by climate change sea-level rise and storm level change. This loss could result in significant shoreline erosion around Sizewell C. (SCARR 2022)

According to SCARR (2022), the Sizewell Dunwich banks will always be of critical importance to Sizewell C and conservative modelling cannot, under any circumstances, rely on their overall retention and maintenance to end of station life. A conservative approach should address the loss of major sections of the marshlands whether from depletion of the Sizewell-Dunwich banks or climate change sea level rise of anything above 1.5°C.

[7] In relation to climate change, latest UK government guidance on climate change (UKCP18 – linked to latest IPCC guidance) has been taken into account for the full life of the station (**using maximum credible projections and sensitivities around maximum possible projections**)

5.3 Conclusions and final recommendations

With regard to possible accidents, reference is made to the Generic Design Assessment (GDA). The Environmental Statement (ES) stated that a detailed assessment of safety, security and environmental risks associated with the UK EPR^{TM} design has been undertaken as part of the GDA process. However, this assessment was completed almost ten years ago. Since this evaluation, the state of science and technology has seen further development, which has been incorporated in new international and European regulations and guidelines.

In the specific PSA of the UK EPR^{TM}, many factors have been left out, because they have been considered out of scope or not addressed appropriately (for example, Common Cause Failure (CCF), internal and external hazards, failure of the containment). Generally, PSA results should only be taken as rough indicators of risk. All PSA results are beset with considerable uncertainties, and there are factors contributing to NPP hazards which cannot be included in the PSA.

Therefore, the probability of occurrence as calculated by a PSA should not be taken as an absolute value, but as an indicative number only. Hence, it is problematic in practice to reliably demonstrate the fulfilment of a probabilistic goal by PSA.

The claimed "practical elimination" of a large early release is not sufficiently demonstrated by the UK EPR^{TM} PSA yet. To practically exclude the occurrence of severe accidents requires a deep knowledge of the specific situation. It is important to note that a 2019 published WENRA report provides a common understanding of the approach to demonstrate the avoidance of early releases and large releases by using the notion of practical elimination. (WENRA 2019) But this guidance was not applied when preparing the safety case of the UK EPR^{TM}. Furthermore, it becomes clear that the concept of practical elimination for late containment failure was not applied. Thus, the installation of a containment filtered venting system, which is included in the design of the Finish EPR (OL3) is not planned yet. (STUK 2019)

It is recommended to re-evaluate severe accidents analysis using the WENRA (2019) guidance to ensure that the concept of practical elimination of severe accidents is used according to the current state of the art.

Site-specific factors (in particular possible danger of flooding, climate change effects) could endanger Sizewell C. Flooding can have catastrophic consequences for a nuclear power plant. The EIA documents explained that a detailed assessment of site-specific nuclear safety risks would be undertaken as part of the nuclear site licensing regime. The authorities accepted that with this regulatory process in place the EIA does not need to present a detailed assessment of nuclear safety risks.

According to SCARR (2022) the low-lying marshlands that surround the proposed Sizewell C could certainly be affected by a climate change scenario that fails to limit global warming to 1.5 degrees. Furthermore, there is no plausible mechanism that could justify the assumption for the maintenance and preservation of the unconsolidated Dunwich bank over the next two 100-year episodes of coastal processes. This loss could result in significant shoreline erosion around Sizewell C. Thus, a conservative approach should address the loss of major sections of the marshlands whether from depletion of the Sizewell-Dunwich banks or climate change sea level rise of anything above 1.5°C.

As concluded in chapter 4 already, it is questionable if preserving containment integrity is guaranteed by the proposed safety design and features neither in the long-term nor in the short term. At this time, it cannot be proven beyond doubt that severe accidents with high releases can be excluded.

A conservative worst-case release scenario should have been included in the EIA. A source term, for example for an early containment failure or containment bypass scenario, should have been analysed as part of the EIA – in particular because of the results of the analysis of trans-boundary effects of a potential severe accident at the Sizewell NPP site indicate that significant transboundary effects cannot be excluded.

Final recommendations

FR3: It is recommended to re-assess external hazards at the Sizewell C site before the design process for the NPP starts. The re-assessment should be based on the latest state-of-the-art methods and take into account most current data. Especially the climate change should be appropriate considered in the scenarios for flooding including the scenario of failing the limit of global warming to 1.5 degrees.

FR4: It is recommended to use a conservative approach that should address the loss of major sections of the marshlands whether from depletion of the Sizewell-Dunwich banks or climate change sea level rise of anything above 1.5°C.

FR5: To achieve the safety goal of new nuclear power plants consisting in the requirement that accidents leading to early or large releases have to be practically eliminated, it is necessary to also consider hazard events with frequencies below $<10^{-4}$ if their impacts reach beyond the design basis. For ensuring compliance with the safety goals, a comprehensive Probabilistic Safety Analysis (Extended PSA) is necessary, taking into consideration all relevant internal and external events and possible accident causes.

FR6: It is recommended to require the implementation of appropriate margins to external hazards in the design of the Sizewell NPP that are based on current scientific studies and data.

FR7: It is recommended to apply the concept of practical elimination consistently in the safety requirements for Sizewell C. Practical elimination of accident sequences has to be demonstrated with state-of-the-art probabilistic and deterministic methods, fully taking into account the corresponding publications of WENRA in 2019.

FR8: It is recommended to consider severe accident scenarios with possible late containment failure in the notion of practical elimination and therefore plan a filtered containment venting systems at Sizewell C like at the Finnish EPR OL3.

FR9: It is recommended to provide information about the upcoming demonstration proving that the level of risk of Sizewell C is as low as reasonably practicable (ALARP).

FR10: It is recommended to include a conservative worst-case release scenario which should have been part of the EIA. A severe accident with a source term for e.g. containment failure or bypass scenario should be analysed as part of the EIA – in particular because of its relevance for impacts at greater distances.

6 ACCIDENTS WITH INVOLVEMENT OF THIRD PARTIES

6.1 Short summary of the expert statement

Terrorist attacks and acts of sabotage can have significant impacts on nuclear facilities and cause severe accidents – also on the planned Sizewell C reactors. Although precautions against sabotage and terror attacks cannot be discussed in detail in public in the EIA process for reasons of confidentiality, the necessary legal requirements should be set out in the EIA documents. Information regarding the issue of terror attacks would be of great interest to the Austrian side, considering the large consequences of potential attacks. (UMWELTBUNDESAMT 2020)

6.2 Questions, answers and assessment of the answers

Question Q8. 4-1

What are the requirements with respect to the planned NPP design against the deliberate crash of a commercial aircraft?

Written answer by the UK side

BEIS (2022):

5.5.1 The UK EPR^{TM} design is demonstrated as robust against deliberate crash of commercial aircraft. This is achieved mainly through a reinforced (concrete) containment structure for safety critical parts of the plant. This is combined with physical separation of critical elements that cannot be protected in this manner.

5.5.2 Furthermore, the UK EPR^{TM} is designed to be resilient to loss of safety systems through the provision of redundant and diverse safety systems (such as those contained in multiple safeguards buildings). Further detail is security sensitive.

ONR (2022):

We expect deliberate crash of a commercial aircraft to be included in the design basis for a new nuclear power station. We assessed the deliberate crash of a commercial aircraft for the UK EPR^{TM} as part of GDA and are satisfied that it is adequately taken into account in the design at HPC. The design of the nuclear island at SZC replicates that at HPC, including the protection against aircraft crash.

Assessment of the answer

The question has been answered. According to BEIS (2022), the UK EPR^{TM} design is demonstrated as robust against deliberate crash of commercial aircraft. This is achieved mainly through a reinforced containment structure for safety critical parts of the plant. This is combined with physical separation of critical elements that cannot be protected in this manner. ONR (2022) confirmed this assessment.

Question Q8. 4-2 *Does the UK EPR™ fulfil those requirements based on the present state of knowledge (not only relying on the data of the supplier but on the assessment of ONR)?*

Written answer by the UK side

BEIS (2022):

5.5.3 Yes. The safety case related to the deliberate crash of aircraft was accepted by ONR for Hinkley Point C. There is no change to the Sizewell C design or in worldwide best practice that would suggest ONR's position would be different for Sizewell C and no concerns have been raised as part of the Nuclear Site Licensing process.

Assessment of the answer The question has been answered. As mentioned before, the safety case in relation to deliberate aircraft crash has been accepted by ONR.

6.3 Conclusions and final recommendations

Terrorist attacks and acts of sabotage can have significant impacts on nuclear facilities and cause severe accidents – also on the planned Sizewell C reactors. Although precautions against sabotage and terror attacks cannot be discussed in detail in public in the EIA process for reasons of confidentiality, the necessary legal requirements should be set out in the EIA documents. Information regarding the issue of terror attacks would be of great interest to the Austrian side, considering the large consequences of potential attacks.

Both BEIS (2022) and ONR (2022) stated that the UK EPR™ design can withstand a crash of commercial aircraft. However, it is not explained what type of aircraft is being considered.

Military action against nuclear installations represents another danger that deserves special attention in the current global situation. Thus at least the crash of a military jet should be considered.

Final recommendation

FR11: Concerning the protection of the Sizewell C against aircraft crash it is recommended that the NPP should be designed in a way that vital safety functions can be fulfilled despite of the thermal and mechanical impacts corresponding to the assumed crash of passenger aircrafts of the largest class (Airbus A-380) and fast military jets.

7 TRANS-BOUNDARY IMPACTS

7.1 Short summary of the expert statement

The results of the analysis of trans-boundary effects of a potential severe accident at the Sizewell NPP site indicate that significant trans-boundary effects cannot be excluded.

The results also indicate the need for intervention measures in Austria. Such measures include agricultural countermeasures, but also iodine prophylaxis for risk groups.

Moreover, the results emphasise the importance of a serious evaluation and discussion of the severe accident scenarios for Sizewell C in the framework of the trans-boundary EIA.

The information the EIA procedure provided so far does not allow a meaningful assessment of the effects that conceivable accidents at Sizewell C could have on Austrian territory. The analysis of a severe accident scenario would close this gap and allow for a discussion of the possible impacts on Austria. This should be taken into consideration before granting further permissions.

7.2 Questions, answers and assessment of the answers

No questions were included in this chapter, but a comment was made in BEIS (2022).

Comment 5.6.1 No questions were included in this section, but it may be helpful to note that a transboundary dose assessment from unplanned/accidental releases was included as part of Chapter 6 of the Sizewell C Article 37 Submission. This included consideration of a severe accident scenario (DEC-B), based on a core melt accident. A copy of this chapter was provided to the Examination as **Appendix B** to the **Relevant Representations Report** [REP1-013]. An updated copy of this chapter is provided with this response, as **Appendix 6**, following an update during the Article 37 Process. (BEIS 2022)

Assessment As already discussed in chapter 5 of this expert statement, the assumed source term of 1.2 TBq Cs-137 (NBB ZZC 2022b, p.226) might not be the most severe accidental release resulting in trans-boundary impacts.

7.3 Conclusions and final recommendations

The results of the analysis of trans-boundary effects of a potential severe accident at the Sizewell NPP site indicate that significant trans-boundary effects cannot be excluded.

The results also indicate the need for intervention measures in Austria. Such measures include agricultural countermeasures, but also iodine prophylaxis for risk groups.

Moreover, the results emphasise the importance of a serious evaluation and discussion of the severe accident scenarios for Sizewell C in the framework of the trans-boundary EIA.

The information the EIA procedure provided so far does not allow a meaningful assessment of the effects that conceivable accidents at Sizewell C could have on Austrian territory. The analysis of a severe accident scenario would close this gap and allow for a discussion of the possible impacts on Austria. This should be taken into consideration before granting further permissions.

Final recommendation

FR12: Because the source term used in the accident analysis of the Environmental Statement does not reflect a severe accident, it is recommended to calculate the consequences of a severe accident with a large release since the effects of severe accidents can be wide-spread and long-lasting and even countries in Central Europe, such as Austria, can be affected.

8 FINAL RECOMMENDATIONS

8.1 Spent fuel and radioactive waste

Final recommendation

FR1: To demonstrate the safe management of nuclear waste and spent fuel from Sizewell C detailed information on the interim storage and final disposal should be provided; also alternative nuclear waste management solutions in case these facilities will not be operable in time.

8.2 Reactor type

Final recommendations

FR 2: It is recommended that the resolution of the problem that occurred at the operating EPR at Taishan NPP be closely followed to avoid the occurrence of the same or similar problem at the EPRs in Sizewell C.

8.3 Accident analysis

Final recommendations

FR3: It is recommended to re-assess external hazards at the Sizewell C site before the design process for the NPP starts. The re-assessment should be based on the latest state-of-the-art methods and take into account most current data. Especially the climate change should be appropriate considered in the scenarios for flooding including the scenario of failing the limit of global warming to 1.5 degrees.

FR4: It is recommended to use a conservative approach that should address the loss of major sections of the marshlands whether from depletion of the Sizewell-Dunwich banks or climate change sea level rise of anything above 1.5°C.

FR5: To achieve the safety goal of new nuclear power plants consisting in the requirement that accidents leading to early or large releases have to be practically eliminated, it is necessary to also consider hazard events with frequencies below <<10-4 if their impacts reach beyond the design basis. For ensuring compliance with the safety goals, a comprehensive Probabilistic Safety Analysis (Extended PSA) is necessary, taking into consideration all relevant internal and external events and possible accident causes.

FR6: It is recommended to require the implementation of appropriate margins to external hazards in the design of the Sizewell NPP that are based on current scientific studies and data.

FR7: It is recommended to apply the concept of practical elimination consistently in the safety requirements for Sizewell C. Practical elimination of accident sequences has to be demonstrated with state-of-the-art probabilistic and deterministic methods, fully taking into account the corresponding publications of WENRA in 2019.

FR8: It is recommended to consider severe accident scenarios with possible late containment failure in the notion of practical elimination and therefore plan a filtered containment venting systems at Sizewell C; the Finnish EPR OL3 included it.

FR9: It is recommended to provide information in a transparent manner about the upcoming demonstration proving that the level of risk of Sizewell C is as low as reasonably practicable (ALARP).

FR10: It is recommended to include a conservative worst-case release scenario which should have been part of the EIA. A severe accident with a source term for e.g. containment failure or bypass scenario should be analysed as part of the EIA – in particular because of its relevance for impacts at greater distances.

8.4 Accidents with involvements of third parties

Final recommendations

FR11: Concerning the protection of the Sizewell C against aircraft crash it is recommended that the NPP should be designed in a way that vital safety functions can be fulfilled despite of the thermal and mechanical impacts corresponding to the assumed crash of passenger aircrafts of the largest class (Airbus A-380) and fast military jets.

8.5 Trans-boundary impacts

Final recommendation

FR12: Because the source term used in the accident analysis of the Environmental Statement does not reflect a severe accident, it is recommended to calculate the consequences of a severe accident with a large release since the effects of severe accidents can be wide-spread and long-lasting and even countries in Central Europe, such as Austria, can be affected.

9 GLOSSARY

ALARP .... As far as reasonably practicable

ASN .... French Nuclear Safety Authority

Bq .... Becquerel

CCF .... Common cause failure

CDF .... Core Damage Frequency

CGCS .... Combustible gas control system

CHRS .... Containment heat removal system

CMSS .... Core Melt Stabilisation System

Cs-137 .... Caesium-137

DAC .... Design Acceptance Confirmation

DBF .... Design basis flood

DCH .... Direct Containment Heating

DEC .... Design Extension Conditions

ECMWF .... European Centre for Medium Range Weather Fore-casting

EDG .... Emergency Diesel Generators

EIA .... Environmental Impact Assessment

ENSREG .... European Nuclear Safety Regulators Group

EPR .... European Pressurised Reactors

ES .... Environmental Statement

EU .... European Union

FL3 .... Flamanville Unit 3

FMEA .... Failure Modes and Effects Analysis

FRA .... Flood Risk Assessment

GDA .... Generic Design Assessment

GDF .... Geological disposal facility

GRS .... Gesellschaft für Anlagen- und Reaktorsicherheit, Deutschland

GW .... Giga Watt hour

HFT .... Hot functional testing

HLW.................................... High level waste

HPME .... High Pressure Melt Ejection

HRA.................................... Human Reliability Analysis

HVAC .... Heating, Ventilation and Air Conditioning

I&C..................................... Instrumentation & Control

I-131 .... Iodine-131

IAEA .... International Atomic Energy Agency

IDAC .... Interim Design Acceptance Confirmation

IE.. Initiating Event

ILW..................................... Intermediate level waste

ISFS .... Interim storage for spent fuel

IWRST .... In-containment refuelling water storage tank

JSW .... Japan Steel Works

LLW.................................... Low level waste

LOCA .... Loss of Coolant Accident

LOOP.................................. Loss of offsite power

MA&D................................ Major Accidents and Disasters

MWh................................... Mega Watt hour

MW .... MegaWatt

NDA .... Nuclear Decommissioning Authority

NFLA.................................. Nuclear Free Local Authorities

NOAA .... National Oceanic and Atmospheric Administration

NPP.................................... Nuclear Power Plant

OL3 .... Olkiluoto Unit 3

ONR................................... Office for Nuclear Regulation

PAR .... Passive autocatalytic recombiners

PBq .... Peta Becquerel, E15 Bq

PCSR.................................. Pre-Construction Safety Report

PDS .... Primary Depressurisation System

PRA ....Probabilistic risk assessment

PSA ....Probabilistic Safety Assessment

RCS ....Reactor Cooling System

RPV ....Reactor Pressure Vessel

RRC ....Risk Reduction Category

SBO....................................Station Black Out

SGTR..................................Steam generator tube ruptures

SMA ....Seismic Margin Assessment

SoDA..................................Statement of Design Acceptability

Sr-90 ....Strontium-90

SZC Co. ....NNB Generation Company Ltd

SZC ....Sizewell C

TBq ....Tera-Becquerel, E12 Bq

TWh ....Tera Watt hour

UDG...................................Ultimate Diesel Generators

UNECE...............................United Nations Economic Commission for Europe

VLLW ....Very low level waste

WENRA..............................Western European Nuclear Regulators´ Association

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