ENVIRONMENT AGENCY AUSTRIA

ENVIRONMENT IMPACT ASSESSMENT FOR THE CONSTRUCTION OF POWER UNITS 5 AND 6 WITH AP1000 REACTOR UNITS AT THE KHMELNYTSKYI NPP SITE

Project element: Full EIA - Consultation Report

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Agriculture and Forestry, Climate
and Environmental Protection,
Regions and Water Management
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1 SUMMARY

Ukraine's "Energy strategy up to 2050" mandates continued reliance on nuclear power. It also requires that the units that would be decommissioned post-2025 would need to be replaced with new units. The AP1000, for which in 2022 an agreement was signed between Westinghouse Electric Corporation (WEC) and Energoatom, are envisaged as the initial western designed units to replace existing ones.

Ukraine's Law "On Environmental Impact Assessment" from 2017 specifically requires that the Environmental Impact Assessment needs to be undertaken for various categories of facilities to be constructed, NPPs among them. As the construction of KhNPP units 5 and 6 may have a significant impact on the environment, the EIAR has been developed.

Ukraine has notified Austria about the Environment Impact Assessment (EIA) procedure under the Espoo Convention for the project "CONSTRUCTION OF POWER UNITS 5 AND 6 WITH AP1000 REACTOR UNITS AT THE KHMELNITSKYI NPP SITE". Austria, having interest in mitigating possible impact to Austrian territory from radioactive releases from Ukraine's NPPs, is participating in the transboundary EIA process with Ukraine.

The Federal Ministry of Agriculture and Forestry, Climate and Environmental Protection, Regions and Water Management commissioned the Federal Environment Agency to prepare an expert opinion on the submitted documents. For the expert statement, the EIA report (EIAR) has been evaluated in detail, including other publicly available documents that offer insight into the subject matter. As the result, a series of 25 distinct questions were raised, covering different areas from procedural aspects of the EIA and treatment of alternatives, over siting and design to severe accidents and transboundary impact, radioactive waste and spent fuel management plans.

Within the framework of the transboundary EIA of the proposed project, Ukraine provided the responses to all of the 25 questions raised by the experts on 1st April 2026, adding some important clarification including the layout map of all NPP units at Khmelnitskyi site as well as the JRODOS dispersion analyses with different weather conditions.

The experts reviewed the answers and additional information provided. The conclusion of the review process is that while the entire set of question has been answered, in some cases the answers were deemed incomplete. Ukrainian answers highlighted that some detailed questions might be possible to answer only during the "design phase" of the

project. Those include issues like site-required modification, development of SAR as well as listing of suppliers and contractors. The expert team agrees and highlighted that some of the issues that could be discussed in the framework of the bilateral nuclear information agreement between Austria and Ukraine, when the design phase is advanced or nearing its completion.

Some relevant experts' questions were not answered in sufficient details. Those include questions related to external events and severe accidents. The EIA document does not contain sufficient information on most of the relevant external hazards. The lack of information in the EIAR raises doubts as to the extent to which site-specific hazard analyses were carried out, and whether this would be appropriate for the planning of a new nuclear power plant. The EIAR fails to demonstrate that the available site assessment considered all natural and man-made hazards and all hazard combinations relevant to the site. Unfortunately, the answers to the experts' questions could not resolve the named deficiencies of the EIAR.

External hazards have the potential to initiate severe accidents with large releases into the atmosphere which could affect Austrian territory, although the distance from Austria to KhNPP is significant. A sound consideration of all possible external events that could lead to accidents with significant releases is therefore important element of the cross-border EIA procedure. From an Austrian perspective, it is not satisfactory to discuss external hazards and their potential impact on nuclear safety only in the design stage of the new NPP and not as part of the EIA. It is therefore suggested that additional clarification is to be provided.

The effect of the climate change is another issue identified in the EIA, where answers did not provide sufficient (additional) clarification. Many countries preparing to construct NPPs are considering the impact of the climate change for a period of up to 100 years. While the climate change might have a stronger influence on costal than inland sites as Khmelnitskyi, the changes in weather patterns, humidity, availability of cooling water etc. might have a significant impact on both the operation and the safety of the plant. It is recommended that this theme receives more attention in future meetings under the “bilateral nuclear information agreement”.

As per the design of the AP1000, it has been approved by the regulators in USA and China (where 2 and 4 AP1000 units operate, respectively) and have been subject to a thorough “Generic Design Assessment” (GDA) process in the United Kingdom, which, among others, established

112 “Assessment Findings”. As the answers do not provide this information, Austria remains interested in being informed whether the "GDA findings” were taken into account in the licensing process in Ukraine.

Overall, it is recommended that the Austrian side is granted access to the key findings of the PSAR upon its completion, in order to assess whether and to what extent the assumptions set forth in the EIAR are met.

In order to assess the potential impacts on Austria, the EIA process requires a transparent presentation of the accident analyses; it should also specify the core damage frequencies (CDF) and severe accidents with large releases (LRF), as well as the potential source terms.

The EIA report relies on a limited source term when determining the impacts of a severe accident. This source term appears to be short of the maximum possible accident of the DEC-B category. Unless the evidence is provided that large and early releases of radioactive materials can be practically eliminated in the event of a severe accident, accidents involving higher releases cannot be ruled out. The answers explain that, starting in 2024, Ukrainian regulations require a practical elimination of severe accidents involving large and early releases. However, it is not explained whether the requirement for practical elimination in accordance with WENRA (2019) has also been implemented in the regulations. It is unclear, however, whether the probabilistic target value is understood merely as a cut-off criterion for severe accidents.

Ukraine is a member of WENRA since 2015, and assumes the obligation to transfer all of the WENRA recommendation in its own regulatory framework. The new regulation (NP 306.2.245-2024) is said to be encompassing all of WENRA requirements but it remains unclear whether WENRA’s “Safety objectives for new reactors" were included.

The expert team raised questions of radiological releases reaching and affecting Austrian territory, in terms of whether the deposition could reach the intervention level for public protection due to accumulation of Cs-137 on the ground. In its answer, Ukraine correctly indicate that the worse impact might be related with a specific weather pattern that deviates from the historical/recorded weather conditions, characterized by light to moderate but steady wind from north east direction. The expert team agrees that a steady wind with constant direction would cause the highest deposition of radionuclides. However, this consideration does not take into the account the effects of the precipitation, leading to a wash-out from the clouds, which was the cause of the highest contamination in Austria from the Chernobyl accident. The experts recommend that the discussion continues in meetings under the "bilateral nuclear information agreement" as to how to most-realistically model possible effects of a large (DEC B) release at Khmelnitskyi and its consequences (deposition) onto Austrian territory.

Questions were also raised in relation with the management of radioactive waste and spent nuclear fuel from Khmelnitskyi units 5 and 6. The answers provided clarified that the concept and facilities for RAW and SNF management exist at the country level in Ukraine. The specific solutions and programmes of RAW and SNF management for units 5 and 6 at Khmelnitskyi were not yet decided. Those will be selected and detailed at the design stage. The experts suggest that the issues and solution for RAW and SNF management at Khmelnitskyi units 5 and 6 are taken on board in meetings under the "bilateral nuclear information agreement" at the time when the design of the units is in an advanced stage.

2 ZUSAMMENFASSUNG

Die ukrainische „Energiestrategie bis 2050" sieht die weitere Nutzung der Kernenergie vor und legt fest, dass nach 2025 stillgelegte Blöcke durch Neubauten ersetzt werden sollen. Als erste Anlagen westlicher Bauart sind dabei Westinghouse-AP1000-Reaktoren vorgesehen, für die im Jahr 2022 eine Vereinbarung zwischen der Westinghouse Electric Corporation (WEC) und Energoatom unterzeichnet wurde.

Das ukrainische Gesetz „Über die Umweltverträglichkeitsprüfung" aus dem Jahr 2017 schreibt vor, dass für bestimmte Kategorien geplanter Anlagen – darunter auch Kernkraftwerke – eine Umweltverträglichkeitsprüfung durchzuführen ist. Da der Bau der Blöcke 5 und 6 des Kernkraftwerks Khmelnitskyi potenziell erhebliche Umweltauswirkungen haben kann, wurde ein entsprechender Umweltverträglichkeitsbericht erstellt.

Die Ukraine hat Österreich gemäß dem Espoo-Übereinkommen über das Umweltverträglichkeitsprüfungsverfahren (UVP) für das Projekt „Bau der Blöcke 5 und 6 mit AP1000-Reaktoren am Standort des Kernkraftwerks Khmelnitskyi" informiert. Österreich nimmt am grenzüberschreitenden UVP-Verfahren teil, da mögliche Auswirkungen radioaktiver Freisetzungen auf das österreichische Staatsgebiet nicht ausgeschlossen werden können.

Das Bundesministerium für Land- und Forstwirtschaft, Klima- und Umweltschutz, Regionen und Wasserwirtschaft beauftragte das Umweltbundesamt mit der Erstellung eines Gutachtens zu den vorgelegten Unterlagen. Im Rahmen dessen wurde der UVP-Bericht umfassend geprüft und durch weitere öffentlich zugängliche Informationen ergänzt, die zur Klärung des Sachverhalts beitragen. Auf dieser Grundlage wurden insgesamt 25 spezifische Fragen formuliert, die ein breites Spektrum abdecken – von verfahrenstechnischen Aspekten der UVP und der Berücksichtigung von Alternativen über Standortwahl und Auslegung bis hin zu schweren Unfällen, grenzüberschreitenden Auswirkungen sowie Strategien zur Entsorgung radioaktiver Abfälle und abgebrannter Brennelemente.

Im Rahmen der grenzüberschreitenden Umweltverträglichkeitsprüfung des geplanten Vorhabens hat die Ukraine am 1. April 2026 Antworten auf sämtliche 25 Fragen der Expertinnen und Experten übermittelt und diese durch zusätzliche Erläuterungen ergänzt, darunter eine Übersichtskarte aller Kernkraftwerksblöcke am Standort Khmelnitskyi sowie JRODOS-Ausbreitungsanalysen für unterschiedliche meteorologische Bedingungen.

Die Expertinnen und Experten haben die Antworten sowie die ergänzend bereitgestellten Informationen geprüft. Dabei wurde festgestellt, dass zwar alle Fragen beantwortet wurden, die Ausführungen jedoch in einigen Fällen als unvollständig zu bewerten sind. In den ukrainischen Stellungnahmen wird darauf hingewiesen, dass bestimmte Detailfragen voraussichtlich erst im Zuge der Designphase des Projekts geklärt werden können. Dazu zählen unter anderem standortspezifische Anpassungen, die Erstellung des Safety Analysis Report (SAR) sowie die Benennung von Lieferanten und Auftragnehmern. Das Expertenteam teilt diese Einschätzung und schlägt vor, dass einige dieser Aspekte im Rahmen des bilateralen Nuklearinformationsabkommens zwischen Österreich und der Ukraine weiter behandelt werden könnten, sobald die Designphase entsprechend fortgeschritten ist oder sich ihrem Abschluss nähert.

Einige der wesentlichen Fragestellungen wurden nicht mit ausreichender Detailtiefe beantwortet, insbesondere jene zu externen Ereignissen und schweren Unfällen. Der UVP-Bericht enthält keine hinreichenden Informationen zu einem Großteil der relevanten externen Gefährdungen. Dieser Informationsmangel wirft Zweifel auf, ob standortspezifische Gefahrenanalysen in ausreichendem Umfang durchgeführt wurden und ob die vorliegenden Bewertungen als Grundlage für die Planung eines neuen Kernkraftwerks angemessen sind. Der UVP-Bericht legt nicht dar, dass im Rahmen der Standortbewertung sämtliche natürlichen und anthropogenen Gefahren sowie alle für den Standort relevanten Gefahrenkombinationen berücksichtigt wurden. Auch die von ukrainischer Seite übermittelten Antworten konnten diese Defizite des UVP-Berichts nicht ausräumen.

Externe Gefahren können schwere Unfälle mit erheblichen Freisetzungen in die Atmosphäre verursachen, die, trotz der beträchtlichen Entfernung, auch das österreichische Staatsgebiet erreichen könnten. Eine umfassende Berücksichtigung sämtlicher potenzieller externer Ereignisse, die zu solchen Freisetzungen führen können, ist daher ein wesentlicher Bestandteil des grenzüberschreitenden UVP-Verfahrens. Aus österreichischer Sicht ist es nicht ausreichend, externe Gefahren und deren mögliche Auswirkungen auf die nukleare Sicherheit erst in der Designphase eines neuen Kernkraftwerks zu behandeln, anstatt sie bereits im Rahmen der Umweltverträglichkeitsprüfung zu analysieren. Vor diesem Hintergrund wird angeregt, ergänzende Klarstellungen vorzunehmen.

Die Auswirkungen des Klimawandels wurden bereits in der Umweltverträglichkeitsprüfung angesprochen, doch die vorliegenden Antworten enthalten dazu keine hinreichenden (ergänzenden) Erläuterungen. Viele Staaten berücksichtigen klimawandelbedingte Veränderungen bei der Planung von Kernkraftwerken über Zeiträume von bis zu 100 Jahren. Auch wenn Küstenstandorte stärker betroffen sein können als Binnenstandorte wie Khmelnitskyi, könnten veränderte Wetterbedingungen, höhere Luftfeuchtigkeit, eine eingeschränkte Verfügbarkeit von Kühlwasser und ähnliche Faktoren erhebliche Folgen für Betrieb und Sicherheit der Anlage haben. Es wird daher empfohlen, diesem Thema im Rahmen des bilateralen Nuklearinformationsabkommens mehr Aufmerksamkeit zu widmen.

Das Design des AP1000 wurde von den Aufsichtsbehörden in den USA und China – wo derzeit zwei bzw. vier Blöcke in Betrieb sind – genehmigt und im Vereinigten Königreich einem umfassenden „Generic Design Assessment" (GDA) unterzogen, in dessen Verlauf unter anderem 112 „Assessment Findings" festgelegt wurden. Da diese Aspekte in der vorliegenden Antwort nicht behandelt werden, besteht seitens Österreich weiterhin Interesse an der Klärung, ob und inwieweit die Ergebnisse des GDA im Genehmigungsverfahren in der Ukraine berücksichtigt wurden.

Es wird empfohlen, der österreichischen Seite nach Abschluss des vorläufigen Sicherheitsberichts (PSAR) Zugang zu dessen wesentlichen Ergebnissen zu gewähren, um überprüfen zu können, ob und in welchem Ausmaß die im Umweltverträglichkeitsbericht dargestellten Annahmen zutreffen.

Zur Bewertung möglicher Auswirkungen auf Österreich ist im Rahmen des UVP-Verfahrens eine transparente Darstellung der Unfallanalysen erforderlich. Dabei sind insbesondere die Kernschadenshäufigkeit (CDF), die Häufigkeit schwerer Unfälle mit großen Freisetzungen (LRF) sowie potenzielle Freisetzungsszenarien darzulegen.

Der Umweltverträglichkeitsbericht basiert bei der Bewertung der Auswirkungen schwerer Unfälle auf einem begrenzten Quellterm, der offenbar unterhalb des für Unfälle der Kategorie DEC-B anzusetzenden maximalen Szenarios liegt. Solange kein Nachweis erbracht wird, dass große und frühe Freisetzungen radioaktiver Stoffe bei schweren Unfällen praktisch ausgeschlossen sind, können Ereignisse mit höheren Freisetzungen nicht ausgeschlossen werden. In den vorliegenden Antworten wird darauf verwiesen, dass die ukrainischen Vorschriften ab 2024 den praktischen Ausschluss schwerer Unfälle mit großen und frühen Freisetzungen vorsehen. Es bleibt jedoch offen, ob die entsprechende Anforderung gemäß WENRA (2019) vollständig in das nationale Regelwerk übernommen wurde. Somit ist unklar, ob der probabilistische Zielwert lediglich als Grenzwert für schwere Unfälle interpretiert wird.

Die Ukraine ist seit 2015 Mitglied der WENRA und verpflichtet sich, alle Empfehlungen der WENRA in ihr eigenes Regulierungssystem zu übernehmen. Die neue Verordnung (NP 306.2.245-2024) soll alle Anforderungen der WENRA abdecken, doch bleibt unklar, ob die „Sicherheitsziele für neue Reaktoren" der WENRA darin enthalten sind.

Das Expertenteam stellte die Frage, ob radioaktive Freisetzungen österreichisches Staatsgebiet erreichen und betreffen können, insbesondere im Hinblick darauf, ob durch die Anreicherung von Cs-137 im Boden der Interventionswert zum Schutz der Bevölkerung erreicht werden könnte. In ihrer Antwort weist die Ukraine zutreffend darauf hin, dass die gravierendsten Auswirkungen unter bestimmten meteorologischen Bedingungen auftreten könnten, die von den historisch beobachteten Wetterlagen abweichen und durch einen leichten bis mäßigen, jedoch konstanten Wind aus nordöstlicher Richtung geprägt sind. Das Expertenteam stimmt zu, dass ein gleichmäßiger Wind mit konstanter Richtung zu einer erhöhten Ablagerung von Radionukliden führen kann. Diese Betrachtung lässt jedoch den Einfluss von Niederschlag unberücksichtigt, der durch Auswaschungsprozesse aus der Atmosphäre maßgeblich zur Kontamination beiträgt und auch die Hauptursache für die hohe Belastung in Österreich infolge des Unfalls von Tschernobyl war. Die Expertinnen und Experten empfehlen daher, die Diskussion im Rahmen des bilateralen Nuklearinformationsabkommens fortzuführen, um zu klären, wie die potenziellen Auswirkungen einer großen Freisetzung (DEC B) am Standort Khmelnitskyi und die daraus resultierende Ablagerung auf österreichischem Staatsgebiet möglichst realitätsnah modelliert werden können.

Im Zusammenhang mit der Entsorgung radioaktiver Abfälle und abgebrannter Brennelemente aus den Blöcken 5 und 6 des Kernkraftwerks Khmelnitskyi wurden ebenfalls Fragen aufgeworfen. Aus den vorliegenden Antworten geht hervor, dass in der Ukraine auf nationaler Ebene sowohl ein konzeptioneller Rahmen als auch entsprechende Anlagen für die Entsorgung radioaktiver Abfälle und abgebrannter Brennelemente bestehen. Konkrete Lösungen und Programme für die Entsorgung aus den Blöcken 5 und 6 liegen jedoch noch nicht vor und sollen erst im Zuge der Designphase festgelegt und weiter ausgearbeitet werden. Die Expertinnen und Experten empfehlen daher, die Fragestellungen sowie mögliche Lösungsansätze zur Entsorgung radioaktiver Abfälle und abgebrannter Brennelemente dieser Blöcke zu gegebener Zeit im Rahmen des bilateralen Nuklearinformationsabkommens zu thematisieren, sobald die Planung einen fortgeschrittenen Stand erreicht hat.

3 EVALUATION OF ANSWERS TO AUSTRIAN QUESTIONS

3.1 Procedural Aspects of the EIA

Question 1 **While it is understood that the EIA has been initiated in antici-pation of the KhNPP units 5 and 6 being constructed, lack of clar-ify on the schedule of implementation is a deficiency. It is obvi-ous that the longer it takes to construct those units, the larger the difference between the findings of this EIA and the real situ-ation might be. This might require an upgrade of the EIAR when the final decision is taken for beginning the construction?**

Answer In Ukraine, the environmental impact assessment (EIA) procedure is regulated by the Law of Ukraine "On Environmental Impact Assessment" No. 2059-VIII dated May 23, 2017. The law establishes the mandatory EIA for large-scale projects that may have a significant impact on the environment, in particular, the construction of new nuclear power plant units.

JSC "NNEGC "Energoatom" plans to begin preparatory work on the project in 2026, with the main stage of unit construction to begin after obtaining a construction and commissioning license in mid-2027, and power start-up is scheduled for the end of 2033.

The Law of Ukraine "On Environmental Impact Assessment" (Article 9) also stipulates that the conclusion on the EIA expires after five years if no decision has been made to carry out the planned activity (in this case it will be Law of Ukraine on the siting, design and construction of power units). If, prior to the decision on the implementation of the planned activity will not be approved, or changes will made to the design documentation or to the legislation that require changes to the environmental conditions specified in the EIA conclusion, the EIA shall be performed again.

Evaluation The question has been answered.

Conclusion No further action is needed.

Question 2 **The uncertainty regarding units 3 and 4 is another issue that does not contribute to the precision of the EIA for KhNPP units 5 and 6. As the possible construction of units 3 and 4 will impact both the construction and operation of units 5 and 6, some clarity in this respect in the EIAR would add to the usefulness of the study in determining the overall environmental impact, including transboundary impact.**

Answer As per the laws of Ukraine, the EIAR conservatively includes the cumulative impact of all units at a single site (existing VVER units and planned units 3, 4, 5, and 6). All information on the cumulative impact of the KhNPP units is provided in Section 5, paragraph 5.5, "The cumulative impact...". Information on transboundary impact is provided in Section 5, paragraph 5.3, subparagraph 5.3.8, "Transboundary transfer" of the EIA report.

Evaluation The question has not been satisfactorily answered. While the Ukrainian laws require assessing cumulative impact of all units at a site, the EIAR does not appear to demonstrate how units 3 and 4 will impact the construction and operation of unit 5 and 6 and vice versa. Also, it does not demonstrate that units 3 and 4 are included in the assessment of the overall environmental impact, including transboundary impact.

Conclusion Further clarification with regard of the impact of the construction of units 3 and 4 on the construction and operation of units 5 and 6 should be provided.

3.2 Alternatives

Question 3 **Despite the fact that the Ukrainian energy strategy calls for the continued use of nuclear power and for replacement of units that reach the limits of their lifetime after 2025, the experts believe that a discussion of possible alternatives, considering energy conversation, penetration of renewables but also hydro potential would be a useful addition to the EIAR.**

Answer Nuclear power plants have significant advantages over renewable energy sources, as they provide stable electricity generation regardless of weather conditions, base load in the power system – unlike solar and wind power plants. They are capable of generating large amounts of energy without greenhouse gas emissions, which helps reduce the impact on the climate. As a result, nuclear energy plays a key role in ensuring the country's energy security. Ukraine's energy strategy until 2050 provides for a specific role and generation volume for each type of generation. Therefore, we consider it inappropriate to consider RES or other types of generation as an alternative to nuclear generation.

The Law of Ukraine on EIA requires to include a description of justified alternatives (of geographical or technological nature) to the planned activity in the EIA report. Considering that specifies the use of the AP1000 reactor unit in the new power unit project, the EIA report considers the territorial alternatives.

Evaluation The question is answered. Ukraine confirms that the nuclear energy plays a key role in their energy system. The RES or other sources are to be considered as alternatives to nuclear energy.

Conclusion Nevertheless, Ukraine does not consider RES or hydro potential as alternative to the nuclear energy. In particular, Austria believes that it would be useful that the EIAR shows that alternative sources have been considered and their potential as an alternative to new nuclear has been evaluated.

Question 4 **More detailed graphics on the layout, where one could see the position of all 6 units as well as new infrastructure that would be needed for units 5 and 6 would be useful.**

Answer The layout plan of the main buildings and structures of units Nos. 5 and 6, including units Nos. 1, 2, 3, and 4 is provided in Appendix A.

Evaluation The question has been answered.

Conclusion No need for further action.

Question 5 **The experts would suggest double checking the area available vs. area needed for 1 AP1000 in construction and in operation.**

Answer The standard certified AP1000 design was used as the basis under the input data provided by Westinghouse Electric Corporation. The site plan for the new power units, namely the location of the main buildings and structures, fully complies with the available land plot and provides all the conditions for their construction and subsequent service.

Evaluation The issue has been adequately resolved. The layout shows that the units 5 and 6 will have its own space north-west of the existing units, with space left for the planned units 3 and 4 on the site.

Conclusion No need for further action

3.3 Siting Issues including External Hazards

Question 6 **Which types of hazards and hazard combinations that apply to the Khmelnytskyi site have been considered in the EIA process so far?**

Answer An analysis of scenarios caused by various types of hazards and their combinations is carried out in the preliminary safety analysis report. However, the EIA report, paragraph 1.4.1 "Characteristics of the NPP site area" also provides information on the compliance of the KhNPP units 5, 6 sites with NP 306.2. 144-2008 requirements "Safety requirements for the selection of a nuclear power plant site ". When assessing the location of the KhNPP units 5, 6 sites, it was considered that the site territory:

- is not subject to catastrophic floods and inundations;
- has no deformation development of river beds and reservoir banks;
- has no active tectonic faults, potentially dangerous landslides, or mudflows;
- has the maximum credible earthquake (MCE) magnitude of no more than 8 points on the Medvedev-Sponheuer-Karnik scale (for the KhNPP design basis earthquake (once in 1.000 years (for new power units) – 5 points, for MCE (once in 10,000 years) – 6 points; according to DBN V.1.1-12:2014 "Construction in seismic areas of Ukraine", the background seismic intensity is 6 points for the city of Netishyn; site seismicity (PGA) 0.1g),

which minimizes the negative impact of the listed hazards and their combinations in relation to the KhNPP site.

A complete hazard analysis and their combinations will be performed during the designing stage "Design" and the preliminary SAR.

Evaluation The answer contains no information beyond what is in the EIA report. It remains unclear if external hazards, comprising of natural and man-made hazards, that apply to the site have been systematically screened and identified as required by WENRA (2021) and WENRA (2020a-d).

It is recommended to perform a comprehensive site characterization with respect to external hazards that apply to the site in line with WENRA requirements. According to WENRA (2021), hazard analyses shall include: (1) hazard screening including the identification of hazard combinations, (2) hazard assessment, (3) definition design basis parameters for hazards that apply to the site, (4) analyses of design extension conditions. A generic list of natural hazards, e.g. the “Non-exhaustive List of Natural Hazard Types” of WENRA (2020a), should be used as a starting point for hazard screening to demonstrate that all relevant hazards are addressed.

With respect to earthquakes, the answer to question AU6 makes reference to the Ukrainian standard DBN V.1.1-12:2014[1] which includes seismic hazard maps for the entire Ukrainian territory and some general guidelines for the application of Eurocode 8 for seismic engineering. Notably, the Eurocode 8 standards apply to the design and construction of common buildings and civil engineering works other than NPPs. DBN V.1.1-12:2014 uses earthquake *intensity* (Medvedev-Sponheuer-Karnik scale) as a measure for hazard severities. This is outdated and not state of the art. A site-specific hazard assessment for the Khmelnytskyi site is not described and it remains open if an adequate probabilistic seismic hazard assessment has been performed for determining the design basis parameters for the new NPP.

Conclusion Additional clarification on the external hazards that apply to the site should be provided.

External hazards have the potential to cause severe accidents with large releases into the atmosphere. In the case of a severe accident at the new KhNPP, Austrian territory could be affected, although the distance of the planned new KhNPP to Austria is large. A sound consideration of all possible initiating events that can lead to accidents with significant releases is therefore important within the framework of the cross-border EIA procedure. From an Austrian perspective, it is therefore not satisfactory to discuss external hazards and their potential impact on nuclear safety only in the SAR and not also in the EIA.

Question 7 **Have updated hazard assessments been performed for the hazards considered in the EIA process, or do the design basis parameters currently in use (e.g., for earthquake) rely on hazard assessments performed for the existing KhNPP units?**

Answer The assessment of the site conditions for AP1000 units was performed based on the reassessment of data for the KhNPP existing units.

[1] Fesenko, O. (2018) “State Norms of Ukraine DBN V.1.1-12:2014 ‘Construction in Seismic Regions of Ukraine’ and Recommendations of European Standard Eurocode 8.”

The assessment of seismic conditions of the site for AP1000 units was carried out in accordance with building codes following a seismic re-examination of the KhNPP site in 2025, namely:

- following a set of works on seismic hazard research, the assessment of seismic hazard at present, including a seismic microzonation for the KHNPP site, is as follows: design basis earthquake – 5 points (once in 100 years (for operating units), maximum credible earthquake (MCE) – 6 points (once in 10.000 years). At the same time, according to the reassessment of seismic hazard, based on the updated data from the seismic monitoring system for the KhNPP site, the peak ground horizontal component acceleration during an earthquake corresponding to MCE is set at 0.1g.

The calculations of building and structure designs and equipment, including seismic conditions, will be performed at the designing stage "Design".

Evaluation The question was partly answered and provides some information on seismic ground motion hazards. With respect to other hazard types, the answer contains no information beyond what is in the EIA report. It remains unclear if hazard assessments have been made for natural hazards other than earthquakes and man-made hazards have been analysed in a way that conforms with WENRA (2021) requirements.

Conclusion It is suggested to provide additional clarification on the hazard assessments and their results for the KhNPP site, in particular to earthquakes (seismic ground motion). Efforts with respect to external hazard analyses need to conform with WENRA requirements and to extend to events with occurrence probabilities well below 10^{-4} per year in order to be able to demonstrate that Core Damage Frequencies (CDF) and large release frequencies (LRF) for the new NPPs are within the Ukrainian regulatory limits (CDF: $1x10^{-6}$ per reactor year; LRF: $1x10^{-7}$ per year; see below). The probabilistic target values CDF and LRF require to demonstrate that, for different hazard types, events with occurrence probabilities in a range below 10^{-7} per year do not lead to early or large releases. This is because the total release frequency is the sum of all hazard contributions (e.g., internal events, fire, earthquake, river flooding, storm etc.).

Question 8 **Do Ukrainian regulations for new-built NPPs require the practical elimination of accidents with core melt which would lead to early or large releases? If so: What are the probabilistic target values to demonstrate practical elimination by extreme unlikeliness?**

Answer In accordance with nuclear and radiation safety regulations in Ukraine, all Ukrainian NPPs implement a strategy of defense-in-depth based on the use of:

- a system of physical barriers to prevent the spread of ionizing radiation and radioactive substances into the environment;
- a system of technical and organizational measures to protect physical barriers and maintain their effectiveness in order to protect personnel, the population, and the environment.

In accordance with NP 306.2.245-2024 The "General Safety Provisions for Nuclear Power Plants" the safety criteria for the construction of new power units are established as follows: not exceeding the frequency of nuclear fuel severe damage in the core, calculated for the full range of initial events in all operating unit conditions, $1x10^{-6}$ per reactor year, and not exceeding the integral frequency of the maximum accidental release of radioactive substances into the environment of $1x10^{-7}$ per unit year.

The main means to achieve a goal of the defense-in-depth level 4 "Management and mitigation of the consequences of severe accidents (DEC category B)" are:

- the availability and use of additional technical means, safety systems, and other systems (components), including normal operation systems, that can perform the necessary functions in emergency conditions to manage severe accidents, mitigate their radiation consequences, and return the NPP to a controlled state;
- the availability and application of severe accident management guidelines to prevent the core melt release from reactor vessel or damaged fuel cooling outside the reactor vessel, to prevent the containment integrity failure, and to limit the radiation impact on personnel, the public, and the environment;
- training of personnel in severe accident management.

Evaluation The question has been answered. Ukrainian regulations set probabilistic limits for both core damage frequency and large release frequency. Both probabilistic values need to be calculated for the full range of initial events in all operating unit conditions.

Conclusion No need for further action.

3.4 Constructability of the Units 5 and 6

Question 9 **Sufficient information about climate related issues should be made available during the bilateral consultations.**

Answer The EIA Report Section 3, paragraph 3.4 "Climate", as well as Appendix D, "Reference on climatic characteristics" (the English translation is in Appendix B), provide characteristics of the climate in the area where the NPP is located, namely: air temperature, wind speed and frequency, precipitation, humidity and cloud cover data, and regional meteorological phenomena. The information provided on the climate is sufficient to assess the impact of the planned activity on the atmospheric air.

Evaluation The provided response does not adequately answer the question. While Section 3 of the EIAR provides information on the current climatic characteristics, the issue of long-term climate change is addressed only superficially. The EIAR fails to analyze how global warming might affect local temperatures, wind patterns, precipitation, or the frequency of extreme weather events in the future. Such analysis is critical for determining the site's resilience over the long term (30–60 years or more).

In addition, the report does not include any assessment of potential additional costs associated with adapting to climate risks—such as structural reinforcements, protective barriers, or upgrades to water drainage infrastructure.

In short, while the EIAR identifies some climate factors, it lacks detailed data, risk assessments, and cost estimates. To be compatible with EIAs for other nuclear facilities in Europe, the EIAR section should be expanded with concrete calculations, climate risk assessments, and cost evaluations of potential climate-related challenges.

Conclusion It is suggested that further clarifications are provided on the climate risk assessments and cost evaluations of potential climate-related challenges.

3.5 AP1000 Design and its Compliance with the EU Standards

Question 10 **Is a special version of the AP1000 reactor being built for Ukraine? What changes are being made compared to the reference plant at the Vogtle NPP?**

Answer It is expected that the AP1000 project in Ukraine will be implemented on the basis of a certified design, with the Vogtle NPP Unit 4 as the reference plant. The electrical part will be designed for a frequency of 50 Hz, and the lessons learned during the implementation of previous AP1000 projects and the specifics of adaptation to local conditions and site infrastructure will be included, as well as the specifics determined by Ukraine's long-term experience in the field of nu clear energy (in the field of radioactive waste and spent fuel management).

All fundamental differences from the Vogtle Unit 4 reference plant design will be reflected at the stage "Design".

Evaluation It is understandably explained that, based on the Vogtle 4 reference project, modifications will be made due to site-specific conditions and lessons learned from previous projects.

As part of the EIA process for the planned AP1000 plant in Poland, it was stated that the supplier Westinghouse/Bechtel proposed dozens of changes for the Polish nuclear power plant compared to the Vogtle 4 reference plant (UMWELTBUNDESAMT 2022). The modifications being made to units 5 and 6 of the Khmelnitskyi nuclear power plant in Ukraine are of particular interest, as the specific situation in Ukraine following Russia’s attack may require enhanced security measures against external attacks and sabotage.

Furthermore, as part of the Polish EIA process, it was stated that the conclusions and recommendations from the “UK Generic Design Assessment” process would be taken into account. (UMWELTBUNDESAMT 2022)

Conclusion The question was answered in general terms; however,

- Information at a later date regarding the safety-related modifications for units 5 and 6 of the KhNPP compared to the reference plant, unit 4 of the Vogtle nuclear power plant should be provided.
- The ONR’s findings regarding the GDA—including all 112 “Assessment Findings” documented by the ONR during the final phase of the GDA should be taken into account.

Question 11 **Can you please explain the function of the passive containment cooling system (PXS) of the AP1000? Is there any action by the personnel needed to activate any of the passive systems?**

Answer The question is kind of misleading. PXS is a passive core cooling system. A passive containment cooling system is PCS.

The AP1000 passive core cooling system (PXS) provides emergency core cooling after postulated design basis events. To perform the mentioned primary function, the passive core cooling system is designed to perform the following functions:

- emergency core decay heat removal
- emergency reactor coolant system makeup and boration
- safety injection to the reactor coolant system
- containment pH control.

The functional purpose of the passive containment cooling system (PCS) is to reduce the temperature and pressure in the containment after a loss-of-coolant accident (LOCA) or a main steam line break (MSLB) accident inside the containment by removing thermal energy from the containment atmosphere. The passive containment cooling system also serves to transfer heat to the ultimate heat sink and for other events that result in a significant increase in containment pressure and temperature.

The AP1000 passive safety systems do not require personnel action for their activation. This is one of the key features and advantages of this reactor design, which provides increased reliability and reduces dependence on human factors in critical emergency conditions.

Evaluation The question has been answered.

Conclusion No need for further action.

Question 12 **When the PSAR will be ready, if not yet available, how the concerned public will get access to the PSAR, to assess if and how the assumptions presented in the EIAR are met.**

Answer The preliminary SAR is developed during the NPP unit designing and justifies the nuclear and radiation safety of the decisions made in the design of the NPP unit and is one of the documents required to obtain a license to carry out the activity at the “construction and commissioning of a nuclear facility” life cycle stage. Before issuing such a license, the regulatory authority holds public hearings where the public can be informed of the main conclusions of the preliminary SAR.

In accordance with the Law of Ukraine "On Citizens' Appeals", Ukrainian citizens have the right to appeal (in oral or written form) to JSC "NNEGC "Energoatom". After receiving such an appeal, JSC "NNEGC "Energoatom" is obliged to provide information on the results of the appeal, considering possible restrictions on citizens' access to relevant information.

Evaluation The question has been answered; the response explained how citizens in Ukraine will gain access to the conclusion of the PSAR.

Conclusion It is recommended that, once the PSAR is finalized, the Austrian side is granted access to its key findings in order to assess whether and to what extent the assumptions set out in the EIAR are met.

Question 13 **What is the technical justification for the beyond design accident selected for the calculation of possible (transboundary) effects?**

Answer A loss-of-coolant accident (LOCA) followed by core meltdown is considered as a beyond design basis accident for the AP1000 unit. The assumed core meltdown is a significant conservatism associated with the analysis. Although the analysis of the core state in the AP1000 reactor during LOCA shows that its integrity is maintained, to assess the radiological consequences of the accident, it was assumed that significant core degradation and melting occur.

Evaluation The question has been answered. However, it has to be mentioned that until evidence has been provided that large and early releases of radioactive materials can be practically eliminated in the event of a severe accident, accidents involving higher releases cannot be ruled out.

Conclusion No need for further action.

Question 14 **Can the probability distributions (quantiles) for the frequencies for core damage (CDF) and severe accidents with large releases (LRF) be specified? What probabilities were determined for early large releases (LERF) in the generic PSA?**

Answer According to the current regulatory requirements for nuclear and radiation safety at the NPPs, the safety criteria for new NPP units are as follows:

- not exceeding the severe nuclear fuel damage frequency in the core, calculated for the full range of initial events in all operating conditions of the power unit, 1×10-6 per reactor year;
- not exceeding the integral frequency of the maximum accidental release of radioactive substances into the environment of 1×10-7 per unit year.

The total result of the probabilistic risk assessment for the AP1000 plant is as follows:

Nuclear fuel damage frequency in the core per reactor year		Large release frequency per reactor year	
Capacity	Shutdown	Capacity	Shutdown
2.97×10^{-7}	2.11×10^{-7}	2.41×10^{-8}	3.53×10^{-8}

Based on the cumulative results of the AP1000 plant probabilistic risk assessment, it can be concluded that the nuclear fuel damage frequency in the core and large release frequency from the AP1000 plant meet the safety criteria for the Ukrainian NPP units.

Evaluation The question has not been answered satisfactorily. The answer provides values of the CDF and the LRF that are different from the values given in the EIAR. (The EIAR provides the CDF= 3.94E-07 per reactor year and LRF=3.83E-08 per reactor year. Furthermore, the EIAR for the planned AP1000 in Poland gives the generic data for PSA, which are higher (CDF = 8.4E0-7 per reactor year and a LRF of 7.4E-8 per reactor year (UMWELTBUNDESAMT 2022)). More importantly, however, the question itself was not answered, as neither the probability distributions (quantiles) for the frequencies of core damage and severe accidents with large releases nor the early large releases frequency (LERF) specified in the generic PSA were provided.

Conclusion It is recommended that the following information regarding accident analysis be provided to enable a transparent assessment of whether Austria could potentially be affected by a severe accident:

- The probability distributions (quantiles) for the frequencies of core damage (CDF) and severe accidents with large releases (LRF).
- The calculated frequency of early large releases (LERF) in the generic PSA.

Question 15 **What are the source terms for the beyond design basis accidents calculated in PSA Level 2 for the other release categories, and what probabilities were calculated for them?**

Answer Probabilistic safety analysis was developed for the standard certified AP1000 design in accordance with ASME/ANSI standards approved by the NRC. The PSA models are recognized as meeting the NRC's PSA safety objectives and relevant regulatory guidance. The analysis found that the overall frequency of a maximum accident release for AP1000 is 3.83E-08 events per year.

For a detailed analysis of the probability of occurrence, accident development paths and final states at the KhNPP AP1000 plant, a probabilistic safety analysis will be performed at the designing stage "Design".

Evaluation The question has not been answered satisfactorily. Information about the related source terms (release of radioactive material) is not provided.

Conclusion It is recommended that the following information on accident analyses and the results of PSA 2are provided to enable a transparent assessment of whether Austria is potentially affected:

- Percentage of core melt accidents that result in a failure of the containment or a bypass of the containment.
- List of beyond-design-basis accidents (BDBAs) and the associated source terms.

Question 16 **According to Ukrainian regulations, is the application of the concept of practical elimination for large and early releases required in the event of a severe accident? Should proof of practical exclusion be provided in Ukraine in accordance with WENRA 2019? Does this also apply to accident scenarios involving late containment failure (accident type III)? Has a target value for probabilistic proof already been defined?**

Answer In 2024, a new reversion of the Ukrainian regulatory document "General Safety Provisions for Nuclear Power Plants" NP 306.2.245-2024 came into force, which includes the requirements of international standards by considering the Western European Nuclear Regulators' Association (WENRA) safety reference levels, the Euratom Directives, and the provisions of the International Atomic Energy Agency's international safety standards, as well as the lessons learned from the accident at the Fukushima Daiichi Nuclear Power Plant.

In accordance with NP 306.2.245-2024, at all stages of the NPP life cycle, the operating organization shall take measures to prevent accidents, mitigate their consequences and, in the event of accidents, practically eliminate early radioactive release and large radioactive release.

Evaluation The question has been answered partly. It is explained that according to the new regulation (NP 306.2.245-2024), the operating organization shall take measures to prevent large and early radioactive release in the event of an accident. However, the three additional sub-questions were not answered; in particular, it is not specified whether the demonstration of practical elimination must be provided in accordance with WENRA (2019), and whether the practical elimination must also be demonstrated for accident scenarios involving late containment failure (Accident Type III). The specified probabilistic target value for the safety demonstration is mentioned in the answer to question 14.

Conclusion Since the question was only partially answered, it is recommended that the outstanding issues be addressed a demonstration of practical elimination in accordance with WENRA (2019) should be carried out in the Ukraine. This should also apply to accident scenarios involving late containment failure (Accident Type III).

3.6 Ukraine Regulatory Requirements and Compliance with WENRA RLs

Question 17 **The EIAR shall address the impact of specific challenges related to the licensing of AP1000 in Ukraine.**

Answer Ukraine has no legislatively established requirements for including in the EIA report the impact of challenges related to the licensing of nuclear facilities.

To arrange preparatory activities for the construction of new power units and to establish cooperation between the operating company (OC) and the regulatory authority during the implementation of a nuclear facility project, the OC develops a Licensing Plan, which is submitted to the regulatory authority for review and approval.

Evaluation The question is answered.

Conclusion While it is understood that the Ukraine's legislative basis would not require that the challenges to the licensing are included in the EIAR, it is suggested that within meetings under the “bilateral nuclear information agreement” with Austria, those challenges are discussed and their resolution presented.

Question 18 **The EIAR shall address or at least comment on the gaps between Ukrainian safety philosophy and that applied in Generation III+ Western reactors.**

Answer The gap analysis of the safety solutions applied will be carried out at the "Design" stage of the AP1000 plant construction and justified in the Preliminary safety analysis report.

The compliance of safety solutions applied in Generation III+ reactors, namely AP1000, with the requirements of the current Ukrainian legislation was performed in the Feasibility study for the new construction of AP1000 units Nos. 5 and 6, which underwent the NRS expert review with a positive conclusion obtained from the State Nuclear Regulatory Inspectorate of Ukraine.

Evaluation The question is answered. Ukraine confirmed that the compliance of the safety solutions applied in AP1000 with requirements of Ukrainian legislation was assessed with positive outcome, but that the gap analysis of the safety solutions will be addressed only in the PSAR. Current Ukrainian regulations rely on deterministic safety analysis, which remains a foundational approach. However, this may not sufficiently accommodate the probabilistic safety methods integral to modern reactor designs such as the AP1000, possibly requiring different safety justifications and these gaps need to be addressed early in the process, before development of PSAR.

Conclusion It is recommended that, once the PSAR is finalized, the Austrian side is granted access to its key findings.

Question 19 **The EIAR shall address the deviation in Ukraine regulatory framework to that of WENRA SRL and Safety objectives for new reactors, as far as those might affect the licensing process of AP1000.**

Answer Ukraine has been a full member of the Western European Nuclear Regulators Association (WENRA) since 2015. Since Ukraine joined WENRA, the harmonization of the NRS national regulatory requirements with WENRA SRL has been one of the priority areas of activity for regulatory authority.

In 2024, a new reversion of the Ukrainian regulatory document "General Safety Provisions for Nuclear Power Plants" NP 306.2.245-2024 came into force, which includes the requirements of international standards by considering the Western European Nuclear Regulators' Association (WENRA) safety reference levels, the Euratom Directives, and the provisions of the International Atomic Energy Agency's international safety standards, as well as the lessons learned from the accident at the Fukushima Daiichi Nuclear Power Plant. The compliance analysis of the design solutions used in the AP1000 with

NP 306.2. 245-2024 requirements were performed in the feasibility study for the new construction of AP1000 units Nos. 5 and 6, which underwent the NRS expert review with a positive conclusion obtained from the regulatory authority.

Evaluation The question is answered. Nevertheless, from the answer it is not clear whether the NP 306.2.245-2024 encompass only the WENRA RL (and whether all of the RL were incorporated into that regulation) or also the WENRA Safety objectives for new reactors.

Conclusion A clarification as above would be appreciated to be provided during meetings under the “bilateral nuclear information agreement” with Austria.

3.7 Potential and Actual Impact of the Russian Aggression on the Construction and Operation of AP1000

Question 20 **The EIAR should update the part of the report that present possible supplies for services and equipment, to reflect their current status and availability to provide expected services or supplies.**

Answer The suppliers of services, equipment, structures, and materials necessary for the construction of units Nos. 5 and 6 using AP1000 technology have been preliminarily determined. The final decisions regarding the suppliers of services, equipment, structures, and materials will be made at the designing stage "Design". The list of suppliers is being finalized at the design development stage and after the completion of tender procedures.

According to the current laws of Ukraine, there is no requirement to include a comprehensive list of equipment and service suppliers in the EIA Report.

Evaluation The question is answered.

Conclusion Sharing information with Austria in respect of selected suppliers for equipment and services for the AP1000 (once those are selected in the design phase) would be appreciated.

Question 21 **The EIAR could discuss potential challenges to construction of new NPP in the view of on-going Russian aggression.**

Answer A threat analysis associated with military activities in Ukraine is performed for all NPP sites, considering the presence of various physical protection zones.

In accordance with the current regulatory requirements of Ukraine, the mentioned analysis is included in the design documentation, which is carried out at the "Design" stage and is justified by a preliminary safety analysis report. The relevant Section of the "Design" is developed by specialized design organizations that have the appropriate permits and is approved by state authorities in the field of physical protection.

To provide additional protection against terrorist acts by the aggressor country, options for protecting individual components, structures, and facilities will be considered at the designing stage of the "Design".

Evaluation The question is answered.

Conclusion No need for further action.

3.8 Transboundary Impact

Question 22 **Could you please explain the selection of the source term used in your transboundary calculation. Why do you select the source term that apparently does not correspond to a most severe possible release.**

Answer When calculating transboundary transfer, data obtained from Westinghouse Electric Company, as presented in Table 5.26 of the EIA Report, was used as source term. Conservatively, the total emission value for all time periods listed in Table 5.26 of the EIA Report was used to calculate transboundary transfer.

The input parameters characterizing the source of emissions into the atmosphere are as follows:

- radionuclide composition of emissions (input data from Westinghouse Electric Company), indicating the following characteristics for each radionuclide: emission activity; physical and chemical form (aerosol, gas, chemical form of radioactive iodine);
- effective emission height;
- geographical coordinates of the source location, etc.

Evaluation The question is answered. In the calculation for transboundary impact, source terms provided by the Westinghouse Electric Company were used. The total emission value was used for all time periods, claimed to reflect a conservative approach; however, these source term values are still lower than values for the maximum severe accidents (DEC B).

Conclusion Table 5.26 in the EIAR indicates that the values are for the emissions of radionuclides for the "maximum design basis accident". The experts believe that for the transboundary impact, the maximum severe accidents (DEC B) are to be used, as it has been used in numerous EIAR studies in the EU. It is recommended that the DEC B source term for AP1000 is used in the dispersion calculation for the transboundary effect analyses.

Question 23 **The weather used for the dispersion and the way it is defined is, in the view of the experts not appropriate for the dispersion analyses over longer distances (it might be appropriate for the emergency planning zone around KhNPP). It is suggested that the JRODOS dispersion calculation is repeated with the actual weather that would show the impact to the potentially affected countries, not just population doses than the deposits on the ground.**

Answer When calculating the probable transboundary impact of the AP1000 unit emissions, conservative weather forecast data was used, which, in our opinion, is more appropriate for considering the worst conditions for dispersion.

For example, in our calculations, the wind speed was assumed to be 1, 2, 3, 5, and 10 m/s throughout the emission, although the range of long-term actual meteorological observations of the average daily wind speed near the KhNPP site is 0.8–5 m/s with gusts of up to 20 m/s. Thus, if we repeat the calculation on the dispersion impact with actual weather conditions, the impact on neighboring countries will be even smaller because the maximum dispersion will occur in the area adjacent to KhNPP.

Therefore, we believe that the conservative approach in our calculations is acceptable and appropriate to take into account.

Evaluation The question is answered. The dispersion calculations used in the EIAR were based on meteorological assumptions including fixed wind directions towards each of the neighboring countries and a selected range of wind speeds. This leads to a more conservative impact than in a case of a recorded weather at the site. Additional dispersion results for ground contamination are provided.

However, the response does not provide information on the precipitation patterns and precipitation rates used in calculations. Precipitation rate and pattern, together with wind speed and direction, represent key parameters determining deposition patterns and resulting ground contamination. Observational data from past nuclear emergencies, such as Chernobyl and Fukushima, demonstrate that “hot spots”, i.e. areas with elevated contamination levels, can occur even at considerable distances, confirming that ground contamination does not simply decrease with increasing distance from the source, as claimed in the provided answer.

Conclusion It is suggested that the JRODOS dispersion calculation is repeated with the most critical actual weather that would enable comparison of the impact to the potentially affected countries.

3.9 Radioactive Waste Generated

Question 24 **Could you please provide the information on the plans and arrangements in Ukraine for the final disposal of radioactive waste from KhNPP units 5 and 6?**

Answer As per the Ukrainian regulatory requirements, the project for the construction of the KhNPP units Nos. 5 and 6 with the AP1000 reactor, provides for the implementation of an integrated process for the radioactive waste (RAW) management, which consists of three main stages:

1. RAW management at the place of its generation (sorting, fragmentation, characterization, etc.);
2. RAW processing (reduction in volume, physical and chemical properties, conditioning, preparation for storage or disposal);
3. RAW long-term storage and/or disposal.

The implementation of an integrated process for RAW management generated during the operation of the KhNPP units Nos. 5 and 6 will be decided at the designing stage "Design". The issue to transfer RAW outside the site for a long-term storage and/or disposal will be resolved in accordance with the approaches defined in the Strategy for Radioactive Waste Management in Ukraine and the National Target Environmental Program for Radioactive Waste Management.

It should also be noted that the current RAW classification system is focused on sorting RAW at the place of its generation according to activity level (low, medium, high) for the purpose of separation for temporary storage, which does not include further stages of processing, etc. Currently, a new regulatory document is being developed in Ukraine, which shall establish requirements for the RAW classification, considering its final disposal.

When designing AP1000 reactors, the RAW classification will be specified in terms of transferring for disposal at the design stage "Design".

It is expected that the AP1000 plant "Design" will provide for the RAW transfer, including for disposal, to the CERAWM "Vector" production complex located in the Chernobyl exclusion zone.

Evaluation The question is answered.

Conclusion No need for further action. Nevertheless, it is suggested that the issue of radioactive waste management is revisited in meetings under the "bilateral nuclear information agreement", at the time the design phase for the Khmelnitskyi units 5 and 6 is completed.

Question 25 **Could you please provide the information on the plans regarding the onsite storage of the spent nuclear fuel, as well as current consideration in Ukraine for the long term management and disposal of SNF/high level radioactive waste.**

Answer Spent nuclear fuel (SNF) management consists of SNF cooling in the spent fuel pool, preparing for shipment, and shipping in special containers for a long-term storage in a dry SNF storage facility. A potential site for SNF storage (AP1000) could be the Centralized Spent Fuel Storage Facility (CSFSF). The CSFSF project was implemented by JSC "NNEGC "Energoatom" for a long-term storage of SNF from Ukrainian NPPs, which involves SNF storing in an inert environment with natural air cooling. According to the CSFSF project, a reserve is provided for the placement of SNF storage systems for new power units.

Regarding the long-term management of high-level RAW and SNF, as per the Ukrainian laws, SNF is considered nuclear material, the management of which is regulated by separate regulatory requirements. As for the high level RAW management, see the answer to question No. 24.

Evaluation The question is answered.

Conclusion No need for further action.

4 CONCLUSIONS AND RECOMMENDATIONS

Within the framework of the transboundary EIA of the proposed project, Ukraine provided the responses to all of the 25 questions raised by the experts. The answers provided some valuable additional insights and clarifications, including the layout map of all NPP units at Khmelnitskyi site as well as the JRODOS dispersion analyses with different weather conditions. The experts concluded that all of the question has been answered, although specific answers were, in some cases, incomplete. Ukrainian answers highlighted that some detailed questions might be possible to answer only during the "design phase" of the project. Those include issues like site-required modification, development of SAR as well as listing of suppliers and contractors. The expert team agrees and highlighted that some of the issues could be discussed during meetings under the "bilateral nuclear information agreement", when the design phase is advanced or nearing its completion.

According to the submitted answers, site-specific modifications as well as changes based on experience from previous projects will be made to units 5 and 6 of the KhNPP compared to the reference plant. More detailed information is not provided. At this time, it is not possible to fully assess the safety level of the planned AP1000 reactors in Ukraine.

The design of the reactor building employs a steel-concrete-steel sandwich construction method that has not yet been used. The conclusion at the end of the so-called "Generic Design Assessment" (GDA) process in the United Kingdom was that the use of steel-concrete modules would not lead to a significant impairment of safety only if the "Assessment Findings" were taken into account in further detailed planning. In this regard, it would be interesting to see whether all 112 "Assessment Findings" are taken into account in the licensing process in Ukraine. They are not mentioned in the answers.

In order to assess the potential impacts on Austria, the EIA process requires a transparent presentation of the accident analyses; it should also specify the core damage frequencies (CDF) and severe accidents with large releases (LRF), as well as the potential source terms.

External hazards have the potential to initiate severe accidents with large releases into the atmosphere that could affect Austrian territory by the atmospheric dispersion of radionuclides. A comprehensive consideration of all possible external events, comprising of natural and man-made hazards, that can lead to accidents with significant releases is therefore important within the framework of the cross-border EIA procedure. The answers to the experts' questions contain insufficient information on external hazards. While there are brief mentions of selected natural hazards and a single human-made hazard (toxic emissions into the atmosphere), other hazards such as extreme temperatures, drought, icing, lightning, external explosion, airplane crash, off-site grid instability, etc. that are expected to apply to the Khmelnytskyi site are neither identified nor analyzed. The doubts remain that design basis parameters for external hazards were developed in accordance with international regulations (WENRA 2021) and IAEA guidance.

It is suggested to provide additional clarification on the hazard assessments, their results for the KhNPP site, and the design provisions foreseen to protect the new NPP against hazards applying to the site. Additional information should relate in particular to earthquakes (seismic ground motion).

The effect of the climate change is another issue identified in the EIA where answers did not provide sufficient clarification, certainly not up to a period of 100 years as it is done in the EIAs for some other NPP projects. While the climate change might be more relevant for coastal sites, inland sites like Khmelnitskyi NPP would also be affected. The changes in the weather patterns, humidity, availability of cooling water etc. might have a significant impact on both the operation and the safety of the plant. It is recommended that this theme receives more attention in future meetings under the "bilateral nuclear information agreement".

The EIAR relies on a limited source term when determining the impacts of a severe accident, i.e. a loss-of-coolant accident (LOCA) followed by core meltdown as a "beyond design basis accident" for the AP1000 unit. This source term appears to be short of maximum possible accident of the DEC-B category. Unless the evidence is provided that large and early releases of radioactive materials can be practically eliminated in the event of a severe accident, accidents involving higher releases cannot be ruled out.

The answers explain that, starting in 2024, Ukrainian regulations require a practical elimination of severe accidents involving large and early releases. However, it is not explained whether the requirement for practical elimination in accordance with WENRA (2019) has also been implemented in the regulations. It is unclear, however, whether the probabilistic target value is understood merely as a cut-off criterion for severe accidents. It is recommended to clarify whether a demonstration of practical elimination in accordance with WENRA (2019) will be carried out in Ukraine, which also applies to accident scenarios involving late containment failure (Accident Type III).

Ukraine is a member of WENRA since 2015, and assumes the obligation to transfer all of the WENRA recommendation in its own regulatory framework. The new regulation (NP 306.2.245-2024) is said to be encompassing all of WENRA requirements, but it remains unclear whether WENRA's "Safety objectives for new reactors" were included.

The expert team raised questions of radiological releases reaching and affecting Austrian territory, in terms of whether the deposition could reach the intervention level for public protection due to accumulation of Cs-137 on the ground, which is set to 650 Bq/m2. Ukraine's answer correctly highlighted that the most distant transfer of radionuclides by air (plume) would occur in a case of a moderate but steady wind from Khmelnitskyi site towards Austria, where there is little or no turbulence (which leads to a dilution). Such weather conditions are very rare or might not even have been experienced over such long distances. That means that such an "artificial" weather would imply the highest deposition on the ground. While agreeing with this premise, the experts believe that this consideration does not take into the account the effects of the precipitation, leading to a wash-out from the clouds. The wash out was the cause of the highest contamination in Austria from the Chernobyl accident. The experts recommend that the discussion continues in the meetings under the "bilateral nuclear information agreement" as to how to most-realistically model possible effects of a large (DEC B) release at Khmelnitskyi and its consequences (deposition) onto Austrian territory.

In other countries, the EIARs for new NPP projects encompass the assessment of management of radioactive waste and spent nuclear fuel. That was not the case in EIAR for Khmelnitskyi units 5 and 6. The answers provided clarified that the concept and facilities for the management of RAW and SNF management exist on the country level in Ukraine. Specific solutions and programmes RAW and SNF management for KhNPP units 5 and 6 will be selected and detailed at the design stage. The experts recommend that the issues related with RAW and SNF management are taken on board in meetings under the "bilateral nuclear information agreement" at the time when the design of the KhNPP units 5 and 6 is in an advanced stage.

5 GLOSSARY

AP1000 .... WEC Pressurized water reactor

Bq .... Becquerel

CDF................................ Core damage frequency

CSFSF .... Centralized Spent Fuel Storage Facility

DBA .... Design Basis Accident

DEC (A-B) .... Design extension condition (extent A or B)

EIA .... Environmental impact assessment

EIAR............................... Environmental impact assessment report

GDA................................ Generic Design Assessment (UK regulatory process)

IAEA............................... International Atomic Energy Agency

JRODOS .... Java based Real-time On-line DecisiOn Support

KhNPP............................ Khmelnitskyi NPP

LOCA .... Loss-of-coolant accident

NPP .... Nuclear power plant

PSA .... Probabilistic Safety Assessment

PSAR.............................. Preliminary safety analyses report

PWR............................... Pressurized water reactor

RAW............................... Radioactive Waste

SAR .... Safety analyses report

SNF .... Spent nuclear fuel

TBq .... Terabecquerel

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

VVER.............................. Soviet designed reactor unit

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