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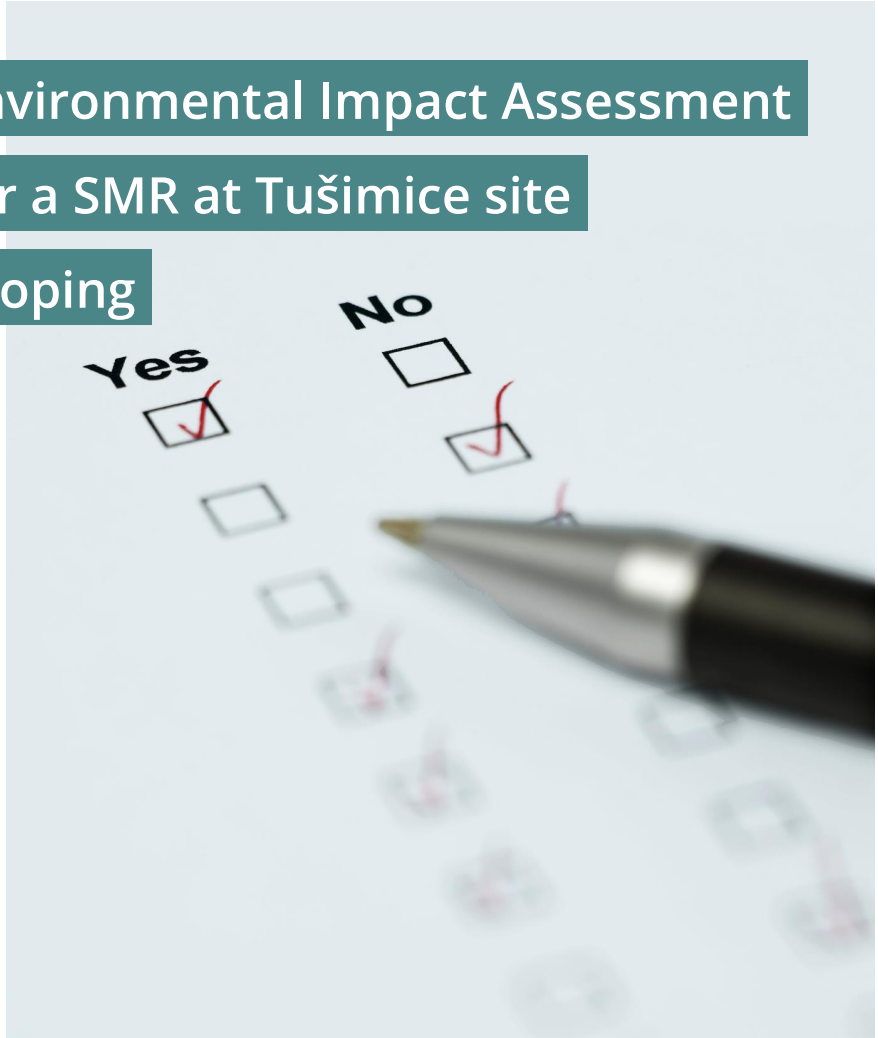
Environmental Impact Assessment for a SMR at Tušimice site

Scoping



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NEW SMR NUCLEAR SOURCE AT THE TUŠIMICE SITE

ENVIRONMENTAL IMPACT ASSESSMENT SCOPING

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EXECUTIVE SUMMARY

The Czech Republic has notified Austria about the Environment Impact Assessment (EIA) procedure under the Espoo Convention and the EU EIA Directive for the project “New SMR Nuclear source at the Tušimice site”. Austria is participating in the transboundary EIA. The Federal Ministry of Agriculture and Forestry, Climate and Environmental Protection, Regions and Water Management commissioned the Environment Agency to prepare an expert opinion on the submitted documents.

The documentation for the "scoping" part of the procedure is currently being assessed. Within the framework of this part of the procedure, it is being discussed what content the project applicant will have to present in the environmental report and in what detail.

The objective of Austria's participation in the EIA procedure is to minimise or prevent possible significant adverse impacts of the project on Austria. The expert opinion on the scoping part of the procedure sets out the requirements for the environmental report.

The Czech Republic’s energy planning includes the commitment for decarbonisation of electricity production by 2045. In addition to planned increase in renewables, the Czech Republic decided to maintain a high share of nuclear in its energy mix. The existing nuclear plants are to be supplemented with (and gradually replaced by) two new large units at the Dukovany site, one SMR unit at the Temelin site and later with an additional two large units at Temelin, and according to this project up to six SMR units (up to 1.5 GWe) at the Tušimice site.

The planned SMRs at Tušimice are intended to replace coal plants at the site and to address the projected rise in electricity needs. The SMRs at the Tušimice site are, according to the timeline presented in the document, projected to follow the planned first SMR project at Temelin site. The construction start of the Temelin SMR is planned for 2029 with the aim of being operational by 2034. The construction start of first unit at Tušimice is planned for 2034.

As required per the legal framework in the Czech Republic the project proponent CEZ a.s. has initiated activities for the project preparation, primarily related with the environmental impact assessment. In this respect, the notification of “New SMR Nuclear source at the Tušimice Site” was prepared to delineate evaluations that are required per Section 7 of the Czech Republic’s Environmental Act. The notification document is not to provide detailed information or assessments on expected environmental effects of the project. Those are to be elaborated in the environmental report.

The new SMR nuclear source at the Tušimice Site will consist of up to six SMRs with a combined maximum electrical capacity of 1.5 GW. The notification document presents and delineates the main characteristics of four SMR models that are considered for the Tušimice site. Those include Rolls Royce SMR, GE’s BWRX, EDF’s NUWARD and Westinghouse AP300. It is stated that any SMR model must

fulfil all the legal and regulatory requirements in the Czech Republic. It is highlighted that SÚJB's safety regulations are modern, in line with the IAEA standards and WENRA objectives for new reactors.

The four presented SMR designs are in different stages of their development (Status June 2025). EDF´s NUWARD was re-designed and a new conceptual design is expected to be presented in 2026.[1] The first BWRX received a construction licence in Canada.[2] Westinghouse with its AP300 entered the Generic Design Assessment (GDA) by the ONR (UK nuclear regulator).[3] The RR SMR is undergoing the GDA by the ONR, of which the Phase 2 (of 3) is completed.

As the detailed designs are still under development, the safety analysis report and the probabilistic safety analysis are not yet completed. This has a significant impact on the implementation of the EIA. It would not be possible to develop a full scope EIA that would assess the radiological impact near the site and in the distance (i.e. transboundary for Austria) until at least the SAR which has to have included DEC A and B analysis and a full scope Level 2 PSA are completed. If the EIA documentation is submitted earlier than the assessments mentioned above are available, this could result in assessments that are neither realistic nor allow an adequate determination of the impact on the environment and the population. It is therefore recommended that the EIA be postponed until the detailed design of the SMR is completed, and the above mentioned analysis are available.

The documentation describes different alternatives, though only in very general terms. An analysis of a "zero option", i.e. that the SMRs are not constructed at all, should be added.

The documentation states that the SMRs at the Tušimice site shall and will meet the safety requirements in the Czech Republic. However, with the SMR models still being under development, what kind of safety level would be achieved, whether there would be some challenges or even cliff edge effects, cannot be certain at this stage of the procedure. This is particularly relevant for the so-called DEC -B conditions, which are to be reflected in the EIA report to assure the credibility of an off-site and transboundary impact from severe accidents. Consequently, the EIA report should provide a list of all internal and external hazards that have been analysed (including their combination) with an indication of the results obtained.

It is recommended to address potential interactions among multiple units in the EIA report. Those should include assessments of external impacts affecting all, or more than one of the units at the site. As external hazards are likely the most important safety challenge affecting all or more than one units simultaneously at the site, it is suggested that those are thoroughly assessed. Furthermore, if

[1] https://www.world-nuclear-news.org/articles/edf-simplifies-nuward-smr-design

[2] https://www.world-nuclear-news.org/articles/canadian-regulator-issues-smr-construction-licence

[3] https://info.westinghousenuclear.com/news/westinghouse-ap300-small-modular-reactor-approved-for-united-kingdoms-generic-design-assessment

one of the units is affected by an accident with radioactive release, the impact on other units should be addressed.

From the perspective of a neighbouring country, where Austrian territory is in about 184 km distance from the Tušimice site, the most relevant part of the EIA report is the transboundary impact. The notification document clearly indicated that the EIA report will take into account analyses of enveloping design basis accidents scenarios and of the design extension condition scenarios, to determine the impact on the population and environment in neighbouring countries. While the notification document suggest that even in a case of core damage at a SMR, the release would happen through “microleaks”, it is suggested that, regardless of rather low probability, a DEC B sequence with an early containment failure should be assessed in the EIA report, e.g. in relation to transboundary impacts. In relation with this, it is recommended that the EIA report describes in detail the sequences selected, including the basis for the source terms used in the dispersion models.

As with any nuclear plant, generation of radioactive waste and spent nuclear fuel has a special impact on the environment. It is therefore recommended that the EIA report discusses generation, processing/treatment, on site storage and off-site disposal for radioactive waste and spent fuel generated by the SMRs at Tušimice.

ZUSAMMENFASSUNG

Die Tschechische Republik hat Österreich über die Umweltverträglichkeitsprüfung (UVP) zum Projekt “Neubau SMR Tušimice” gemäß dem Übereinkommen über die Umweltverträglichkeitsprüfung im grenzüberschreitenden Rahmen (Espoo Konvention) und Art. 7 UVP-RL notifiziert. Österreich nimmt an diesem Verfahren teil. Im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Klima- und Umweltschutz, Regionen und Wasserwirtschaft wurde vom Umweltbundesamt eine Fachstellungnahme zu den übermittelten Dokumenten erstellt.

Die Unterlagen für den Scoping-Teil des Verfahrens werden derzeit geprüft. Im Rahmen dieses Teils des Verfahrens wird erörtert, welche Inhalte der Projektwerber im Umweltbericht darzustellen hat und in welchem Umfang diese behandelt werden müssen.

Ziel der österreichischen Beteiligung am UVP-Verfahren ist es, mögliche signifikante nachteilige Auswirkungen des Projekts auf Österreich zu minimieren oder zu verhindern. In der Fachstellungnahme zum Scoping-Teil des Verfahrens werden die Anforderungen an den Umweltbericht dargelegt.

Die Energieplanung der Tschechischen Republik beinhaltet die Verpflichtung zur Dekarbonisierung der Stromerzeugung bis 2045. Neben dem geplanten Ausbau der erneuerbaren Energien hat die Tschechische Republik beschlossen, einen hohen Anteil an Kernenergie in ihrem Energiemix beizubehalten. Die bestehenden Kernkraftwerke sollen durch zwei neue große Blöcke in Dukovany, einen kleinen modularen Reaktor (SMR)-Block am Standort Temelin und später durch zwei weitere große Blöcke in Temelin ergänzt (und schrittweise ersetzt) werden. Zusätzlich sind bis zu sechs SMR, mit einer kombinierten Leistung bis zu 1,5 GWe, am Standort Tušimice geplant.

Die geplanten SMR am Standort Tušimice sollen das bestehende Kohlekraftwerk am Standort ersetzen. Gemäß der Projektplanung sollen die SMR Tušimice nach dem SMR in Temelin errichtet werden. Der Baubeginn für den SMR in Temelin ist für 2029 und die Inbetriebnahme 2034 geplant. Der Baubeginn für den ersten Block in Tušimice ist für 2034 vorgesehen.

Der Projektträger CEZ a.s. hat Aktivitäten zur Projektvorbereitung eingeleitet, die in erster Linie mit der Umweltverträglichkeitsprüfung zusammenhängen, wie es der Rechtsrahmen in der Tschechischen Republik vorschreibt. In diesem Zusammenhang wurde der “Neubau SMR Tušimice” vorbereitet, um die Bewertungen darzulegen, die gemäß Abschnitt 7 des tschechischen Umweltgesetzes erforderlich sind. Die Unterlagen sollen keine detaillierten Informationen oder Bewertungen zu den erwarteten Umweltauswirkungen des Projekts enthalten. Diese werden im Umweltbericht ausführlicher behandelt.

Der KKW-Standort Tušimice soll aus bis zu sechs SMR mit einer maximalen elektrischen Leistung von insgesamt 1,5 GW bestehen. In den Unterlagen werden die wichtigsten Merkmale von vier SMR-Modellen, die für den Standort

Tušimice in Betracht gezogen werden, vorgestellt und beschrieben. Dazu gehören die SMR-Reaktorkonzepte von Rolls Royce SMR, GEs BWRX, EDFs NUWARD und Westinghouse AP300. Jedes SMR-Modell muss alle gesetzlichen und behördlichen Anforderungen in der Tschechischen Republik erfüllen. Es wird hervorgehoben, dass die Sicherheitsvorschriften von SÚJB modern sind und den IAEA-Standards wie auch den WENRA-Zielen für neue Reaktoren entsprechen.

Die vier SMR Designs befinden sich (Stand Juni 2025) in unterschiedlichen Phasen ihrer Entwicklung. NUWARD von EDF wird aktuell überarbeitet und ein neues konzeptionelles Design wird für das Jahr 2026 erwartet[4]. Der erste BWRX hat im Jahr 2025 die Baubewilligung in Kanada erhalten[5]. Der AP300 von Westinghouse wird in Großbritannien im Rahmen des Generic Design Assessment (GDA) des britischen Regulators begutachtet[6]. Der Rolls Royce SMR ist ebenfalls im Generic Design Assessment (GDA) des britischen Regulators und hat dort die Phase 2 von drei Phasen abgeschlossen[7].

Da sich das detaillierte Design, der in Rede stehenden Reaktoren noch in der Entwicklung befinden, sind die Sicherheitsanalyseberichte und die probabilistische Sicherheitsanalysen noch nicht abgeschlossen. Dies hat erhebliche Auswirkungen auf die Umsetzung der UVP. Es wäre nicht möglich, eine umfassende UVP zu erstellen, die die radiologischen Auswirkungen in der Nähe des Standorts und weiter entfernt (d. h. grenzüberschreitend für Österreich) bewertet, bis zumindest der SAR, der eine DEC A und B Analyse umfasst, und eine umfassende PSA der Level 2 abgeschlossen sind. Sollte der Umweltbericht vor Verfügbarkeit dieser Analysen zur öffentlichen Stellungnahme vorgelegt werden, könnte dies zu Bewertungen führen, die weder realistisch sind noch die Auswirkungen auf die Umwelt und die Bevölkerung angemessen bestimmen können. Es wird daher empfohlen, die UVP zu verschieben, bis der detaillierte Entwurf des SMR abgeschlossen ist und die oben genannten Analysen vorliegen.

Was die Alternativen betrifft, so werden diese nur sehr oberflächlich beschrieben. Eine Analyse einer „Null Option“, d. h., dass ein SMR überhaupt nicht gebaut wird, könnte eine sinnvolle Ergänzung darstellen.

In den Unterlagen heißt es, dass die SMR am Standort Tušimice die Sicherheitsanforderungen der Tschechischen Republik erfüllen sollen und werden. Da sich die in Aussicht genommenen SMR-Modelle jedoch noch in der Entwicklung befinden, lässt sich derzeit noch nicht mit Sicherheit sagen, welches Sicherheitsniveau erreicht werden würde, und ob es zu Herausforderungen oder sogar zu Cliff-Edge-Effekten kommen würde. Dies ist insbesondere für die sogenannten DEC-B-Bedingungen relevant, die Umweltbericht berücksichtigt werden müssen, um die Glaubwürdigkeit der Analysen zu Auswirkungen schwerer Unfälle auf andere Standorte und über Grenzen hinweg sicherzustellen. Daher sollte der

[4] https://www.world-nuclear-news.org/articles/edf-simplifies-nuward-smr-design

[5] https://www.world-nuclear-news.org/articles/edf-simplifies-nuward-smr-design

[6] https://www.world-nuclear-news.org/articles/canadian-regulator-issues-smr-construction-licence

[7] https://info.westinghousenuclear.com/news/westinghouse-ap300-small-modular-reactor-approved-for-united-kingdoms-generic-design-assessment

Umweltbericht eine Liste aller internen und externen Gefahren enthalten, die analysiert wurden (einschließlich ihrer Kombination), wie auch die ermittelten Ergebnisse angeben.

Es wird empfohlen, dass der UVP-Bericht mögliche Wechselwirkungen zwischen mehreren Anlagen behandelt. Dazu sollten Bewertungen der externen Auswirkungen gehören, die alle oder mehr als eine der Anlagen am Standort betreffen. Da externe Gefahren wahrscheinlich die wichtigste Sicherheitsherausforderung darstellen, die alle oder mehr als eine Anlage gleichzeitig am Standort betrifft, wird empfohlen, diese gründlich zu bewerten. Darüber hinaus sollten die Auswirkungen auf andere Einheiten berücksichtigt werden, wenn eine der Einheiten von einem Unfall mit Freisetzung radioaktiver Stoffe betroffen ist.

Aus Sicht eines Nachbarlandes, dessen Staatsgebiet rund 184 km vom Standort Tušimice entfernt ist, ist der relevanteste Teil des Umweltberichts die grenzüberschreitende Auswirkung. In den Unterlagen wurde klar darauf hingewiesen, dass im Rahmen des Umweltberichts Analysen von Szenarien für abdeckende Auslegungsstörfälle und Szenarien mit auslegungserweiternden Bedingungen durchgeführt werden, um die Auswirkungen auf die Bevölkerung und die Umwelt in den Nachbarländern zu ermitteln. Während angedeutet wird, dass selbst im Falle einer Beschädigung des Reaktorkerns in einem SMR die Freisetzung durch „Mikrolecks“ erfolgen würde, wird vorgeschlagen, dass, ungeachtet der eher geringen Wahrscheinlichkeit, im Umweltbericht hinsichtlich der grenzüberschreitenden Auswirkung eine DEC-B-Sequenz mit einem frühen Containmentversagen bewertet wird. In diesem Zusammenhang wird empfohlen, dass im Umweltbericht die ausgewählten Sequenzen detailliert beschrieben werden, einschließlich der Grundlage für die in den Ausbreitungsmodellen verwendeten Quellterme.

Wie bei jedem Kernkraftwerk hat die Erzeugung radioaktiver Abfälle und abgebrannter Brennelemente besondere Auswirkungen auf die Umwelt. Es wird daher empfohlen, dass der Umweltbericht die Erzeugung, Verarbeitung/Behandlung, Lagerung vor Ort und Entsorgung der radioaktiven Abfälle und abgebrannten Brennelemente aus der Kernkraftwerksanlage in Tušimice erörtert.

1 INTRODUCTION

The Czech Republic has notified Austria about the Environment Impact Assessment (EIA) procedure under the Espoo Convention and the EU EIA Directive for the project “New SMR Nuclear source at the Tušimice site”. Austria is participating in the transboundary EIA. The Federal Ministry of Agriculture and Forestry, Climate- and Environmental Protection, Regions and Water Management commissioned the Environment Agency to prepare an expert opinion on the submitted documents.

The documentation for the "scoping" part of the procedure is currently being assessed. Within the framework of this part of the procedure, it is being discussed what content the project applicant will have to present in the environmental report and in what detail.

The objective of Austria's participation in the EIA procedure is to minimise or prevent possible significant adverse impacts of the project on Austria. The expert opinion on the scoping part of the procedure sets out the requirements for the environmental report.

Due to the similarities in the notification document of the project for the SMRs at Tušimice and the SMR at the Temelin site, several recommendations and relevant questions are similar. Therefore, the expert statement published by the Umweltbundesamt and prepared by ENCO Consulting “New nuclear source: a SMR at the Temelin Site, Environmental Impact Assessment –Scoping” published in January 2025[8] served as basis of this expert opinion.

The Czech Republic’s energy planning includes the commitment for decarbonisation of electricity production by 2045. In addition to the planned increase in renewables, the Czech Republic decided to maintain a high share of nuclear in its energy mix. The existing nuclear plants are to be supplemented with (and gradually replaced by) two new large units at the Dukovany site, one SMR unit at the Temelin site and later with an additional two large units at Temelin, and according to this project up to six SMR units (up to 1.5 GWe) at Tušimice site.

The planned SMRs at Tušimice are intended to replace coal plants at the site and to address the projected rise in electricity needs. According to the timeline presented in the document, the SMRs at the Tušimice site are projected to succeed the planned first SMR project at Temelin site. The construction start of the Temelin SMR is planned for 2029 with the aim of being operational by 2034. The construction start of first unit at Tušimice is planned for 2034. It is not mentioned in the notification document if and how experience gained by the licensing, preparation and construction of the Temelin SMR might influence the Tušimice SMR project.

[8] Umweltbundesamt (2025): New Nuclear Source, a SMR at the Temelin Site, Environment Impact Assessment – Scoping, ENCO, Umweltbundesamt Report 0916

The Czech SMR Road Map - Applicability and Contribution to Economy by the Ministry of Industry and Trade of the Czech Republic, published in May 2023 (MPO, May 2023), indicates the Tušimice site as one potential site for SMRs.

The project "New SMR Nuclear source at the Tušimice site" is still in an early planning stage. The eventual construction is planned from 2034 to 2042. The intended start-up of the first unit is intended to happen after 2038.

As required per the legal framework in the Czech Republic the project proponent CEZ a.s. has initiated activities for the project preparation, primarily related with the environmental impact assessment (EIA). In this respect, the notification of "New SMR Nuclear source at the Tušimice site" was prepared to delineate evaluations that are required per Section 7 of the Czech Republic's Environmental Act. The notification document is not to provide detailed information or assessments on expected environmental effects of the project. Those are to be elaborated in the environmental report, as being part of the next step within the EIA procedure.

The aim of the notification document is to present basic information on the project, including various environmental impacts stemming from the construction and operation of the facility. According to the environmental regulations in the Czech Republic, nuclear facilities are considered "Category 1" projects, meaning that those are always subject to a full environmental assessment.

The aim of the notification document is not to provide detailed information or assessments on expected environmental effects of the project, rather to provide basic information that would then be further elaborated in the EIA report.

The planned SMRs at Tušimice are intented to replace coal plants at the site. The existing coal power plants are planned to be shut down, and afterwards dismantled. The new SMR nuclear source at the Tušimice Site will consist of up to six SMRs with a combined maximum capacity of 1.5 GWe for the site. It is stated that no actual design has been chosen yet.

The notification document establishes that any SMR to be selected needs to fulfil the legal and regulatory requirements for new nuclear plants in the Czech Republic, which reflect the newest IAEA as well as WENRA requirements, including WENRA RL and WENRA Safety objectives for new reactors.

The future Tušimice SMRs shall be a light water reactor (LWR), which means either pressurised (PWR) or boiling water (BWR). The notification document summarises main characteristics of four different SMR models:

1. UK SMR Project (Rolls Royce SMR): 498 MWe design under development in the UK
2. BWRX-300: 300 MWe design that is undergoing review in Canada, first construction permit was given in May 2025 in Canada
3. NUWARD (EDF) Project: 2x170 MWe at the stage of conceptual design by EDF [design was abandoned in the meantime, with the plan to redesign the SMR to about 400 MWe]

4. Westinghouse SMR (AP300) Project: 330 MWe conceptual design of a reduced version of the Westinghouse AP1000

The notification document states that the supplier has not been selected yet. It further establishes that the "selection of a supplier is not part of the EIA process".

In contrast to the existing nuclear sites in Czechia, there is the need for additional studies for the Tušimice site. The studies, some explicitly planned for the next step, should identify potential risks and threats to nuclear facilities planned at the Tušimice site. Those studies should include all relevant external natural hazards to the site as elaborated in IAEA SSG 35 (i.e. geology, natural events, inland (river) flooding, geological and geotechnical hazards, changes of hazards with time). Additionally future developments in the region, incl. changes in land use, population density, etc. should be taken into account when performing an in-depth analysis of the site.

In an additional step, a storage facility for spent fuel is planned at the Tušimice site or "*in another selected location*"[9]. It is mentioned that this storage facility is not subject of the current project (within the meaning of Act No. 100/2001 Coll.) There will be a separate project for the assessment of the storage facility.

The notification document justifies that the EIA process has been initiated before the supplier or the SMR model is known by the fact that "*The environmental parameters of the equipment, not the specific types of equipment of specific manufacturers or their trademarks, are decisive*"[10]. Although it is obvious that the "environmental parameters of a facility" are relevant for environmental impact, it should be noted that all of the four preselected designs are still under development or, in case of NUWARD, are being completely revised.

This has a profound impact on the implementation of the EIA. The SMR model to be selected for the construction at the Tušimice site would obviously need to comply with SÚJB's standards and requirements on safety. In terms of the off-site release, SÚJB does have clearly defined limits for the effluents (during normal operation) as well as targets in terms of severity and frequency related to severe accidents and resulting radiological releases. In the view of the experts, it is not possible to develop an EIA report that assesses the radiological impact near the site and in the distance (i.e. transboundary) until at least the SAR with DEC A and B scenarios and a full scope Level 2 PSA are completed for the envisaged reactor types. For these documents to be developed to a reasonable level of detail that would enable using the results in a comprehensive dispersion analysis as required in the EIA, the detailed design of the SMR needs to be completed first. Furthermore, even though LWR SMRs would be taking over general reactor technologies and (some) Structures, Systems and Components (SSC) solutions from existing large PWRs, the actual details including the operation of SMRs are still (and will remain so until some operational experience with real

[9] Notification of the Project Section B.I.6.3.3.1., pg. 43

[10] Notification of the Project Section B.I.6, pg. 21

SMRs has been gained) an unknown factor, adding to the uncertainty of the analysis.

It is therefore not clear what the intention of the project developer CEZ is, in terms of initiating an environmental report before the design is finalised and the associated safety and probabilistic analysis is completed and reviewed. Without these documents, there is no way to establish any realistic "environmental parameters" that are a necessary input for an EIA.

Recommendation

It is recommended to postpone the development of an EIA report, in particular with regard to the environmental impact of radiological releases, until the detailed designs of the planned SMRs to be selected for the Tušimice site are completed and the main safety documents (SAR and PSA) are developed and accepted by the Czech regulator SÚJB. Only such an approach would allow for a reasonable assessment of the potential impact from the Tušimice SMR on the environment and population in and outside the Czech Republic.

The EIA report should provide detailed information on the scope and the schedules of relevant licensing procedures of the SÚJB:

1. Approval of the Tušimice SMR site (site licence)
2. Design approval
3. Expected issuance of the construction licence

The EIA report should distinguish between information (mainly plant specific technical data) that is based on assumptions and information that is based on a detailed design that is ready for construction.

Furthermore, the EIA report should describe how the Tušimice SMR will be operated and how the radiological releases (during normal operation and in accident conditions) are modelled, given that there is no operating experience with the SMR models selected.

The environmental report should be based on all relevant site-specific studies, taking into account all credible external hazards to the site. Those studies should be made publicly available to ensure maximum transparency.

2 PROCEDURAL ASPECTS OF THE EIA

The procedural aspects of the EIA are defined in the Espoo and Aarhus Conventions, of which all EU member states are signatories. Furthermore, the EU Directive 2011/92/EU is establishing the requirements and the procedural steps.

As already mentioned in the introduction, the main problem is that there is too little information available on the design of the SMR to be constructed at the Tušimice site to carry out an EIA. All the SMRs that are considered are not advanced in the design (apart from possibly BWR-X), which leaves big uncertainties related to the safety status, operation, generation of radioactive waste and spent nuclear fuel, effluents, etc., all of which are an essential input to the EIA.

In accordance with the environmental legislation of the Czech Republic, the notification document is to provide this basic information on:

- Project developer,
- Project technical and technological solution and its environmental demands,
- Options of the project solution,
- State of the environment in the affected territory,
- Possible project effects on public health and the environment to support other relevant supplementary data.

In the case of Tušimice SMR, the notification document formally fulfils the requirements. It identifies CEZ as the developer, provides a (high level) description of the technological solutions, although not quite on its “environmental demands” – simply as those are not really available at this stage, provides the options (see later in this document) and lists possible effects on the population and the environment.

In terms of the technology to be used for the project, two sets of information are of relevance. Firstly, the requirements are defined as:

- Power unit: number of units: one to six power units
- Type: light water reactor (LWR)
- Generation: III+ with a high degree of passive safety elements
- Net electrical power: up to 1500 MWe
- Design lifetime: 60 - 80 years

Four different SMR designs (in two cases, only rather conceptual) that complied with these (very high level) requirements have been presented. While this might be enough for the notification document (i.e., scoping phase of the EIA), where the requirement is defined as a “nuclear power plant with up to 1500 MW electric”, it does not allow for a detailed analysis as expected in the EIA report.

Other relevant requirements presented in the notification document are the list of legal and regulatory requirements that would be applicable to the Tušimice SMR. Most importantly, that encompasses SÚJB safety requirements that are

well developed, in line with the (newest) IAEA standards and incorporate WENRA Safety objectives for new reactors.

As mentioned in the introduction, establishing only high level requirements and having assurances that a facility would "comply with national standards" does not establish the basis for undertaking the assessment (in particular of radiological impact) within an EIA. Therefore, the statement in the notification document "…the subsequent selection of a supplier cannot be to the detriment of environmental protection"[11] does not quite give an assurance that one or another model might have better or worse impact onto the environment and population, in particular in the transboundary framework.

Recommendation

The notification document provides overall information on the procedures to be followed in the EIA process. It lists the national legislation of the Czech Republic, which defines the steps in terms of the interactions on the international level to take place once the environmental report is developed. It is believed that those are in line with the requirements of the Conventions and with applicable EU Directives and would allow Austria to receive the documents and assess those to determine possible impact on the environment and population.

In general, the concept for the development of the EIA as described in the notification document is acceptable. Nevertheless, the fact that that the EIA appears to be carried out at a generic level, i.e. before the detailed design and relevant safety justification have been developed and approved by the regulator, could result in assessments that are neither realistic nor allow an adequate determination of the impact on the environment and the population of Austria. It is therefore recommended that the EIA report should not be prepared until the necessary information is available.

[11] Notification of the Project Section D.VI, pg. 130

3 ALTERNATIVES

The Czech Republic's decarbonisation strategy is based on a continuously rising share of nuclear power. In addition to large-scale reactors, this is planned to be achieved by the construction of small modular reactors (SMRs), so that energy production from fossil fuels decreases (and to disappear entirely after 2045) and the electricity demand of the Czech Republic can be met solely by nuclear and renewables.

Analyses show that the new reactors already approved for the Dukovany site (units 5 and 6) will not be sufficient to cover future demand, even when considering the increased availability of renewables. The study "Assessment of the Resource Adequacy of the Electricity Network of the Czech Republic by 2040 (MPO & ČEPS, 2023)" determines a shortfall of up to 3 GWe by 2050. To close this gap, the government of the Czech Republic intends to replace retiring coal units with SMRs. The proposed Tušimice SMR would therefore expand the generation mix, while nuclear power as a whole remains a cornerstone of Czech energy security and grid stability.

The notification document provides various options and alternatives as following:

Alternative sites within the Czech Republic: The selection of the Tušimice site reflects the availability of infrastructure and workforce, including regulatory requirements in the Czech Republic. Based on the existing coal plant on the site, the continuity of energy generation at Tušimice was also considered. It is therefore assessed in the notification document that the proposed Tušimice site represents the best environmental and social solution for building an SMR plant in the Czech Republic. While this is a reasonable assumption, it might also be worth to consider other coal power sites in the region (e.g. Ledvice or Počerady) as alternative to the Tušimice site. A comparative site screening using uniform criteria focused on safety aspects would be recommended.

Options of specific location at the Tušimice site: The decision of the specific location of the plant was based on the spatial requirements of the existing coal-fired power plant ETU II, taking into account the spatial, urban, ecological, technical, and infrastructure conditions. According to the notification document, the SMR will be positioned in such a way that at least parts of ETU II can remain in operation until the construction process is completed.

Options of reactor output capacity: A total output of up to 1.500 MWe with a maximum of six modules) is envisaged. Four LWR-SMR models (Rolls-Royce SMR, GE BWRX-300, EDF NUWARD, and Westinghouse AP300) are considered. The chosen reactor capacity reflects the capacity of the commercially available SMR models, as well as the spatial conditions and the regulatory restrictions. The notification document also mentions that the SMRs should be able to replace the coal plants Tušimice and Punerov, which makes a lower reactor capacity economically senseless.

Options of technical solution: The selection of the LWR-type, generation III+ reactor, reflects that LWRs are the most advanced in the development of all SMR models, and the experience with operating nuclear power plants, in particular in the Czech Republic. That is a reasonable choice.

Options for the connection to the infrastructure: The selection of the Tušimice site will benefit from all existing infrastructure, including traffic flows, water supply as well as high voltage grid connection. An optimisation or extension of the infrastructure is foreseen, depending on the final technical realisation of the project.

Zero option: From the discussion in the notification document, it appears that the zero option (i.e., non-implementation of the project) is considered only as reference option to compare the environmental impact of the project. The notification document indicates that the zero option would imply that there will be no new sources at the Tušimice site, and instead a new (nuclear or non-nuclear) energy source at a different site would need to be found. A detailed analysis of an actual zero option in the EIA might be a prudent addition.

Recommendation

While the notification document briefly highlights the aforementioned alternatives, they are not really discussed in detail, and it is concluded that the chosen implementation is the optimal choice. The project is therefore considered as single option with only specific alternatives for the technical realization of the infrastructure connections. This conclusion seems to be prematurely and should be rectified by a consideration of possible alternatives, as well as a discussion of the decision-making processes related with choosing one over another alternative in the EIA report.

1. For each of the alternatives, the EIA report shall provide a detailed discussion on a technical basis, the safety and impact, in particular the radiological impact, as well as the basis and criteria that is being used to evaluate the alternatives that are being considered.
2. To compare different possible sites, a comparative site screening using uniform criteria focused on safety aspects should be performed.
3. The zero option should be considered as valid alternative, not only as reference option.

4 SIMULTANEOUS OPERATIONS AND INTERACTIONS OF MULTIPLE UNITS AT THE SITE

The Tušimice nuclear site is planned for up to six nuclear power reactors up to a maximum electrical power of 1500MWe, and additionally all auxiliary buildings that are needed for the operation of NPP units. Further, a spent fuel storage facility could be built in the future.

The notification document does not quite provide guidance as to how the existence of multiple units would be treated in the EIA.

With multiple nuclear facilities on the site, there are, in particular with post-Fukushima considerations, questions whether the multiple units could jeopardise each other, and what kind of safety impact could be caused from one unit to another, e.g. accidents affecting multiple units that might lead to off-site consequences. The risk analysis should consider common-cause impacts on multiple SMR modules, as well as any possible interactions with the remaining coal-plant structures during decommissioning.

The assessment of severe accidents, initiating events, its propagation and its releases, e.g. due to a simultaneous damage to multiple “features” of the plant including safety systems and structures, needs to be addressed in the EIA report for the Tušimice SMR. In particular, potential impact of external hazards that might become more severe with the acceleration of global warming needs to be considered. Also important are the external events of human origin, those being e.g. large-scale fires in the vicinity, dangerous goods transports as well as aircraft crashes and terrorist attacks. It is understood that the latter might not be publicly discussed, but general information could be provided.

The plant specific challenges including e.g. the turbine missiles need to be assessed, e.g. as required by the US NRC Regulatory Guide RG 1.115.

The impact of a radiological emergency on site, in the case one unit is experiencing a large release of radioactivity, needs to be assessed. In case of a release of radioactivity, there will be very strict restrictions and general difficulties for the operational and/or maintenance staff to be reaching and working in units not directly affected by an accident. The measures, which are planned to be in place to enable a safe shutdown of non-affected units, should be considered in the EIA.

The notification document provides little information neither on the planned assessment in relation with external impacts, nor on the interaction for the multiple units at the site. The importance of external hazards cannot be underestimated. Most studies addressing NPPs have shown that in terms of the risk (probability x consequence), the external impact hazards dominate the risk, in particular regarding potential off-site impacts. The EIA process is a good opportunity to perform such an assessment.

Recommendation

The EIA report should contain the following information on possible interactions among multiple units, including assessment of external impacts affecting all the units at the site (as well as the potential SNF interim store):

1. Assessment of the severe weather conditions with consideration of new trends in climate change and the fact that Tušimice SMR would be expected to continue its operation through 21st century;
2. An assessment of man-made external events;
3. Assessment of a combination of external events, including consideration of multiple plants on the site;
4. Investigation into interaction among the plants, including effects like turbine missiles;
5. Thorough analysis of the possible events affecting multiple units on the site.
6. Assessment of the effects on the operation and safe shutdown of other units in a case where one or more units at the site have released radioactivity into the environment, making site access and/or communication difficult or impossible.

5 SAFETY AND SEVERE ACCIDENTS

The notification document clearly states that the SMR reactors at the Tušimice site shall and will ensure "nuclear safety, radiation protection, physical protection and emergency preparedness in accordance with the requirements of the applicable legislative regulations, IAEA and WENRA standards and other industry-specific standards." The notification document facilitates the fundamental radiological protection criteria K3, meaning that even in a core-melt event no evacuation or long-term food-chain restrictions shall be required in the surroundings of the plant. Any sequences that could cause a large or early release must be practically eliminated with an exceedance frequency of less than 10^{-6} per year.

Whatever SMR design is finally chosen will undergo a full SÚJB review; site-specific adaptations and possible design changes may be required to satisfy the regulatory requirements of SÚJB. This might take time and add uncertainty for the project. The description of specific safety principles and requirements, starting with the defence in depth, is well covered in the notification document.

While discussing safety of SMRs, the notification document stresses that the safety concept of the SMR technologies presented in the document is built upon "proven and advanced technologies of large nuclear units" while also using "passive solutions and passive safety systems". This should help ensure the autonomy of the units and the management of emergency situations even without the intervention of an operator or without a power supply.

While this is, in principle, the design objective of every SMR on the market, all four-candidate SMR concepts are still under development. Important safety documentation - in particular the final Safety Analysis Report (SAR) covering Design Extension Conditions (DEC) A & B and a complete Level-2 Probabilistic Safety Assessment (PSA) - is not yet available and will not be available in the near future. Until this documentation is provided, an EIA that quantifies normal and accident releases (including transboundary doses) cannot be completed.

The lack of documentation is particularly relevant for the DEC B conditions. The notification document emphasises the SMR objective of virtually excluding large or early releases of radioactivity for a full spectrum of internal initiators, internal and external hazards, mainly through passive systems and robust containment. Nevertheless, because those claims remain unproven, the EIA must analyse a severe-accident scenario in which the containment is breached (or bypassed). Such a scenario should be modelled with a plausible source term, release duration and thermodynamic parameters, to assure the credibility of an off-site and transboundary impact analysis for severe incidents affecting the Tušimice SMR.

Risk at modern nuclear sites is dominated by external events. It is recognised that the SÚJB regulation generally requires a broad range of external hazards to be evaluated, as the notification document lists numerous examples of external hazards that could challenge the safety of the SMR. The notification document further indicates that all of those would be assessed within the licensing

process in the Czech Republic. While this approach seems to be sufficient, it should nevertheless be emphasised that the EIA report should list a systematic inventory as well as clear results for all internal and external hazards (natural and man-made) and their credible combinations. The EIA report also has to clarify how the hazard combinations were applied and what the respective results are.

The EIA must therefore include for each of the envisaged reactor types:

1. A quantitative demonstrate how the 10^{-6} per year criterion for large or early releases will be met.
2. A severe-accident (DEC-B) assessment with early containment failure or bypass. Until the Level-2 PSA is available, conservative but realistic assumptions should be used for the assessment.
3. A systematic table of all internal and external hazards and their credible combinations.
4. An assessment of common-cause impacts on multiple SMR modules.

6 TRANSBOUNDARY IMPACT

Under the Espoo Convention, the EU EIA Directive and the Czech EIA Act, the EIA must demonstrate that transboundary effects have been identified, modelled and - where significant – mitigated. The distance from the Tušimice site to the Austrian border is 184 km. Although this distance exceeds the emergency-planning zone of the plant, it is within the range at which atmospheric releases can reach Austrian territory under unfavourable weather conditions, in case of accident conditions at one or more reactor blocks at Tušimice site.

The notification document states that the proponent plans to analyse radiological effects for the nearest neighbouring states for normal operation, an enveloping Design-Basis Accident (DBA) and a representative Design-Extension Condition with severe core damage (DEC-B).

For both enveloping DBA and DEC-B analysis, it once again has to be mentioned that a specific SMR design for the Tušimice site is still to be chosen. Because all candidate designs are still under development, the robustness of the design, strength of the containment, possibilities of bypass, etc. for a full spectrum of possible hazards, remains uncertain until the design is completed and appropriately analysed and justified. Therefore, a possible source term can at this stage only be roughly estimated, based on a conservative but physically plausible approach.

The notification document seems to suggest that a leak from the containment would only happen through “microleaks” of the containment. This approach is justified by the fact that the design acceptance criteria is set in such a way that there will be no need for the evacuation or food restrictions in the surroundings of the site, even in case of a core damage, because the radioactivity would be (mostly) retained in the containment.

However, it is recommended that the EIA report should also evaluate an early breach or bypass of the containment. This is not also in alignment with the EIA for large generation III reactor designs, where severe accidents including early large releases are typically still considered, in particular in the EIA framework. That approach would be sufficient to estimate the doses to the population and the impact on the environment (i.e., deposition on agricultural land, etc.) in Austria.

The EIA report should contain the following information as relevant for the transboundary impact that might affect Austria for each of the envisaged reactor types:

1. An introduction of the selection process for envelope cases (DBA and DEC-B) and justify how they contain all credible initiating events and hazard combinations;
2. A full description of the chosen DEC-B sequence, including an estimation of the source term based on the fuel inventory, fuel retention factors and containment structure;

3. A description of the assumptions for modelling DEC-B accident sequences, including duration of a release, levels of release, energy, etc.;
4. A description of the used dispersion model, including the meteorological parameters used; and present the resulting radiological impacts such as air-concentration, ground-deposit and depositions doses for distances up to 300 km;
5. A comparison of doses with the Austrian intervention criteria (early and late), indicating whether sheltering, iodine prophylaxis, food restrictions or other counter-measures would be triggered;
6. Sensitivity analyses (release start delay, release height, precipitation, wind direction) to illustrate the robustness of the conclusions.

7 SPENT FUEL AND RADIOACTIVE WASTE

The notification document states that a spent nuclear fuel storage could be added to the site in a later stage of the project. The storage will be situated in the area for SMR Tušimice or in an adjacent area. It is stated, that its preparation will include an EIA that is a separate project subject to assessment (Category I, Article 12 of Annex 1 to the Act) pursuant to Act No. 100/2001 Coll., on environmental impact assessment.

Further the notification document states, that the principles for radioactive waste handling for SMR Tušimice will be the same as for the existing operating nuclear units at Dukovany and Temelín power plants. In accordance with the Atomic Act, radioactive wastes are defined as "substances, objects or equipment containing or contaminated by radionuclides, for which no further use is foreseen" and include gaseous, liquid and solid radioactive waste.

Given that the SMR is in a design development stage, it is obvious that the information/concepts needed for any reasonable modelling of generation and subsequent processing of radioactive waste (RAW) would not be available. The notification document provides the quantity of radioactive waste to be generated per year (up to 920 m^3/year), which is said to be the "enveloping" amount of the waste generated before processing. Furthermore, it is stated that the "amount of processed and treated radioactive waste will only be specified on the basis of applied processing technology". The technology will be selected depending on the waste acceptance criteria for the waste repository in the Czech Republic.

The notification document suggests that the "amount and type of radioactive waste produced during the operation of Tušimice SMR will be specified after the selection of SMR technology". It has to be noted, that depending on the design selected the type of radioactive waste could or could not be similar to the large units at Dukovany and Temelin.

In terms of spent nuclear fuel generation, the notification document estimates that it will be "up to 37,5t UO_2/year". This value comes from the estimate of the maximum power of a SMR, which is defined per conditions set up by CEZ (1.500 MWe), rather than a real estimate for a specific SMR model.

Recommendation

The EIA report needs to analyse the impact to the environment from the processing and storage and later from the disposal of radioactive waste generated by the Tušimice SMR. In order to accomplish this, the SMR model to be considered needs to be selected first and then the radioactive waste storage and processing facilities can be designed. This would eventually lead to a prediction of the quantities and types of radioactive waste to be generated during the operation of a SMR. As there is no operational experience for any SMR mentioned in the notification document, the actual generation of radioactive waste cannot be determined with a certainty. However, a best estimate for each of the designs in question could be made.

It is further required that the EIA report describes the disposal of RAW, in terms of what is the current status of the plans for facilities to dispose of the RAW from the Tušimice SMR. While it is clear that a disposal facility in the Czech Republic will have its own EIA developed, a section to “close the cycle” in the EIA for the SMR at Tušimice is recommended.

The same applies to the spent nuclear fuel. Once the SMR model is selected, the type of fuel to be used will be known. The generation of the spent fuel would depend on the availability factor as well as on the enrichment (in reality, AP 300 would have higher enriched fuel and therefore smaller weight of spent fuel). Additionally, the dimensions of spent fuel would then be known, so the plans for the onsite storage (beyond the SNF pools) could be presented in the EIA report.

8 GLOSSAR

Bq	Becquerel
BWR	Boiling Water Reactor
CDF	Core damage frequency
CEZ a.s.	Czech nuclear plants operator and electricity generation company
DBA	Design Basis Accident
DEC-A/B	Design Extension Condition A and B part
EIA	Environmental impact assessment
EU	European Union
GDA	Generic Design assessment
GW	Gigawatt
GWe	Gigawatt electric
IAEA	International Atomic Energy Agency
LERF	Large early release fraction
LWR	Light water reactor
LILW	Low- and Intermediate Level radioactive Waste
MW	Megawatt
MWe	Megawatt electric
MWth	Megawatt thermal
NPP	Nuclear power plant
ONR	UK Nuclear regulator
PSA	Probabilistic safety assessment
PSR	Periodic safety review
PWR	Pressurized water reactor
RAW	Radioactive Waste
RL	Reference Level
RR	Rolls Royce
SSC	Structures, Systems and Components

SMR ..... Small modular reactor

SNF ..... Spent Nuclear Fuel

SÚJB ..... Státní úřad pro jadernou bezpečnost
(State Office for Nuclear Safety)

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