

Site Visit Paks II and
28th Bilateral Meeting
Hungary-Austria



VISIT PAKS II AND 28th BILATERAL MEETING HUNGARY-AUSTRIA

30 November – 01 December 2022

Kurt Decker
Christoph Grützner

Project Manager Franz Meister (Umweltbundesamt, Industry & Energy Supply)

Authors Kurt Decker (Universität Wien)
Christoph Grützner (Universität Jena)

Layout Doris Weismayr

Title photograph © iStockphoto.com/imagestock

Contracting authority Bundesministerium für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie, Sektion VI – Klima- und Energie, Abteilung VI/8 – Allgemeine Koordination von Nuklearangelegenheiten;

GZ: 2021-0.557.724

Publications For further information about the publications of the Umweltbundesamt please go to: <https://www.umweltbundesamt.at/>

Imprint

Owner and Editor: Umweltbundesamt GmbH
Spittelauer Laende 5, 1090 Vienna/Austria

This publication is only available in electronic format at <https://www.umweltbundesamt.at/>.

© Umweltbundesamt GmbH, Vienna, 2022

All Rights reserved

ISBN 978-3-99004-661-6

CONTENTS

1	INTRODUCTION AND BACKGROUND	5
2	SITE VISIT PAKS II	6
3	OFF-AGENDA DISCUSSION OF THE SITE VISIT DURING THE HUNGARIAN-AUSTRIAN BILATERAL MEETING (BET)	8
4	INTERNATIONAL AND NATIONAL REGULATIONS AND GUIDELINES ON THE GEOLOGICAL DOCUMENTATION OF EXCAVATIONS FOR NPPS.....	9
5	CONCLUSIONS AND RECOMMENDATIONS	12
6	REFERENCES	13

1 INTRODUCTION AND BACKGROUND

Hungary and Austria are currently involved in a technical discussion on the geological site characteristics of the Paks II NPP. Discussion focuses on the potential capability of the Dunaszentgyörgy-Harta fault zone and linked subordinate structures, and the possible existence of capable faults on the Paks site. In 2021 EEA¹ experts concluded that the geological and geophysical data documented in the Geological Site Report and the Site Safety Report of the Paks II NPP are not sufficient to reliably exclude the potential of a permanent surface displacement (fault capability) at the site as required by the Hungarian Governmental Decree No. 118 of 2011, requirement 7.3.1.1100 (Decker et al., 2021). The authors concluded that, on the contrary, the paleoseismological data derived from the trench Pa-21-II next to the site confirm the existence of capable faults in the site vicinity of Paks II.

In February 2022 the issue was discussed in the Hungarian-Austrian professional workshop on the Paks II site characteristics in Budapest hosted by the HAEA. The EAA experts summarized their view on results of this workshop in a report by Decker et al. (2022).

In November 2022, the Hungarian Atomic Agency Authority (HAEA) and Paks II Ltd. invited an Austrian delegation including the EAA expert team to visit the construction site and the construction pit of Paks II NPP. This visit was organized in time connection with the 28th Bilateral Meeting on Issues of Common Interest in the Field of Nuclear Safety and Radiation Protection (BET) between Hungary and Austria and took place on 30. November 2022.

The results of the visit were then shortly discussed in the 28th BET on 01. December 2022, although the issue of the Paks II site conditions was not part of the formal meeting agenda.

The site visit and the discussion off the agenda, was highly appreciated by the Austrian delegation to the BET and the EAA experts.

¹ EAA: Environmental Agency Austria

2 SITE VISIT PAKS II

The visit to the Paks II site was organized and guided by technical staff of Paks II Ltd. and observed by a representative of HAEA. The visit provided insights into the current stage of construction and the geological outcrop conditions of the open construction pit. The visit encompassed stops at a viewpoint North of the construction site, stops in the construction pit and a visit to the cooling water intake channel of the existing NPP.

Excavations of the pit down to the “-5 m level” had already been completed at the time of the visit. The pit exposed virtually continuous soil profiles along the slopes around the pit, and the horizontal section at the bottom of the pit. The slopes of the pit are inclined by about 45°. Parts of the slopes were covered by geotextile and not accessible for geological assessment.

Open slopes exposed the following succession of sediments (from top to base):

- Anthropogenic landfill (about 1-4 m thick)
- Native soil (ca. 0.5 m thick) forming a layer of strong color contrast (black to dark-brown) at the base of the anthropogenic deposits. The soil layer was exposed in virtually all of the slopes and in parts of the floor of the excavation at -5 m.
- Fine sand with abundant shells (bivalves and gastropods). Further differentiation of these natural sediments was not possible under the conditions of the visit.

The thickness of natural soil and sediments exposed below the landfill material reached up to about 3 m. Slopes had been excavated with serrated excavator shovels leaving very “rough” surfaces that did not permit detailed geological and paleoseismological observations.

During the site visit technical staff of Paks II Ltd. informed the Austrian delegation about the following:

- A geological documentation of the construction pit and the profiles exposed in slopes has not been accomplished, and Paks II Ltd. was not intending such documentation in the future. This referred to both, the existing exposures and to exposures created during the next steps of excavation down to the target level of -27 m. Paks II Ltd. regarded the results of site investigation as final saying that continued geological investigations and documentations would render the results of the geological site assessment as not reliable. Paks II Ltd. therefore would not provide any documentation necessary to exclude the presence of faults in the construction pit.
- Geological documentations of the construction pit are not required by the licenses issued by HAEA so far (including the license for excavating down to the -5 m level).

- HAEA required soil conditioning of the soil profile below the nuclear island to exclude soil liquefaction. The EAA experts understood that soil conditioning should include water extraction from the liquefiable layers and other measures not discussed in detail.
- A retaining wall shall be emplaced before continuing excavation to the level of -27 m.
- Paks II Ltd. expected a time frame of about 9 months for implementing the two last mentioned measures.
- The representatives of Paks II Ltd. offered the possibility of additional site visits to observe the progress. This offer was gratefully accepted.

The EAA experts concluded the following from the site visit:

- The existing exposures in the slopes around the construction (100% exposed) provide a unique opportunity to document continuous profiles around all safety-related engineered structures of Paks II in order to exclude the occurrence of faults offsetting the exposed Quaternary strata in this part of the site.
- The slope angles of about 45° of the existing profiles guarantee safe conditions for geological and paleoseismological documentation work without further safety measures.
- For meaningful geological or paleoseismological documentations smooth and clean surfaces of the slopes need to be established, e.g., by smoothing the rough surface with smooth excavator shovels. The effort for such out-crop cleaning is regarded to be very limited.
- The cleaned floor of the construction pit would provide the unique opportunity to check for the (non-)existence of an active fault in 3D.

3 OFF-AGENDA DISCUSSION OF THE SITE VISIT DURING THE HUNGARIAN-AUSTRIAN BILATERAL MEETING (BET)

In the discussion the EAA experts expressed their surprise about not documenting the geology of the construction site of the reactor building and the other constructions relevant to nuclear safety. In their opinion, a thorough geological and paleoseismological documentation is necessary to exclude the presence of Quaternary and/or capable faults below the foundations of the reactor blocks and other constructions relevant to nuclear safety.

The existing exposures along the slopes down to the -5 m level and the future exposures that will be opened during the excavation down to the -27 level offer the unique opportunity to exclude the existence of faults in the concerned Quaternary sediments. The EAA experts added that demonstrating the absence of Quaternary and/or capable faults could also facilitate meeting the WENRA Safety Objectives for New NPPs (WENRA, 2010; 2013) and demonstrating the practical elimination of early or large releases for accident scenarios initiated by seismotectonic hazards (RHWG, 2019). A detailed discussion of the issue was provided by H. Hirsch in the report by Decker et al., 2021 (p. 70-72).

The EAA experts further noted that detailed geological mapping of excavations for safety related structures was also required or recommended by IAEA Specific Safety Requirements, guidelines by the IAEA and several national regulatory bodies. A selection of relevant papers is cited in Chapter 3 below.

The HAEA replied that it could be difficult to require a geological documentation of the excavations due to the fact that the relevant licenses have already been issued without adding the geological documentation as a license condition. The EAA experts, however, understood that the license for starting excavation to the -27 m level was still pending.

As a result of the off-agenda discussion HAEA invited Austrian representatives and the EAA experts for a second expert workshop on the Paks II site conditions. The technical meeting should be held in January, 2023. The Austrian delegation gratefully accepted this invitation and confirmed its readiness to continue the technical discussion.

4 INTERNATIONAL AND NATIONAL REGULATIONS AND GUIDELINES ON THE GEOLOGICAL DOCUMENTATION OF EXCAVATIONS FOR NPPS

IAEA, 2019. Site Evaluation for Nuclear Installations. IAEA Safety Standards, Specific Safety Requirements No. SSR-1²:

*“5.3 The potential effect of fault displacement on safety related structures, systems and components shall be evaluated. **The evaluation of fault displacement hazards shall include detailed geological mapping of excavations for safety related engineered structures** to enable the evaluation of fault capability for the site.”* (p.18).

IAEA, 2004. Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants. IAEA Safety Standards, Safety Guide No. IAEA NS-G-3.6³:

“4.1. This section addresses the geotechnical aspects of preliminary foundation work. ... These activities directly affect the performance of the foundation under the anticipated loading conditions and are therefore critical to safety. They may include:

- ...
- **Mapping of excavations;**
- ...

*4.2. The **earthwork aspects of these activities should include** testing requirements for proper control and **documentation of construction.** ...* (p. 27).

U.S.NRC, 2021. Geological and Geotechnical Site Characterization Investigations for Nuclear Power Plants. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.132, Revision 3⁴:

“6. Construction Mapping

*It is necessary to confirm that in situ conditions revealed in excavations for safety-related structures were accurately captured and interpreted during the preconstruction site characterization stage to ensure that information related to actual in situ conditions is properly incorporated into plant design analyses. **Detailed geologic mapping should be performed for all construction excavations for safety-related structures and other excavations important for verification of subsurface conditions (e.g., cut slopes, tunnels, chambers, and water inlets and outlets).** Particular attention should be given to geologic features and characteristics that might be important in assessment of the behavior of foundation materials, **including tectonic and nontectonic features** and lithologic variations, which might*

² https://www-pub.iaea.org/MTCD/Publications/PDF/P1837_web.pdf

³ https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1195_web.pdf

⁴ <https://www.nrc.gov/docs/ML2129/ML21298A054.pdf>

be undetected and different from what was assumed based on the results of site investigations prior to excavations. The detailed geologic mapping should be performed after the completion of excavations and before placement of backfill.

*The importance of the geologic mapping is reinforced by the geologic mapping license condition normally imposed in a combined or construction license. This license condition requires a licensee to commit to performing the following associated activities: (1) conduct detailed geologic mapping of excavations for safety-related structures, (2) examine and evaluate geologic features discovered in those excavations, and (3) notify the NRC once the excavations are open for inspection by NRC staff. Changes in foundation design that result from information acquired by the detailed geologic mapping should be noted on appropriate plans and included in maps, cross sections, and the database. All pertinent newly discovered geologic features should be evaluated for their potential impact on foundation materials. **This evaluation might require relative or absolute age dates on certain features and particular tectonic structures such as faults and shear zones.** The maps, cross sections, and database should include any features installed to improve, modify, or control geologic conditions (e.g., reinforcing systems, permanent dewatering systems, and special treatment areas). Photographic records of foundation geologic mapping and treatments should be made and retained in the database. The GIS and other databases should be continuously updated, up to and including the construction phase, resulting in inclusion of final as-built information in the database.*

*Appendix A to **NUREG/CR-57385** provides detailed guidance on appropriate technical procedures for geologic mapping of foundation materials. ...” (p. 22).*

ASN, 1985. Etudes géologiques et géotechniques du site; détermination des caractéristiques des sols et études du comportement des terrains. Rule No. 1.3.c (1er August 1985)⁶:

*“2.2.2. ... L'étude de la géologie du site comprend la reconnaissance des différents sols et/ou roches et de leurs dispositions géométriques, le relevé de leurs discontinuités significatives pour l'analyse envisagée et les éventuelles variations au sein des différentes formations. A cet effet, l'étude de la géologie du site doit comprendre, sauf cas particuliers justifiés, des essais d'investigations propres à la géophysique. En outre, **avant réception pour bétonnage, il est procédé à un lever géologique des fonds de fouilles.**” ...*

*“2.2.4. Rejeux * de faille.*

Les données sismotectoniques actuellement disponibles en France montrent que les rejeux de faille en surface sont actuellement exceptionnels. Cependant, si les reconnaissances des terrains du site mettent en évidence certains accidents pouvant être interprétés comme des manifestations de telles failles, il y a lieu de s'assurer par une

5 NUREG/CR35738, 1999. Field Investigations for Foundations of Nuclear Power Facilities. U.S. NRC, Washington. <https://www.nrc.gov/docs/ML0037/ML003726925.pdf>

6 <https://www.asn.fr/l-asn-reglemente/rfs/rfs-relatives-aux-rep/rfs-i.3.c.-01-08-1985>

analyse tectonique et néotectonique détaillée que le risque de rejeu, pendant la durée de vie de l'installation, peut être écarté.”

5 CONCLUSIONS AND RECOMMENDATIONS

The opportunity to visit the construction site, the openness allowing to visit all relevant parts of the site, and the first-hand information obtained by Paks II Ltd. is highly appreciated. Paks II Ltd. organized the visit in a way that fostered the mutual understanding, although differences in opinion exist. The invitation to follow-up site visits must be particularly emphasized here. The EAA experts further acknowledge HAEA's courtesy to discuss the issue at the 28th BET and invite the experts to a second technical meeting on the Paks II site conditions, expected to be held in January, 2023.

The EAA experts recommend that HAEA issues a regulatory decision requiring targeted geological documentation and paleoseismological investigations of the excavation pit with the aim to prove the non-existence of active and/or capable faults below the foundations of the reactor buildings and other safety related engineered structures. Such decision would be in line with the IAEA Specific Safety Requirements (IAEA SSR-1) and national requirements in other countries (see paragraph above).

Geological documentation and paleoseismological investigations should include both, the existing exposures down to the -5 m level and new exposures resulting from excavation down to the -27 m level. The EEA experts note that a meaningful paleoseismological documentation can only be obtained from excavations with thoroughly cleaned trench-wall surfaces and rigorous stratigraphic and structural logging. Such conditions cannot be expected from routine earthwork and excavations reaching below the groundwater table. Excavations therefore need to provide adequate time for establishing such outcrop conditions and documenting the profiles in sufficient detail. A convincing data set to disprove the existence of capable faults will have to cover the whole stretch of the excavation pit and, as a minimum, the whole length of the future reactor buildings and other infrastructure relevant to safety.

Information on the project planning obtained from Paks II Ltd. indicated a currently open time window in which adequate investigations could at least be performed for the exposures down to the -5 m level without conflicting with other works.

6 REFERENCES

- ASN, 1985. Etudes géologiques et géotechniques du site; détermination des caractéristiques des sols et études du comportement des terrains. Rule No. 1.3.c (1er August 1985), 7 pp. <https://www.asn.fr/l-asn-reglemente/rfs/rfs-relatives-aux-rep/rfs-i.3.c.-01-08-1985>
- Decker, K. & Hintersberger, E., 2021. NPP Paks II Paleoseismological assessment of the Siting Report and the Site License with respect to fault capability. Umweltbundesamt / Environment Agency Austria, Report REP-0759, 91pp.
- Decker, K., Grützner, C., Hintersberger, E. & Strecker, M., 2022. Workshop on the Paks II site characteristics. Assessment of the Hungarian-Austrian professional workshop on the Paks II site characteristics in Budapest, Feb 15, 2022. Environment Agency Austria (Umweltbundesamt), Report REP-0828, 64pp., 3 appendices.
- IAEA, 2004. Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants. IAEA Safety Standards, Safety Guide No. IAEA NS-G-3.6, 67pp. https://www-pub.iaea.org/MTCD/Publications/PDF/Pub1195_web.pdf
- IAEA, 2019. Site Evaluation for Nuclear Installations. IAEA Safety Standards, Specific Safety Requirements No. SSR-1, 56 pp. https://www-pub.iaea.org/MTCD/Publications/PDF/P1837_web.pdf
- NUREG/CR35738, 1999. Field Investigations for Foundations of Nuclear Power Facilities. U.S. NRC, Washington, 147pp. <https://www.nrc.gov/docs/ML0037/ML003726925.pdf>
- U.S.NRC, 2021. Geological and Geotechnical Site Characterization Investigations for Nuclear Power Plants. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.132, Revision 3, 56pp. <https://www.nrc.gov/docs/ML2129/ML21298A054.pdf>

Umweltbundesamt GmbH

Spittelauer Laende 5
1090 Vienna/Austria

Tel.: +43-(0)1-313 04

office@umweltbundesamt.at
www.umweltbundesamt.at