REPUBLIC OF SLOVENIA
MINISTRY OF THE ENVIRONMENT AND SPATIAL PLANNING

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Pursuant to Article 38a of the State Administration Act (Official Gazette of RS, Nos. 113/05 [official consolidated version], 89/07 [Constitutional Court decision], 126/07 [ZUP-E], 48/09, 8/10 [ZUP-G], 8/12 [ZVRS-F], 21/12, 47/13, 12/14, 90/14, 51/16, 36/21,82/21 and 189/21), the second paragraph of Article 61 of the Environmental Protection Act (Official Gazette of RS, Nos. 39/06 [UPB], 49/06 [ZMetD], 66/06 [Constitutional Court decision], 33/07 [ZPNačrt], 57/08 [ZFO-1A], 70/08, 108/09, 108/09 [ZPNačrt-A], 48/12, 57/12, 92/13, 56/15, 102/15, 30/16, 61/17 [GZ], 21/18 [ZNOrg], 84/18 [ZIURKOE] and 158/20) and the seventh paragraph of Article 105 of the Nature Conservation Act (Official Gazette of RS, Nos. 96/04 [UPB], 61/06[ZDru-1], 8/10 [ZSKZ-B], 46/14, 21/18 [ZNOrg], 31/18 and 82/20), the Ministry of the Environment and Spatial Planning hereby issues, in the administrative matter of the granting of an environmental protection consent for the extension of the operational lifetime of Krško nuclear power plant from 40 to 60 years, to the developer of the project, Nuklearna elektrarna Krško, d.o.o., Vrbina 12, 8370 Krško, represented by president of the management board Stane Rožman and member of the management board Saša Medaković, the following

E N V I R O N M E N T A L P R O T E C T I O N C O N S E N T

I. An environmental protection consent for the following project is granted to the developer of the project, Nuklearna elektrarna Krško, d.o.o., Vrbina 12, 8370 Krško: extension of the operational lifetime of NEK from 40 to 60 years on land in the cadastral municipality of 1321 Leskovec, land parcel nos. 1197/44, 1204/192, 1197/397, 1246/2, 1197/398 (partial), 1204/206, 1204/209, 1246/6, 1249/1, 1246/33, 1195/107, 1195/109 and 1195/111.

II. This environmental protection consent is issued under the following conditions:

1. <u>Conditions for the protection of surface waters, groundwater and the natural environment, including from the standpoint of climate change:</u>
   1. continuous measurements of the Sava flow rate upstream of the offtake of Sava water for NEK must be carried out, or data on this flow rate obtained from Krško HPP, and records kept of the measurement results;
   2. when the NEK dam is in operation, continuous measurements of the Sava flow rate at the dam must be carried out and records kept of the measurement results;
   3. continuous measurements of the flow rate of the offtake of Sava water for NEK must be taken at the measuring point at Gauss-Krüger coordinates Y=540294 and X= 88198 in cadastral municipality 1321 Leskovec, land parcel no 1249/1, and records kept of the measurement results;
   4. continuous measurements of the temperature of the Sava must be taken at the measuring point at Gauss-Krüger coordinates Y=540294 and X= 88198 in cadastral municipality 1321 Leskovec, land parcel no. 1249/1, at the offtake of Sava water for NEK, and records kept of the measurement results;
   5. continuous measurements must be taken of the temperature and flow rate of wastewater from NEK for at least wastewater from the small SW cooling system,

wastewater from the cooling of the condenser in the large CW cooling system and cooling water from the cooling towers of the large CW cooling system, and records kept of the measurement results;

6. continuous measurements must be taken of the flow rate at the time wastewater is sampled under the preceding point (performed as part of operational monitoring), where these measurements must be performed by an authorised operational wastewater monitoring contractor;
7. measuring points for the implementation of operational wastewater monitoring must be set up;
8. continuous measurements must be taken of the wastewater flow rate for every 100,000 m^3 of the annual quantity of wastewater from the discharge from which the highest annual quantity of wastewater flows (V2 (flushing of the rotating rakes), V3 (discharge from fire protection pumps), V4 (essential service water), V5 (flushing of the travelling screens) or V6 (pumping during an outage);
9. the point at which the Sava and wastewater from NEK are completely mixed must be determined at the macro-location of the old steel bridge in Brežice, a measuring point set up at that location, continuous measurements taken of the temperature and records kept of the measurement results;
10. steps must be taken to ensure that the average daily emission proportion of transmitted heat from NEK at the point at which the Sava and wastewater from NEK are completely mixed (with due regard to the cumulative figure for all wastewater discharges from NEK), calculated for the daily average of all actual flow rates (watercourse and wastewater), does not exceed the limit emission proportion of transmitted heat, which is 1;
11. steps must be taken to ensure that the discharge of wastewater does not heat the Sava by more than 3°C above its natural temperature, where the daily average temperature increase of the Sava (ΔT) is calculated as the difference between the average daily temperatures measured at the offtake of Sava water for NEK and the daily average temperatures measured at the point at which the Sava and wastewater from NEK are completely mixed;
12. electricity generated at NEK must be reduced accordingly if the requirements set out in the two preceding points cannot be met;
13. the cooling towers need to be in operation if the flow rate is less than 100 m^3/s as measured upstream from the offtake of Sava water for NEK;
14. 24-hour sampling of Sava water at the offtake for NEK must be carried out and an analysis performed of the parameters of insoluble and suspended substances at the measuring point at Gauss-Krüger coordinates Y=540294 and X= 88198 in cadastral municipality 1321 Leskovec, land parcel no 1249/1, when the concentrations of insoluble and suspended substances in the river are elevated as a result of a high flow rate. This sampling must be performed at the same time as the sampling of wastewater at measuring points MM1, MM3 and MM4 from the environmental protection permit;
15. prior to discharge into the Sava, NEK must take its own measurements of boron in wastewater in which boron can appear, and records kept of the measurement results;
16. extreme weather events must be monitored constantly and analysed in detail. If the effects of extreme weather events exceed the design bases of the structures, systems or components of the power plant, those SSCs must be upgraded on the basis of an analysis, or protected against the effects of such extreme events. In periods not longer than the interval between two consecutive periodic safety reviews, the cumulative impact of extreme weather events, including combinations of such events, must be subjected to an in-depth analysis.

III. An environmental protection consent is being granted instead of a nature protection consent because an environmental impact assessment procedure is being carried out for the extension of NEK's operational lifetime from 40 to 60 years.

IV. This environmental protection consent shall cease to be valid if the developer does not begin the project within five years of the entry into force of the consent.

V. No costs were incurred in this procedure.

G r o u n d s

On 15 October 2021 the Environment Directorate at the Ministry of the Environment and Spatial Planning (hereinafter: ministry) received an application from the developer of the project, Nuklearna elektrarna Krško, d.o.o., Vrbina 12, 8370 Krško, represented by president of the management board Stane Rožman and member of the management board Saša Medaković (hereinafter: developer) for an environmental protection consent for the extension of the operational lifetime of NEK from 40 to 60 years in the cadastral municipality of 1321 Leskovec, land parcel nos. 1197/44, 1204/192, 1197/397, 1246/2, 1197/398 (partial), 1204/206, 1204/209, 1246/6, 1249/1, 1246/33, 1195/107, 1195/109 and 1195/111.

The following were enclosed with the application:
- Project: Long Term Operation of Krško Nuclear Power Plant (2023–2043), no. NEK ESD – RP – 205, Revision 3, October 2021 (Nuklearna elektrarna Krško, d.o.o., Vrbina 12, 8270 Krško);
- Environmental Impact Assessment Report for the Extension of NEK's Operational Lifetime from 40 to 60 years – Nuklearna elektrarna Krško d.o.o. no. 100820-dn, October 2021 (E-NET OKOLJE d.o.o., Linhartova cesta 13, 1000 Ljubljana);
- Supplement Assessing the Acceptability of the Impacts on Protected Areas for the Extension of NEK's Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o., order no.: 1456-20 VO, October 2021 (AQUARIUS d.o.o. Ljubljana, cesta Andreja Bitenca 68, 1000 Ljubljana);
- Soil Status Report for the Site of the Planned Construction of an SFDS Facility for Nuklearna elektrarna Krško d.o.o., no. 360/2020, 29 July 2020 (TALUM INŠTITUT, raziskava materialov in varstvo okolja, d.o.o., Tovarniška cesta 10, SI-2325 Kidričevo).

The application was supplemented with the following documentation on 9 November 2021:
- Environmental Impact Assessment Report for the Extension of NEK's Operational Lifetime from 40 to 60 years – Nuklearna elektrarna Krško d.o.o. no. 100820-dn, October 2021, supplemented 8 November 2021 (E-NET OKOLJE d.o.o., Linhartova cesta 13, 1000 Ljubljana);

The application was supplemented again with the following documentation on 10 January 2022:
- Second supplement to the application for an environmental protection consent for the extension of NEK's operational lifetime from 40 to 60 years (letter), no. ING.DOV-007.22, 10 January 2022.
- Environmental Impact Assessment Report for the Extension of NEK's Operational Lifetime from 40 to 60 years – Nuklearna elektrarna Krško d.o.o. no. 100820-dn, October 2021, supplemented 8 November 2021 and 10 January 2022 (E-NET OKOLJE d.o.o., Linhartova cesta 13, 1000 Ljubljana);
- Supplement Assessing the Acceptability of the Impacts on Protected Areas for the Extension of NEK's Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o., order no.: 1456-20 VO, October 2021, supplemented January 2022 (AQUARIUS d.o.o. Ljubljana, cesta Andreja Bitenca 68, 1000 Ljubljana).

Pursuant to Article 50 of the Environmental Protection Act (Official Gazette of RS, Nos. 39/06 [ZVO-1-UPB1], 49/06 [ZMetD], 66/06 [Constitutional Court decision], 33/07 [ZPNačrt], 57/08 [ZFO-1A], 70/08, 108/09, 108/09 [ZPNačrt-A], 48/12, 57/12, 92/13, 56/15, 102/15, 30/16, 61/17 [GZ], 21/18 [ZNOrg], 84/18 [ZIURKOE] and 158/20, hereinafter: ZVO-1), prior to the start of any activity that could have a significant impact on the environment, an assessment of its impact on the environment must be conducted and an environmental protection consent obtained from the ministry. The obligation to carry out this assessment is laid down in the Decree on activities affecting the environment for which an environmental impact assessment is mandatory (Official Gazette of RS, Nos. 51/14, 57/15, 26/17 and 105/20).

In accordance with point D Energy, D.III Renewable energy sources, D.II.1 Annex 1 to the Decree on activities affecting the environment, an environmental impact assessment is mandatory in the case of nuclear power plants and other nuclear reactors, including their decommissioning or removal.[13]
Footnote 13 states: “Nuclear power stations and other nuclear reactors cease to be such an installation when all nuclear fuel and other radioactively contaminated elements have been removed permanently from the installation site.”

According to the second paragraph of Article 2 of the Decree on activities affecting the environment for which an environmental impact assessment is mandatory, an environmental impact assessment is also mandatory for a modification to an activity affecting the environment regardless of whether an environmental protection consent or decision has been obtained for the activity affecting the environment in a screening procedure prior to modification under the law governing environmental protection if it concerns a modification referred to in the previous paragraph which, in itself, reaches or surpasses the threshold or a multiplication of the threshold set for this type of activity in Annex 1 to this Decree; Article 3 of this Decree, which reaches or surpasses the threshold or a multiplier of the threshold set for this type of activity in the description of the type of activity marked with an X in the column titled EIA in Annex 1 to this decree.

According to the second paragraph of Article 3 of the Decree on activities affecting the environment for which an environmental impact assessment is mandatory, a screening procedure is carried out for a modification to an activity as referred to in the first paragraph of the previous article for which an environmental protection consent has been obtained prior to modification, if it concerns a modification that, in itself, reaches or surpasses the threshold or a multiplication of the threshold for which a screening procedure must be carried out for this type of activity under Annex 1 to this Decree, where the activity, together with the previous changes will reach or surpass the threshold at which a screening procedure must be carried out for this type of activity under Annex 1 to this Decree, or a multiplication of the threshold.

According to the fourth paragraph of Article 3 of the Decree on activities affecting the environment for which an environmental impact assessment is mandatory, screening shall also be carried out for a modification to an activity as referred to in the first paragraph of the previous article or the first paragraph of this Article for which Annex 1 to this Decree does not set a threshold.

In addition to this, point 6 of Article 1a of the Decree explains that a modification to an activity affecting the environment is a modification permitted in accordance with the regulations, is under way or has been completed, where the impacts on the essential characteristics of the activity are such that its environmental impacts increase significantly or can be expected to increase significantly.

A screening procedure was conducted for the lifetime extension and, on 2 October 2020, decision no. 35405-286/2016-42 was issued by the Slovenian Environment Agency, Vojkova 1b, 1000 Ljubljana. That decision states that, for the extension of the operational lifetime of NEK from 40 to 60 years, i.e. until 2043 in cadastral municipality 1321 Leskovec, land parcel nos. 1197/44 and 1204/192, the developer is required to carry out an environmental impact assessment and obtain an environmental protection consent.

It has been established that the planned activity (lifetime extension) involves a modification that affects the essential characteristics of the existing activity, since NEK's operational lifetime is being extended until 2043 (i.e. an extension of operation) and, because of the modification, the impacts would significantly increase or a significant increase in environmental impacts can be expected as a result of the planned modification. It was also established that the planned activity (lifetime extension) was functionally and economically related to at least another planned activity, i.e. the construction of a spent fuel dry storage building.

The impact area for protected areas (protected areas and Natura 2000 areas) is determined in the Rules on the assessment of the acceptability of impacts caused by the execution of plans and activities affecting nature in protected areas (Official Gazette of RS, Nos. 130/04, 53/06, 38/10, 3/11, hereinafter: the Rules). Article 5 of the Rules provides as follows: (1) The assessment of the acceptability is carried out for plans that may have a significant impact on protected areas, either on their own or as cumulative impacts. (2) Plans that may have a significant impact on protected areas are those which, due to the implementation of activities affecting nature as set out in Annex 2 to these Rules, designate the intended use of land or the modifications thereof (hereinafter: designation of the intended use of land) as set out in Annex 1, which is an integral part of these Rules, and those plans that designate or plan said activities affecting nature in protected areas, or in areas whose distance from protected areas is smaller than the maximum area of remote impact specified for activities affecting nature in Annex 2 to these Rules.
According to the Decree on the classification of buildings (Official Gazette of RS, No. 37/18), the NEK complex is a built industrial complex. According to the Rules, complex industrial buildings are defined in Chapter II of Annex 2 as: areas of production activities that are areas of direct impact (100 m) for all groups, and areas of remote impact (1,000 m) for birds, bats, aquatic and riparian habitat types, and beetles.
Article 20 of the Rules further provides: (4) Remote impact is established if the plan envisages an activity affecting nature, as defined in Chapters I to XVIII of Annex 2 to these Rules, in the area of remote impact, except for those types of activity for which an environmental impact assessment is mandatory in accordance with the regulation governing the types of activities affecting the environment for which an environmental impact assessment is mandatory. For activities that require an environmental impact assessment, the remote impact is established in an area twice as large as the remote impact area referred to in Annex 2 of those Rules, unless findings from the field, detailed data on the implementation of the activity or other factual circumstances indicate that the area of remote impact is different. (5) The area of remote impact established for a specific activity affecting the environment may differ at any time from the area of remote impact of an activity affecting the environment referred to in Annex 2 of these Rules if this is based on findings from the field, detailed data on implementation of the activity and other actual circumstances.
It follows from the above that the area of remote impact for the lifetime extension under the Rules is 2,000 m. There are no protected areas in the area of direct impact. There is one Natura 2000 area situated in the area of remote impact (2,000 m) according to the provisions of the Decree on special protection areas (Natura 2000 areas) (Official Gazette of RS, Nos. 49/04, 110/04, 59/07, 43/08, 8/12, 33/13, 35/13 [corrigendum], 39/13 [Constitutional Court decision], 3/14, 21/16 and 47/18): Vrbina SAC (SI3000234), at a distance of approx. 350 m.
Under Article 20 of the Rules, the area of remote impact established for a specific activity affecting the environment may differ at any time from the area of remote impact of an activity affecting the environment referred to in Annex 2 of these Rules if this is based on preliminary findings from the field, detailed data on implementation of the activity and other actual circumstances. NEK uses water from the Sava river to operate its cooling systems. The plant has 9 discharges through which wastewater flows into the Sava. In addition to the remote impact within a radius of 2,000 m as defined by the Rules, remote impact is therefore also possible downstream along the Sava.

A Supplement Assessing the Acceptability of the Impacts on Protected Areas for the Extension of NEK's Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o., order no.: 1456-20 VO, October 2021, supplemented January 2022 (AQUARIUS d.o.o. Ljubljana, Cesta Andreja Bitenca 68, 1000 Ljubljana) was drawn up under the assumption that the area of remote impact downstream along the Sava stretches up to 8 km downstream of the discharges from NEK, where the Lower Sava SAC has been declared a Natura 2000 area (SI3000304).

Pursuant to the first paragraph of Article 61 of the ZVO-1, which provides that the ministry shall send applications for environmental protection consents and a draft decision on an environmental protection consent to ministries and organisations that are competent for individual environmental protection matters, the protection or use of natural resources, or the protection of cultural heritage with respect to the planned activity, the ministry requested that the following issue an opinion on the acceptability of the planned activity within 21 days of receiving the application:

- Slovenian Nuclear Safety Administration, Litostrojska cesta 54, 1000 Ljubljana;
- Institute of the Republic of Slovenia for Nature Conservation, Tobačna ulica 5, 1000 Ljubljana;
- Fisheries Research Institute of Slovenia, Spodnje Gameljne 61a, 1211 Ljubljana – Šmartno;
- Ministry Of Health, Public Health Directorate, Štefanova ulica 5, 1000 Ljubljana;
- Slovenian Water Agency, Mariborska cesta 88, 3000 Celje;
- Slovenian Environment Agency, Vojkova 1b, 1000 Ljubljana.

On 7 December 2021 the ministry received an opinion from the Slovenian Nuclear Safety Administration, Litostrojska cesta 54, 1000 Ljubljana (hereinafter: URSJV) no. 3570-13/2020/27, 7 December 2021. After reviewing the Environmental Impact Assessment Report for the Extension of NEK's Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o., no. 100820-dn, October 2021, supplemented 8 November 2021 (E-NET OKOLJE d.o.o.), the URSJV established that the report dealt satisfactorily with issues relating to nuclear safety and ionising radiation protection. The URSJV then gave a positive opinion, with the following condition attached:
"The operator of the power plant must monitor extreme weather events constantly and analyse them in detail. If the effects of extreme weather events exceed the design bases of the structures, systems or components of the power plant, those SSCs must be upgraded on the basis of an analysis, or protected against the effects of such extreme events. In periods not longer than the interval between two consecutive periodic safety reviews, the cumulative impact of extreme weather events, including combinations of such events, must be subjected to an in-depth analysis."
In connection with this condition, which the ministry has incorporated into the operative part of this environmental protection consent, the URSJV explains that the environmental impact assessment addresses the impact of extreme weather events and climate change on the safety aspects of the activity (lifetime extension) (Section 5.6.1.2), and that the environmental impact assessment report estimates that the impact of the lifetime extension and overall impact from the standpoint of climate change on the activity during operation will be "3" (impact not significant) as a result of the mitigation measures that NEK already implements and that it is obliged to continue to implement during extended operation. Of these measures, the following are particularly important for maintaining nuclear safety:

- the structures, systems and components of the power plant are dimensioned to withstand extreme weather events and meteorological parameters by ensuring highly conservative margins;
- the periodic safety review, which is performed every 10 years, includes a deep analysis of the impact of extreme weather events on the safety of the power plant.

As a result of the climate changes that the environmental impact assessment report predicts will take place during the period leading up to the end of the NEK lifetime extension, the frequency or impact of extreme weather events could increase. NEK must therefore monitor such events particularly carefully, analyse them in detail and take the appropriate steps set out as a condition in the operative part of the URSJV opinion. The basis for addressing extreme events and planning power plant structures, systems and components so that they are able to withstand those events are requirements

set out in the Rules on radiation and nuclear safety factors (Official Gazette of RS, Nos. 74/16 and 76/17 [ZVISJV-1])), particularly Annex 1, Chapter 5.
In the opinion, the URSJV goes on to propose specific technical amendments to the environmental impact assessment by suggesting a number of explanations that could be added to the report. The URSJV also suggests that corrections be made to the draft environmental protection consent in response to the deficiencies established.

On 7 December 2021 the ministry also received an opinion from the Ministry of Health, Public Health Directorate, Štefanova ulica 5, 1000 Ljubljana (no. 354-108/2018-24, 6 December 2021) with an annex titled "Opinion under Article 61 of the ZVO-1 on the acceptability of a planned activity from the aspect of impacts on human health" for the extension of the operational lifetime of NEK from 40 to 60 years. It was drafted under reference no. 354-142/2018-7 (256) by the Health Ecology Centre of the National Institute of Public Health, Trubarjeva cesta 2, 1000 Ljubljana (hereinafter: NIJZ) and dated 6 December 2021. Based on the data provided in the documentation enclosed, the NIJZ believes that the lifetime extension is acceptable from the aspect of its impact on human health. The opinion further states that the environmental impact assessment report adequately addresses the potential environmental impacts on human health, and refers to additional mitigation measures required to protect human health. The results of the checks made of the expected environmental impacts that are caused by the activity and that could have an impact on human health and well-being showed that changes to specific elements of the environment (quality of ambient air, noise pollution, quality of surface waters and groundwater, drinking water supply, waste management, wastewater management, electromagnetic radiation, light pollution) are, given the additional mitigation measures set out in the report, very unlikely to have a significant impact on human health.
The NIJZ remarks that the opinion does not relate to impacts of the planned activity (lifetime extension) on human health relating to radioactive radiation regardless of medium (air, water, soil, waste) and regardless of phase (construction, operation or decommissioning) or of whether a nuclear accident occurs in connection with the extension of NEK's lifetime from 40 to 60 years. The competent institutions with the appropriate authorisations will produce an opinion on the impacts of radioactive radiation on human health.

On 8 December 2021 the ministry received opinion no. 3562-0380/2021-6 (8 December 2021), which had been drafted by the Novo Mesto office of the Institute of the Republic of Slovenia for Nature Conservation (hereinafter: ZRSVN), Adamičeva ulica 2, 8000 Novo Mesto.
The ZRSVN produced the following expert opinion in the procedure of assessing the acceptability of the lifetime extension as part of the process of issuing an environmental protection consent pursuant to the provisions of Article 101e of the Nature Conservation Act (official consolidated version, Official Gazette of RS, Nos. 96/04 [ZON-UPB2], 61/06 [Zdru-1], 8/10 [ZSKZ-B] and 46/14, hereinafter: ZON) and the fourth paragraph of Article 40 of the Rules on the assessment of the acceptability of effects caused by the execution of plans and activities affecting nature in protected areas (Official Gazette of RS, Nos. 130/04, 53/06, 38/10 and 3/11) in accordance with the first paragraph of Article 61 of the Environmental Protection Act (Official Gazette of RS, Nos. 39/06, 70/08, 108/09, 48/12, 57/12 and 92/13):
A. Finding regarding the adequacy and compliance of the supplement to the environmental impact assessment report for protected areas:
after reviewing the material, the ZRSVN finds that the extension of NEK's operational lifetime does not affect Natura 2000 areas or other protected areas, and that it also lies outside the area of direct impact. Vrbina SAC and Lower Sava SAC (both Natura 2000 areas) are located within the area of remote impact. Lower Sava SAC is approx. 8 km from the NEK complex, although it is estimated that the potential impacts could reach that far.
The material therefore has a supplement for protected areas that the ZRSVN finds, after a review, has been drawn up in the appropriate way, is in compliance with the legislation and enables an assessment to be made. The following key summary follows from the enclosed supplement. Emissions of substances and heat by NEK present potential impacts on the Sava. To mitigate the

impact of thermal pollution, NEK will have to continue to comply with the provisions of the environmental protection permit (with regard to emissions into waters). A significant impact from NEK's operational lifetime extension is not expected as long as the provisions of the environmental protection permit are observed. While additional mitigation measures are not necessary, NEK must implement all measures to prevent excessive burdens from the discharge of wastewaters into the Sava, thus ensuring that wastewater parameters remain below the limit values set out in the environmental protection permit in future (temperature of the Sava when mixed with cooling water from NEK does not exceed the river's natural temperature by more than 3°C).
The ZRSVN goes on to highlight the following recommendation as a technical supplement to the documentation: that the material should clearly show the point of complete mixing, where the temperature of the Sava does not exceed the river's natural temperature by more than 3°C when mixed with cooling water from NEK, as the ZRSVN finds, after its review, that it has not been explicitly mentioned.

B. Finding on the acceptability of the impacts of the activity on protected areas:
After reviewing the material, the ZRSVN finds that the lifetime extension of NEK would not have a significant impact on protected areas or their integrity or connectedness if the conditions contained in the environmental protection permit and water consents already issued are adhered to.

The ZRSVN then produced the following expert opinion pursuant to the provisions of Article 117 of the Nature Conservation Act (Official Gazette of RS, Nos. 96/04 [ZON-UPB2], 61/06 [Zdru-1], 8/10 [ZSKZ-B] and 46/14, hereinafter: ZON):
A. Finding regarding the adequacy and compliance of the environmental impact assessment report:
After reviewing the material, the ZRSVN finds that the lifetime extension of NEK does not have a direct impact on natural resource areas, important ecological areas, the habitats of protected animal and plant species, or habitat types. The envisaged potential impacts relate primarily to the emissions of substances and heat into the Sava, an issue addressed adequately by the material. The ZRSVN finds that the lifetime extension of NEK alone would not have a significant impact on protected areas if the conditions contained in the environmental protection permit and water consents already issued are adhered to.
After reviewing the material contained in the environmental impact assessment report, the ZRSVN finds that it has been drawn up adequately and in accordance with the legislation. Section 7 of the environmental impact assessment report defines the measures for preventing, minimising and compensating for significant adverse impacts on the environment. They highlight the importance of complying with all the measures stemming from consents, permits and regulations already issued for the lifetime extension. Section 8 of the environmental impact assessment report defines the monitoring of the status of impact mitigation factors and measures.

B. Finding on the acceptability of the impacts of the activity on the natural environment:
After reviewing the material, the ZRSVN finds that the lifetime extension of NEK will not have a significant impact on valuable natural features, important ecological areas, the habitats of protected species or protected habitat types. As the lifetime extension is planned within the boundaries of the existing complex and operations, because no increase in environmental impact relative to the current situation is envisaged and because the existing operation already envisages measures to reduce environmental impact, the ZRSVN does not expect any major impact on the functional properties of the important ecological area. It therefore assesses the lifetime extension as acceptable if the environmental protection consents and permits already granted are adhered to.

On 13 December 2021 the ministry received an opinion from the Fisheries Research Institute of Slovenia (hereinafter: ZZRS), Sp. Gameljne 61a, 1211 Ljubljana – Šmartno no. 4204-61/2016-7, 13 December 2021. The ZZRS opinion states that the issues of freshwater fisheries and the protection of fish and fish habitats have been adequately addressed and considered in the environmental impact assessment report (E-NET OKOLJE d.o.o., Ljubljana, October 2021), that the report does state that the greatest adverse impact on fish comes from the temperature maximum in the summer months (as it can cause reduced levels of oxygen in the water or even overheating of organisms at extremely high temperatures), and that it is important, given the adverse impact of high water temperatures on fish, that the mitigation measures relating to water cooling be strictly observed. According to the opinion, the lifetime extension is acceptable from the standpoint of fisheries if all the mitigation measures contained in the environmental impact assessment report and the draft environmental protection consent are carried out.

On 15 December 2021 the ministry received an opinion from the Slovenian Environment Agency (hereinafter: ARSO), Vojkova 1b, 1000 Ljubljana (dated 15 December 2021). ARSO reports that the environmental impact assessment report (E-NET OKOLJE d.o.o., document no. 100820-dn, Ljubljana, October 2021, supplemented 8 November 2021, hereinafter: the report), addresses the issue of soil comprehensively, with expertise and in accordance with the Decree on the method of drafting and on the content of reports on the effects of planned activities affecting the environment (Official Gazette of RS, Nos. 36/09 and 40/17) and that a Soil Status Report for the Site of the Planned Construction of an SFDS Facility for Nuklearna elektrarna Krško d.o.o. (TALUM INŠTITUT, raziskava materialov in varstvo okolja, d.o.o., document no. 360/220, Kidričevo, 29 July 2020, hereinafter: soil status report) had been submitted in order to establish current soil status and quality. As part of the report process, soil sampling was carried out at the NEK site in order to determine any potential contamination of the soil. On the basis of the soil status report, ARSO established that the soil at the NEK site was not excessively contaminated and that the value of the parameters for dangerous substances in the soil did not exceed the limit immission values referred to in the Decree on limit values, alert thresholds and critical immission values of dangerous substances in soil (Official Gazette of RS, Nos. 68/96 and 41/04 [ZVO-1]). The ARSO opinion goes on to state that the scope of the lifetime extension consists exclusively of the continuation of operation of NEK for a further 20 years (i.e. an extension from 40 to 60 years, or from 2023 to 2043) using the existing operating characteristics, and does not envisage the construction of new structures or facilities that would change the physical characteristics of NEK. Based on the statements contained in the enclosed documentation, ARSO established that the lifetime extension did not involve the construction of structures or any activities affecting the soil. In light of all the facts outlined above, ARSO's opinion was that as long as the developer observed the measures for preventing, reducing or eliminating adverse effects on the environment and human health set out in the environmental impact assessment report and the applicable legislation during construction and operation, the planned activity (lifetime extension) was acceptable with regard to impact on the soil.
In the opinion, ARSO also made observations on the sections of the environmental impact assessment report that describe the existing chemical status of surface waters, and drew attention to the irregularities it had identified in the statements. The ARSO opinion states that Section 4.1.4 (Surface waters, Tables 27, 28 and 29) has correctly taken the assessments of the chemical status of surface waters from the Danube River Basin Management Plan 2022–2027; that Section 4.4.4 (Quality and quantities of surface waters and their use – Comments on the status of the water body) has been drawn up with reference to the periodic assessment for 2009–2013, but must be supplemented with reference to the periodic assessment on the basis of monitoring data for 2014–2019; and that this is important because assessment of chemical status must be entered for the most recent period (because poor chemical status has been determined in biota as a result of breaches of the environmental quality standard for mercury and brominated diphenyl ethers). The opinion goes on to state that Section 5.3.1.1 (Operation), which is part of Section 5.3.1 (Impacts on waters), must be updated in line with the periodic assessments for 2014–2019; that the chemical status of water bodies for the Management Plan 2022–2027 is good in this area for the water matrix, while the chemical status for the biota matrix and for the biota and water matrices together is poor; that assessments of status must be set out precisely and in the same way in all sections; that statements in the environmental impact assessment report must be amended to take account of the statements of ecological and chemical status of waters for the Management Plan 2022–2027 in this area; that Section 4.4.3 (Quality and quantities of groundwater and its use) does not make explicit reference to the assessment of the chemical status of groundwater for RBMP3; and that the status of the Krška

Kotlina for 2009–2020 has been correctly presented, as has the status at facilities close to NEK (Vrbina and Stari Grad) for 2006–2020. In the opinion, ARSO proposed that a table containing the results of ecological status by individual quality element for 2014–2019 for the Sava Krško-Vrbina, Sava Boštanj-Krško and Sava border section water bodies be added to Section 4.1.4 (Surface waters).

On 24 December 2021 the ministry also received an opinion from the Slovenian Water Agency (hereinafter: DRSV), Mariborska cesta 88, 3000 Celje (no. 35019-46/2021-9, 23 December 2021) that states that the impact of the lifetime extension on the water regime and water status has been adequately addressed; that the lifetime extension does not involve the implementation of additional activities within the existing NEK complex, but the continuation of operation, in line with all the prescribed conditions and the environmental and water permits issued; and that the developer has also been granted an extension of the water permit by the DRSV for the use of water for process purposes (cooling water) from 2039 to 2051. The DRSV opinion states that the lifetime extension is acceptable from the standpoint of impact on the water regime and water status if all the planned protective measures set out in the supplemented environmental impact assessment report are carried out.
The ministry explains that the statement regarding the extension of the water permit to 2051 is not entirely correct: only the permit granted for the SPW006 BB2 well is valid until 7 September 2051. The water permit for the West-1/19, South-1/19 and East-1/19 wells is valid until 31 October 2050, while the validity of the water permit for abstraction from the Sava at Gauss-Krüger coordinates Y= 540294, X= 88198, Z 150 m a.s.l. on land parcel no. 1246/6 in cadastral municipality 1321 Leskovec and from the well at Gauss-Krüger coordinates Y= 540269, X= 88045, Z 150.47 m a.s.l. on land parcel no. 1195/47 in cadastral municipality 1321 Leskovec expires on 31 August 2039.

In letter no. 35428-4/2021-2550-23 dated 15 December 2021, the ministry asked the developer to submit evidence, i.e. to respond to the opinions received and the administrative authority’s findings.

The developer responded to the request on 10 January 2022 by submitting the following documentation:

- Second supplement to the application for an environmental protection consent for the extension of NEK's operational lifetime from 40 to 60 years (letter), no. ING.DOV-007.22, 10 January 2022;
- Environmental Impact Assessment Report for the Extension of NEK’s Operational Lifetime from 40 to 60 years – Nuklearna elektrarna Krško d.o.o. no. 100820-dn, October 2021, supplemented 8 November 2021 and 10 January 2022 (E-NET OKOLJE d.o.o., Linhartova cesta 13, 1000 Ljubljana);
- Supplement Assessing the Acceptability of the Impacts on Protected Areas for the Extension of NEK’s Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o., order no.: 1456-20 VO, October 2021, supplemented January 2022 (AQUARIUS d.o.o. Ljubljana, cesta Andreja Bitenca 68, 1000 Ljubljana).

After establishing that the developer had submitted complete documentation, the application for the environmental protection consent, the environmental impact assessment report and the draft decision on the environmental protection consent were made available to the public (as per Article 58 of the ZVO-1). In public announcement no. 35428-4/2021-2550-x of ………………., the public was informed of all of the requirements arising from Article 58 of the ZVO-1 on the ministry’s website, at the head office of Krško Administrative Unit, Cesta krških žrtev 14, 8270 Krško and at the head office of the Municipality of Krško, Cesta krških žrtev 14, 8270 Krško. Pursuant to the third paragraph of Article 58 of the ZVO-1, the public was permitted to submit opinions and observations for 30 days from the date given in the public announcement, i.e. from ………………. to …………………...

Between these dates, the following observations were sent to the Ministry of the Environment and

Spatial Planning, Dunajska cesta 48, 1000 Ljubljana or to gp.mop@gov.si ………………………:
1. ……………………
2. ………………………………

Based on the documentation enclosed and obtained, the following was established in the course of the procedure, as set out below in the grounds of this environmental protection consent.

Description of current situation
Krško nuclear power plant is located in the Municipality of Krško, southeast of the town of Krško, in the cadastral municipality of Leskovec, at the address Vrbina 12, Krško, in an area of long-term energy use on the left bank of the Sava. NEK is located at latitude: 45.938210 (north) and longitude: 15.515288 (east) or 455617.556 (north) and 153055.037 (east) in WGS-84 coordinates and by Gauss-Krüger coordinates x = 88353.76 m and y = 540326.67 m. The location of the lifetime extension is, according to the applicable spatial planning act, i.e. the Ordinance on the municipal spatial plan for the Municipality of Krško (Official Gazette of RS, No. 61/15), located in an area of building land containing mainly industrial buildings classified as E (energy infrastructure) in spatial planning unit (SPA) KRŠ 025, and VI (water infrastructure area) in spatial planning unit (SPA) HJE 01.
The area has good road and rail connections as it is located near the intersection of regional roads and in the immediate vicinity of the railway line. An industrial road leads up to the power plant and connects to the regional road R1 Krško – Spodnja Pohanca. The plant also has an industrial railway track, which connects it to Krško railway station.
The nearest residential areas are located northeast (Spodnji Stari Grad) at a distance of approx. 500 m, north (Spodnja Libna) at a distance of approx. 550 m, and west (Žadovinek) at a distance of approx. 1.4 km from the site of the planned lifetime extension.
The nearest kindergartens (Vrtec Dolenja vas, Vrtec Krško) are located more than 2 km northeast and northwest, the nearest primary school (Osnovna šola Leskovec pri Krškem) about 2.6 km west and the nearest secondary school (Šolski center Krško-Sevnica) 2.2 km northwest of the NEK location. The Krško Retirement Home is more than 2 km away from the site of the lifetime extension.
The terrain is flat and the site of the lifetime extension is approx. 155 m above sea-level. The following manufacturing companies operate north of the location: SECOM d.o.o., principal activity: 22.230 (Manufacture of products from plastic for construction); GEN energija d.o.o., principal activity: 64.200 (Activities of holding companies); GEN-I d.o.o., principal activity: 35.140 (Electricity trading); Saramati Adem, d.o.o., principal activity: 41.200 (Construction of residential and non-residential buildings). East of the location the following companies operate: KOSTAK d.d. Center za ravnanje z odpadki (IED installation), principal activity: 36.000 (Water collection, treatment and supply). There are three IEDs at a distance of between 800 and 2,000 m from the site of the lifetime extension: VIPAP VIDEM KRŠKO d.d., KRKA d.d. and KOSTAK d.d. There are currently no installations with upper-tier or lower-tier major accident hazard (Seveso) in the area of Krško.

Description of planned activity (lifetime extension)
The developer intends to extend NEK's operation from 40 to 60 years, i.e. from 2023 to 2043. This does not change NEK's position, location, dimensions, technical design or production capacity, or its mode of operation. The extension of the operational lifetime does not envisage the construction of new structures or facilities that would change the physical characteristics of NEK.
NEK has an output power of 696 MWe, which accounts for ~38% of the total amount of electricity generated in Slovenia, making it the country's largest electricity producer. Half of the energy produced is exported to the Republic of Croatia.
NEK is equipped with Westinghouse's Light-water pressurised reactor with a thermal power of 1994 MW. Its net electrical output is 696 MW. The power plant is connected to the 400 kV network that supplies electricity to consumers in Slovenia and Croatia.

All the technologically important buildings of NEK stand on a massive reinforced concrete plate that is anchored on the clay-sand layers of the Pliocene sediments of the Krško Polje plain. This plate forms

a solid and earthquake-safe foundation. The buildings are designed and constructed in such a way that they can withstand the expected earthquakes in this area without suffering major damage.
The reactor building, which contains the reactor with the coolant loops and the safety systems, consists of an inner steel pressure shell and external reinforced concrete protective building. The tunnels into the reactor building for people and equipment are fitted with air locks with double doors. The penetrations through walls for piping and cables are double sealed. Alongside the reactor building there are auxiliary building, component cooling building, fuel handling building, emergency diesel generators building and the turbine building.
The cooling water and essential service water intakes are on the bank of the Sava above the dam. This ensures sufficient water supply in all conditions. The cooling wastewater discharge is below the dam. In the event of insufficient water in the Sava, the condensate is cooled by cooling towers with forced draft cooling cells.
The storage space for intermediate and low-level radioactive waste is on the southwest rim of the power plant. The administrative building with workshops and the switchyard are at the northern rim, near the entrance to the power plant.

Reactor with coolant loops:
The Westinghouse pressure reactor with two coolant loops consists of the reactor vessel with internals and closure head, two steam generators, two reactor coolant pumps, pressuriser, piping, valves and auxiliary reactor systems.
Ordinary demineralised water is used as reactor coolant, neutron moderator and solvent for boric acid. In the steam generator the reactor coolant gives off heat which on the secondary side of the steam generator heats the feedwater and turns it into steam. The coolant pressure is maintained by the pressuriser by means of electric heaters and water sprays which are fed by water from the cold leg of the reactor's coolant loop.
The meters for neutron flux, temperature, reactor coolant flow, pressure and water level in the pressuriser give the required data for operating the work process and maintaining the safety of the reactor system.
The power of the reactor is controlled with control rods. The drive mechanisms of the control rods are fixed to the reactor vessel shutter head. Their absorption rods reach into the reactor core. Long-term changes in the reactivity of the core and its poisoning with fission products are compensated by changing the concentration of boric acid in the reactor coolant.

Nuclear fuel:
The reactor core consists of 121 fuel elements. The fuel element consists of the fuel rods, the lower and upper nozzle, spacers and guide tubes for the absorption rods and instrumentation. The fuel rods consist of fuel pellets of uranium dioxide which are clad with zirconium alloys.
During outages, almost half of the fuel elements are replaced with new ones. Fresh fuel elements are dry stored. Spent fuel elements are stored under water in the spent fuel pool, where they cool down.
The technology for storing spent fuel is being upgraded with the introduction of dry storage. The dry storage building for spent fuel is being constructed within the existing nuclear facility in accordance with building permit no. 35105-25/2020/57 of 23 December 2020 granted by the Ministry of the Environment and Spatial Planning, Spatial Planning, Construction and Housing Directorate, Dunajska c. 48, 1000 Ljubljana.
When the fuel is changed, the fuel elements are brought along the water canal through the wall of the reactor building in the reactor pool. The fuel is loaded while the reactor is open and the space above it is filled with water. The charging machine hoists spent fuel elements from the reactor core and replaces them with fresh ones. A fuel element usually stays in the core for at least two fuel cycles. One fuel cycle lasts 18 months.

Turbine generator and electrical system:
The steam generators produce saturated vapour, which propels the turbine. The steam in the double-flow high pressure part of the turbine expands to pressure of 0.8 Mpa, then after the moisture is

removed and it is superheated it expands in the two low-pressure parts of the turbine to pressure of 5 kPa. It condensates in the four-part condenser, condensate pumps then return the condensate through the heaters into the steam generators.
When the Sava flows at more than 100 m^3/s, the condenser is cooled by flow cooling. If the flow rate is lower, the flow cooling is combined with cooling towers, whereby a smaller quantity of water from the Sava is taken and the rest is recirculated in the cooling towers.
The electricity generator produces three-phase current with power 850 MVA, cos phi 0.876 and voltage 21 kV. The rotor of the three-phase generator is cooled by hydrogen while the stator is water-cooled. The exciter does not have brushes.
NEK is connected to the 400 kV electricity transmission system. Electricity flows from the generator via two transformers into the power plant’s switchyard and from there via one transmission line towards Maribor, along two lines towards Ljubljana and Zagreb, and via two transformers to the 110 kV Krško distribution substation.
For its own needs, the power plant uses electricity produced by its own generator, or takes it from the 400 kV system. If the latter is down, then it uses the 110 kV line from the Krško substation. Additional electrical energy can be provided by Termoelektrarna Brestanica (gas power plant), which is located approx. 7 km from NEK. Brestanica power plant can disconnect all other users and provide electricity only for NEK.
In the event of a loss of off-site power, NEK has three independent diesel generators (DG#1 and DG#2 producing 3.5 MW each, and DG#3 4 MW). These can provide electricity within ten seconds. Each one can power the equipment necessary to shut down the power plant safely. NEK is also equipped with mobile generators which would be used in the event of an urgent need for electricity due to damage to the internal electrical grid.

<u>Radioactive waste:</u>
The operation of NEK produces gaseous, liquid and solid radioactive waste.
For the treatment of waste radioactive gases the power plant has two parallel closed loops with a compressor and catalytic incinerator for hydrogen, and six tanks for the decay and storage of compressed fission gases. Four gas tanks are used during regular operation while two are for when the reactor is not in use. The capacity of the tanks is enough to store gas for more than one month. In this period most short-lived fission gases decay, while the remaining gases go into the atmosphere when the meteorological conditions are favourable. Automatic radiation monitors in the plant ventilation stack prevent uncontrolled discharge when the concentration of radioactive gases is greater than the allowed limit.
Liquid radioactive waste is treated in a system consisting of tanks, pumps, filters, an evaporator and two ion exchangers. Blowdown water from the steam generators is treated separately. The radioactivity of the wastewater released into the Sava is much lower than the permitted level. The effective dose for an adult from releases into the Sava was 0.006 μSv per year (time spent on the bank and the consumption of fish) in Brežice in 2020. The calculated annual effective dose for an adult 350 m from the NEK dam is 0.014 μSv. If the average habits of the reference person are taken into account, the effective dose received is several times lower. Tritium H-3 accounts for the biggest single share of the total effective dose (44%), with the predominant pathway being the consumption of fish.
The estimated effective doses are several 1,000 times smaller than 0.1 mSv, which is defined in Article 18 of the Decree on limit doses, reference levels and radioactive contamination (Official Gazette of RS, No. 18/18) as the dose to be used to calculate the implemented concentrations for drinking water.
All solid radioactive waste that is produced during the power plant’s operation, and during maintenance work and repairs, is collected in the solid waste plant. Most of the waste consists of used ion exchangers, sludge from the evaporator, spent filters and other contaminated solid waste such as plastic, paper, cloths, personal protective equipment, tools and mechanical parts.
After being dried, extracted for incineration, compacted or solidified (depending on the purpose), the solid radioactive waste is put into different packages: 208 l steel barrel, 200 l stainless steel barrel or 150 l stainless steel barrel with biological protection. The barrels and pressings are then placed into

Tube Type Containers. The containers are temporarily stored in the power plant. During the plant's operation, the radiation dose contributed to the environment by NEK is less than 0.1% of the annual dose received from the natural background and artificial sources. This is ensured by modern cleaning devices and constant monitoring of the plant's surroundings.
Radioactivity on the Krško Polje plain has been measured at 50 different points around the power plant since 1974. At these points measurements are taken of the air, water, precipitation and biological samples also during the plant's operation. The data is compared with natural radioactivity and radioactive fallout prior to the plant's operation. The state of the water and biotope in the Sava and the groundwater is also monitored. These measurements also continue during the plant's operation.

<u>Preparation of water for process purposes:</u>
There are two process water systems:

- the water filtering system (PW - Water Pretreatment System) and
- the system that produces demineralised water (WT – Water Treatment System).

The filtered (PW) and demineralised (WT) water systems are located in the pretreatment building. The whole process water production system is controlled by computer. It is operated remotely by means of two PLCs (programmable logic controllers). The process water systems do not belong to the safety class, but the loss of these systems can nevertheless cause the automatic loss of components that require process water for their normal operation.
Raw water is drawn either from wells or the public water supply. It is collected in the raw water tank. From there it is pumped through two-layered filters, where the water steriliser (sodium hypochlorite) is added, into the PW tanks. The aim of the system that filters water is to provide all users with filtered water. The aim of the system that produces demineralised water is to produce water that is as pure as possible and provide it to consumers in the primary and secondary circuits.
A water treatment system is planned to provide filtered water for the water treatment system (WT), seal water for CW and CT pumps, and the distribution of PW water:

- during normal operation of the power plant, the system produces 45.9 m^3/h of PW water;
- in the period of increased consumption after the annual outage, the system provides 129.2 m^3/h of PW water.

The system that produces WT water includes:

- production of demineralised water,
- preparation of chemicals to support the water purification process,
- storage and distribution of demineralised water.

The aim of the system that prepares demineralised water (WT) is to prepare the required amount of water that has the prescribed quality. It also enables the storage and pumping of demineralised water (DD) to different consumers. The aim of the DD system is to distribute highly purified water from the WT system to consumers on the primary and secondary side of the power plant.
The demineralised water (DD) system is designed to provide the maximum flow rate of 70 m^3/h (308.2 gpm) into the DD tanks. The two DD tanks have capacities of 379 m^3 (10,000 gallons) and 1,000 m^3 (26,000 gallons).

<u>NEK technology:</u>
NEK produces heat through the fission of uranium nuclei in the reactor. The reactor consists of the reactor vessel with its fuel elements which constitute the core. In the primary circuit, demineralised water with boric acid circulates through the reactor. Under pressure it carries the released heat into the steam generators.
In the steam generators on the secondary side, steam is produced which drives the turbine and this in turn drives the electricity generator. When the steam leaves the turbine it condenses in the condenser which is cooled by water from the Sava. The condensate is then pumped back into the steam generators where it again turns into steam.
Water from the Sava flows through the condenser (the so-called tertiary loop), where it makes the steam condense and rejects surplus energy into the river. All the reactor equipment and that of the

corresponding primary cooling loop is located in the reactor building which is also called the containment building because of its function.
The reactor vessel containing the fuel elements is tightly closed and under high pressure during operation. The power plant's operation must be shut down and the reactor coolant system cooled down when the planned refuelling is to be carried out. The period between two refuellings is called the fuel cycle, which lasts 18 months at NEK. After the end of each fuel cycle the spent fuel elements are replaced with fresh ones. A fuel element usually stays in the core for at least two fuel cycles.

The primary circuit consists of the reactor, steam generators, reactor coolant pumps, pressuriser and piping.
The heat released in the reactor core heats the water which circulates in the primary circuit. The heat of the water is transmitted through the walls of the pipes in the steam generators to the water in the secondary circuit. The circulation of the water in the primary circuit is ensured by the reactor coolant pumps. The pressuriser maintains the pressure in the primary circuit and prevents the water from boiling at the core. All components of the primary circuit are installed in the containment that isolates the primary system from the environment, even in the event of an incident.

The secondary circuit consists of the steam generators, turbine, generator, condenser, feed water pumps and piping.
The steam generators are in fact boilers in which water from the secondary circuit evaporates to steam to power the turbine. In the turbine the energy from the steam is converted into mechanical energy. The generator converts this energy into electricity and transfers it to the electricity grid via transformers.
Expended steam from the turbine flows into the condenser where in contact with cold pipes it condenses, i.e. is converted into water. The feed water pumps pump the water from the condenser back into the steam generator where steam is again produced.

The tertiary circuit consists of the condenser, cooling pumps, cooling towers and piping.
The tertiary circuit is intended for cooling the condenser and removing the heat, which cannot be usefully utilised for electricity production.
The cooling pumps draw the water from the Sava into the condenser and then discharge it back to the river. When the water flows through the condenser, it heats, as it absorbs the heat from the expended steam. Heating the river water is NEK's most significant impact on the environment as it can affect the biological properties of the Sava. This impact is limited by administrative decisions specifying the permitted temperature increase and the quantity of water abstracted. In the event of adverse weather conditions, the cooling towers are used. In extremely unfavourable weather conditions, the power of the nuclear power plant has to be reduced to keep the set values within the specified limits.

<u>Technical data on facility:</u>
<u>Basic data on power plant:</u>

Reactor type:	Pressurised light-water reactor
Reactor thermal power:	1,994 MW
Gross electric power:	727 MW
Net electric power:	696 MW
Thermal efficiency:	36.6%

<u>Basic data on fuel:</u>

Number of fuel elements:	121
Number of fuel rods in a fuel element:	235
Fuel rod array:	16 x 16
Fuel rod length:	3.658 m
Cladding material:	Zircaloy-4, ZIRLO
Chemical composition of fuel:	UO2

Total quantity of uranium: 48.7 t

Basic data on reactor coolant:

Substance: H_2O
Additives: H_3BO_3
Number of cooling loops: 2
Pressure: 15.41 MPa (157.1 kp/cm^2)
Temperature at reactor inlet: 287°
Temperature at reactor outlet: 324°

Basic data on control rods:

Number of assemblies: 33
Neutron absorber: Ag-In-Cd
Composition percentage: 80–15–5%

Basic data on steam generators:

Material: INCONEL 690 TT
Number of steam generators: 2
Pressure of steam leaving generator: 6.4 MPa (65.6 kg/cm^2)
Steam flow rate from both generators: 1,088 kg/s

Basic data on turbine and generator:

Maximum power: 730 MW
Inlet pressure of fresh steam: 6.4 MPa (63 ata)
Temperature of fresh steam: 280.7°C
Turbine rotation speed: 157 rad/s (1500 rot./min)
Steam moisture at inlet: 0.10%
Condensation pressure (vacuum): 5.1 kPa (0.052 ata)
Average condensate temperature: 33°C
Rated power of generator: 850 MWA
Rated voltage: 21 kV
Rated frequency of generator: 50 Hz
Rated cos 0: 0.876

Basic data on transformers:

Block transformers: rated power: 2 x 500 MVA, voltage ratio: 21/400 kV
Unit transformers: maximum permitted continuous power: 2 x 30 MVA, voltage ratio: 21/6.3 kV
Auxiliary transformer: maximum permitted continuous power: 60 MVA, voltage ratio: 105/6.3/6.3 kV

Safety systems:

Safety systems prevent the uncontrolled release of radioactive material into the environment. A high level of attention is paid to nuclear safety already in the phase when the reactor and power plant are being designed. The design of safety systems provides safety functions in all operational states, even in the event of specific equipment failure.

The nuclear power plant is in a safe state if three basic safety conditions are met at all times:

1. effective reactivity control (reactor power control);
2. cooling of the fuel in the reactor, the spent fuel pool and in the spent fuel dry storage;
3. confinement of radioactive material (prevented release of radioactive material into the environment).

The release of radioactive material into the environment is prevented by 4 successive safety barriers:

- the first barrier is nuclear fuel (or fuel pellets) retaining radioactive material within itself;
- the second barrier is a waterproof cladding that encloses fuel pellets and prevents leakage of radioactive gases from fuel;
- the third barrier is the primary system boundary (pipe walls, reactor vessels and other

primary components) that confines the radioactive water for reactor cooling;
- the fourth barrier is the containment that hermetically separates the primary system from the environment.

The basic objective of the first three barriers is to prevent radioactive material from passing to the next barrier, while the fourth barrier prevents radioactive material from being released directly into NEK's surroundings.

Since the operation of safety systems in the event of a defect and failure or a very unlikely accident at a nuclear power plant is paramount, all safety systems are redundant (NEK has two trains of safety systems).

To comply with safety conditions and maintain safety barriers, the operation of only one train of safety systems is always sufficient. Furthermore, all safety systems and their individual devices are systematically tested during the operation of the power plant and during regular outages.

<u>Spent fuel:</u>

Since it began operating, NEK has stored all spent fuel inside the fence encircling the plant's technological section in the spent fuel pool (SFP) located in the fuel handling building (FHB), as was planned in the original design. The removal of residual heat from the spent fuel takes place via the spent fuel pool's active cooling system. The set of safety upgrades that were carried out included an improvement for the alternative cooling of the spent fuel pool.

An analysis of possible improvements to the storage of fuel was part of the response to the Fukushima accident by the nuclear industry and administrative bodies. It follows from the conclusions of analyses by NEK and the analyses and decisions of the Slovenian Nuclear Safety Administration that the introduction of dry storage for spent fuel constitutes an important safety upgrade in response to the new safety requirements. The proposed technical solution for the dry storage of spent fuel is noted in the Resolution on the National Programme for Radioactive Waste and Spent Fuel Management 2016–2025 (ReNPRRO16–25) (Official Gazette of RS, No. 31/16).

The main purpose of the spent fuel dry storage building is to provide a technological upgrade of the temporary spent fuel storage arrangements. Spent fuel dry storage is a safer way of storing spent fuel; this is because the cooling system is passive, which means that no device, system or energy source is needed for cooling and operation. Additionally, both radiation safety and the robustness of the system are improved. The building and containers with spent fuel will be located on the NEK site, inside the fence encircling the power plant's technological section.

Dry storage is a safer way of storing spent fuel under the same environmental and radiation conditions as are prescribed in the existing operating licence. Dry storage is recognised worldwide as the safest and most widespread technological solution for storing spent fuel. In addition to the passive cooling method, better radiation safety and increased robustness, dry storage technology has other benefits, particularly by providing better protection against intentional and unintentional negative influences or human acts.

After several years of cooling in the spent fuel pool (SFP), the spent fuel is transferred to special canisters. These are hermetically sealed and placed in a suitable overpack (for transfer, storage or transport). These canisters in special storage overpacks are then placed in the spent fuel dry storage building. The building is divided into several areas: manipulation, technical and storage area.

Spent fuel will be stored in the building until a decision on the national strategy for spent fuel disposal or re-processing is made. There was therefore a total of 1,323 fuel elements stored in the spent fuel pool at the end of 2020, including two special containers with fuel rods and a fission chamber from 2017. The first phase of dry storage loading follows in 2023, when the initial 592 spent fuel elements will be transferred. In the second phase in 2028, the next 592 spent fuel elements will be transferred.

<u>Safety upgrade programme:</u>

In compliance with Slovenian legislation in the field of nuclear safety (Rules on radiation and nuclear safety factors, Official Gazette of RS, Nos. 74/16 and 76/17 [ZVISJV-1]) NEK has analysed the systems, structures and components in relation to severe accidents. Deriving from the analysis, NEK should take all reasonable measures to prevent and mitigate the consequences of severe accidents

within the set deadlines. Following the accident at Japan's Fukushima Daiichi power plant in March 2011, this process was given high priority. Decision no. 3570-11/2011/7 of 1 September 2011 issued by the Slovenian Nuclear Safety Administration demanded that a severe accident analysis and a programme of safety upgrades be drawn up.
Even prior to the accident in Japan, NEK was already implementing certain upgrades, such as the installation of a third diesel generator to power the safety systems, which contributes to safety and also supports modernising initiatives in the wake of the Fukushima disaster. It also reacted rapidly and effectively in the wake of the Fukushima disaster. The programme proposed by NEK as a response to the Slovenian Nuclear Safety Administration decision complies with the requirements of the Western European Nuclear Regulators' Association (WENRA) and is comparable with industrial practice in other European countries.

<u>Periodic safety review:</u>
The first paragraph of Article 112 of the Ionising Radiation Protection and Nuclear Safety Act (ZVISJV-1, Official Gazette of RS, Nos. 76/17 and 26/19) provides that the operator of a radiation or nuclear facility is required to ensure regular, comprehensive and systematic assessment and monitoring of the radiation or nuclear safety of a facility by means of periodic safety reviews.
The frequency, content, scope, duration and method of performing periodic safety reviews, and the method of reporting on those reviews, are defined in the Rules on the operational safety of radiation and nuclear installations (Official Gazette of RS, Nos. 81/16 and 76/17 [ZVISJV-1]). A successful periodic safety review is a precondition for extending operation for ten years.
The aim of the periodic safety review is for the operator of a radiation or nuclear facility to:

- review the overall impacts of plant aging, the impacts of modifications to the facility, operational experience, technical development, impacts of changes on the site and any other potential impacts on radiation or nuclear safety, and to determine the compliance with the design bases, based on which the operating licence was issued, with international safety standards and international practice, thereby confirming the facility is at least as safe as projected during the design phase and that it continues to be fit for safe operation;
- use the latest relevant, systematic and documented methodology based on deterministic as well as probabilistic approaches to analyses and assessments of radiation and nuclear safety;
- eliminate, at the earliest opportunity, any deviations from the design of the facility established during a periodic safety review, taking into account their significance for nuclear safety;
- examine and organise knowledge of the facility and processes, as well as the complete set of technical documentation;
- identify and evaluate the significance for safety of deviations from applicable standards and best international practice;
- carry out all appropriate and reasonable modifications resulting from the periodic safety review;
- carry out modifications in such a way that a written assessment of the state of each item of content is compiled, documented and supported by relevant analyses.

In keeping with the requirements, NEK successfully carried out two periodic safety reviews, the first in 2003 and the second in 2013. The Slovenian Nuclear Safety Administration issued decisions approving both reviews. The comprehensive safety assessments undertaken as part of the periodic safety review confirmed that the power plant was safe and that it was capable of operating safely until the next review. The third periodic safety review is currently under way and will be completed in 2023.

<u>Independent international expert reviews:</u>
NEK participates in a number of independent international expert reviews (missions), which examine in detail all aspects of safe and reliable operation of the power plant. These reviews are carried out by various organisations: IAEA – International Atomic Energy Agency, WANO – World Association of Nuclear Operators and others.
The aim of the missions is to promote improvements concerning nuclear safety and reliability of nuclear power plants through the exchange of information between foreign experts and NEK, and to

promote communication and comparisons between WANO members. A comparison of one's own practices with the global experience and an objective assessment of the operation status are directed towards achieving the highest standards of nuclear safety, availability and excellence in the operation of nuclear power plants.

The auditors compared NEK with high operational standards as defined by the nuclear industry in the field of safety culture and human behaviour, organisation and administration, improvements in efficiency and operational experience, operation, maintenance, chemistry, work process management, engineering, configuration control, nuclear fuel efficiency, equipment reliability, radiological protection, training and qualifications, fire protection, occupational health and safety, organisation and measures in the event of an emergency, and implementation of international recommendations. The observers also observe the operational shift scenarios to assess the response of operating personnel to potential unplanned events.

In the mid-1990s, analyses of selected accident scenarios that go beyond design basis accidents were also performed as part of the Level 2 probabilistic safety analyses for the power plant. These analyses included situations with reactor core damage and containment failure, known as severe accident analyses. These analyses provided a platform for the preparation of Severe Accident Management Guidelines (SAMG). Furthermore, equipment was inspected and some modifications were made to allow a more appropriate response both from the equipment and personnel in the event of such accidents. Some examples include: the strategy of flooding the space under the reactor vessel (wet cavity) in the event of the reactor vessel meltdown, replacement of the recirculation sump strainer in the containment and thermal insulation of the containment piping. After purchasing a simulator for operator training and preparing the SAMG, NEK is able to perform emergency preparedness drills for accidents that go beyond design basis accidents too. During the trainings, the functionality of the SAMG procedures was also tested.

At the invitation of the Slovenian Nuclear Safety Administration, a RAMP mission, involving a review of accident management programmes and organised by the IAEA, was held at NEK in 2001. The mission reviewed the scope and adequacy of the aforementioned analyses and the guidelines for severe accident management. The RAMP recommendations were partially implemented in the post-review period, while the remaining recommendations required additional and in-depth analyses, which were carried out by NEK in the framework of the action plan for the first periodic safety review (e.g. generation, distribution of hydrogen and risk management for the case of hydrogen explosion in the containment in the event of a severe accident). As part of the action plan for the periodic safety review, NEK also prepared specific grounds for emergency operating procedure (EOP) instructions, and revised the set-points on the basis of analyses for these instructions. All the actions from this action plan were completed (and also reviewed and approved by the Slovenian Nuclear Safety Administration as part of various administrative procedures).

As part of the stress tests a review of severe accident management (equipment, procedures, organisation etc.) was also carried out. Alongside the IAEA and WANO reviews in 2017 and 2019, a review of the suitability of organisation for managing accidents was also carried out. In 2018 the validation of the new SAMG on the NEK simulator was successfully carried out.

<u>Aging Management Programme (AMP):</u>

The Aging management programme was drawn up as part of the Periodic Safety Review (PSR1) and with the actions that stemmed from the concluding report of the PSR1.

NEK has completed all actions that were part of its periodic safety review that referred to the plant's extended operational lifetime. In the administrative procedure, the Slovenian Nuclear Safety Administration approved the Updated Safety Analysis Report (USAR) and the NEK technical specifications (NEK TS) referring to the extension of NEK's operational lifetime (Slovenian Nuclear Safety Administration decision no. 3570-6/2009/28 of 20 April 2012 and Slovenian Nuclear Safety Administration decision no. 3570-6/2009/32 of 20 June 2012), and approved the Aging Management Programme (AMP) in its entirety. The NEK Aging Management Programme is based on US legislation NUREG-1801, Generic Aging Lessons Learned, Revision 2. The AMP programme therefore covers all passive and long-life systems, structures and components. The European AMP, prepared by the IAEA

(International Generic Aging Lessons Learned (IGALL) for Nuclear Power Plants) envisages that the aging programme also addresses active components. NEK monitors active components in accordance with the Maintenance Rule (10 CFR 50.65) and Environmental Qualification Programme (10 CFR 50.49).

The review of the aging of active components and the maintenance itself were prepared on the basis of:

- 10 CFR 50.65 – Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, Regulatory Guide 1.160,
- "Monitoring the Effectiveness of Maintenance Rule at Nuclear Power Plants" Rev. 3 and NUMARC 93-01,
- "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants", Rev. 4A.

An important part of the AMP consisted of the time-limited aging analyses (TLAA), among which the AMP-TA-10 analysis "Update of USAR Chapters 11 and 15" should be highlighted, as it has shown that extending NEK's operational lifetime does not change the existing situation and lead to new environmental hazards or burdens.

The compliance and integrity of the aging programme was reviewed in a number of missions:

- 2014, WANO Peer Review mission at NEK (AMP),
- 2017, IAEA OSART + LTO + PSA mission,
- 2017, NEK actively participated in the preparation of the national ENSREG Topical Peer Review (TPR) on Aging Management,
- 2019, WANO Peer Review of the NEK AMP.

A special programme for aging management was drawn up for the dry storage project.

All missions (including the 2017 OSART mission) and the Slovenian Nuclear Safety Administration review, along with the decision issued in the procedure described above, demonstrated the compliance of the aging programme with international recommendations and the Rules on the operational safety of radiation and nuclear installations.

Besides, in 2021 the NEK AMP will be reviewed and evaluated as part of the IAEA mission pre-SALTO (Safety Aspects of Long Term Operation). The pre-SALTO mission will carry out a thorough review of the aging management programmes and their implementation on the basis of IAEA standards and the best international practices. The aging programme will, however, be evaluated comprehensively and systematically as part of the third Periodic Safety Review (PSR3), in accordance with the programme approved by the Slovenian Nuclear Safety Administration in decision no. 3570-7/2020/22 on 23 December 2020.

<u>Key safety characteristics of the plant in 2021:</u>

All the safety modifications and upgrades listed below represent the latest state of technology at NEK in its present state.

<u>Major modifications in the primary circuit:</u>

- Replacement of steam generators

The replacement of steam generators was carried out as part of the power plant modernisation. The modernisation comprised a number of subprojects. The first one involved the design, manufacture, finishing, assembling, testing and transporting of the new steam generators. The second one dealt with safety analyses and obtaining permits for the replacement. The third one, which was completed when the outage began, involved building a comprehensive personnel training simulator and analysing the power plant's response in different situations. The replacement of the steam generators and the installation of the simulator took place in 2000.

- Introduction of a new system for measuring the temperature of the primary circuit

The temperature measurement system for the primary coolant had a bypass installed on the A and B coolant loops that was connected to the hot, cold and intermediate legs and had a total of 30 valves. Due to the difficultly of maintenance and the possibility of leaks, all valves and bypass lines were removed during the 2013 outage, whereas the temperature measuring sensors were installed directly in the primary coolant pipe. This solution reduces the number of operational and maintenance interventions and the risk of primary coolant leaks.

- Upgrade of reactor coolant pump motors

Both electric motors of the reactor coolant pump were renewed and upgraded. The control panel and visual indicators for monitoring bearing temperature, oil levels in bearings and motor vibrations have also been modernised. The upgrade took place in 2007 and 2010.

- Replacement of the reactor vessel closure head

On the basis of operational experience in the industry, the reactor vessel closure head was replaced. Materials with better corrosion-resistant properties and improved manufacturing processes ensure safer and more reliable operation of the power plant. The reactor vessel closure head was replaced in 2012.

<u>Most significant modifications in the secondary circuit and electrical systems:</u>

- Replacement of low-pressure turbines

NEK replaced both low-pressure turbines, as they were worn-out and the production of electricity needed optimisation. The new low-pressure turbines have a higher internal efficiency compared to the old turbines. The replacement took place in 2006.

- Replacement of the stator and rotor of the main generator

The modification involved the replacement of the stator part of the generator (outer and inner housing, core, winding, main connections with bushings, hydrogen coolers), stator cooling water system, hydrogen temperature control valve, local alarm panel, installation of a new hydrogen dryer and the modernisation of control instrumentation with data transfer to the main control room. NEK decided to replace the rotor of the main generator, taking into account the estimate that all generator subcomponents are designed and manufactured for a 30-year operational life span under normal operation conditions and reliability. The generator rotor was replaced with a new one that has better characteristics in terms of efficiency and reliability. The stator and rotor of the main generator were replaced in 2010 and 2012 respectively.

- Replacement of the turbine regulation and protection system (turbine operating and monitoring system)

The old digital electrohydraulic system (DEH) of the turbine control system was replaced with a new programmable digital electrohydraulic system (PDEH), manufactured by the original supplier.
The installation of the new PDEH turbine operating and monitoring system also involved replacing the turbine emergency trip system (ETS), control systems for steam superheating and moisture separation, and the relocation of the operating and testing controls for twelve valves of the steam separation system from the autonomous panel to the new PDEH-system. The replacement took place in 2012.

- Replacement of the exciter, voltage regulator and main generator switch

The third project concerned with upgrading the generator system involved replacing the exciter and the voltage regulator of the main generator.
The replacement of the main generator switch was one of the performed upgrades of the generator system to enhance the reliability of the nuclear power plant operation. The project involved replacing the main generator switch with all its associated equipment and the replacement of overvoltage protection. As the new generator switch requires neither water cooling nor compressed air for its functioning, both the existing compressor plant and the cooling system of the old generator switch were removed. The system was replaced in 2016.

- Refurbishment of the switchyard and replacement of the 400-kilovolt system buses

In accordance with the Agreement on Technical Aspects of Investments, the switchyard was thoroughly refurbished in cooperation with the system operator ELES. The refurbishment has already begun in the 2010 outage and continued in the 2012 and 2013 outages when all the primary equipment including circuit breakers, isolators and buses, and measuring and control systems was replaced.
Some of the 400-kilovolt buses with insulating supports and portals were replaced in the section stretching from the double fence between NEK and the Krško RTP (distribution substation) to the NEK transformer field. The replacement of buses is the first phase of the joint project of NEK and ELES in reconstructing the 400-kilovolt switchyard.

- Installation and connection of the energy transformer

NEK replaced the main transformer (400 MVA rated power) with a new 500 MVA one. The bottleneck in electricity distribution to the grid is eliminated and the basic configuration of the power plant with two transformers of equal power is restored. The replacement took place in 2013.

<u>Most significant modifications in the tertiary circuit and subsystems:</u>

- Extension of the cooling tower system

The design modification is the result of changes in the power plant and the environment. The cooling system of the NEK tertiary circuit was improved with carefully chosen technical solutions. Four new cooling cells (a new cooling tower – CT3) were installed, and all the electrical equipment of the cooling tower system was replaced. The replacement took place in 2008.

- Reconstructions resulting from the construction of Brežice HPP

As a result of Brežice HPP, the level of the Sava at the NEK site has risen by 3 m, to the level of 153.20 m a.s.l. As a result of these changed hydraulic circumstances, it was necessary to reconstruct certain systems on the NEK site so that they could still operate inside the existing design bases following the Sava's rise in level. At the same time, it has been made possible to maintain the affected systems and structures in the normal way.

- Modification to the dam's hydraulic system

The modification required all the necessary mechanical, construction, electric and I&C activities that are needed on the NEK dam due to the construction of Brežice HPP. Due to hydraulic alterations on the Sava, upstream and downstream of the NEK dam, it was necessary to carry out the following interventions:

Construction part:

- providing access to and arranging the dam surroundings,
- expansion of the repository for the outage floodgates,
- raising the pillars of the spillways and building a new bridge for the crane,
- reconstruction of the downstream foundation with an additional steel crest,
- installation of additional guides on the dam's side walls,
- extension of the foundations of the crane tracks and
- an additional embankment to complete the plateau of the expanded repository.

Mechanical part:

- supply and installation of downstream outage segmental floodgates (six new elements);
- supply and installation of upstream outage floodgates (two new rolling segments), supply and installation of new mobile lifting frames, 2 x 100 kN for manipulating the downstream outage floodgates on the water channels using the crane track;
- supply and installation of lifting tongs for grabbing and releasing elements of the downstream outage floodgates; they hang from the mobile lifting frame;
- supply and installation of a load transfer mobile hydraulic device for transporting the downstream outage floodgates from the mobile lifting frame to the repository for the

floodgates with crane track;

- supply and installation of equipment for the downstream outage floodgates repository, which encompasses a set of bases for installing the floodgates; and
- reconstruction of the hydraulic lifting equipment of the radial floodgates, which includes electric, motor and hand-powered hydraulic units, hydraulic cylinders and piping with flexible pipes for flexible connections.

Electrics and control:
The current system for control and monitoring of the equipment on the NEK dam, which includes the regulation of the height of the Sava by taking measurements of flows and levels, was replaced by a new system. Two-way data connections with the control equipment of Brežice HPP and Krško HPP were also set up, which enable the joint control of these dams together with the NEK dam.

- Reconstruction of the CW system (cooling water)

To ensure the power plant’s normal and safe operation in the event of an increase in the level of the Sava resulting from the construction of Brežice HPP, the tertiary circulating water (CW) system also required certain reconstruction work, including:

- installation of extra stop logs for isolating the CW inflow facilities, enabling maintenance of the coarse screens and travelling screens and CW pumps;
- reconstruction and modernisation of CW cleaning systems – a new device for cleaning the screen racks (two new and more powerful machines);
- CW 105TSC-001 travelling screens; -006 modernisation (increased speed of movement of the screens, modification of the safety valves);
- installation of an extra pump for flushing the screens and extra nozzles for each screen;
- replacement of the electrical cabinets and modification of the control system, upgrading of measurements of water level differences on the coarse screens and travelling screens;
- reconstruction of the CW de-icing piping to prevent the accumulation of ice in the CW;
- installation of a new pump to meet the requirements of the functioning of the de-icing system;
- modification of the nozzles on the de-icing piping (extra nozzles on the CW de-icing piping);
- renewal of the manipulation surfaces.

- Reconstruction on the Essential Supply Water (SW) system

Due to the construction of Brežice HPP it also became necessary to carry out a reconstruction on the tertiary safety cooling system (the SW system), which ensures cooling of the safety components. The reconstruction included:

- the installation of extra barriers and the re-qualification of the existing ones,
- alterations to the SW pumps control system,
- installation of new working platforms,
- upgrading or replacement of the existing sediment removal system,
- modernisation of the system for measuring the level of silt in the intake basin,
- adaptation of the system of cathode protection for underwater structures and pipelines.

- Reconstruction of the PW (filtered water system) and sanitary drain systems

Due to the construction of Brežice HPP it was also necessary to carry out the reconstruction of the system of underwater wells, rainwater drainage and sewerage pipes:

- Underground wells: in order to keep the water table at the same level as before construction, three underground wells are built inside the diaphragm wall, with accompanying connecting piping to the existing pretreatment building.
- Rainwater drainage system: demolition of the existing pumping station for rainwater drainage and the construction of a new one at the same location.
- Faecal sewage system:
    - construction of a new gravitational discharge above the future elevation of the Brežice HPP dam at 153.50 m a.s.l.
    - Replacement of the two existing submersible pumps.

Other design-related modifications to improve safety

- Improvement of the AC safety power supply – DG3

The power plant's AC safety power supply was improved by providing an alternative source in the event of loss of the complete AC power supply (Station Blackout - SBO). The upgrade of the safety power supply included the installation of an additional diesel generator (DG3) with a power of 4 megawatts (6.3 kV, 50 Hz, start-up time less than 10 seconds), which is connected to the MD1 or MD2 safety buses via a new 6.3-kilovolt bus (MD3). The upgrade took place in 2006 and 2013.

NEK safety upgrade projects

Following completion of the Safety Upgrade Programme, NEK is prepared for any severe accident that might occur, as required by the Ionising Radiation Protection and Nuclear Safety Act and the Rules on radiation and nuclear safety factors. The Safety Upgrade Programme was reviewed and approved by the Slovenian Nuclear Safety Administration in February 2012 in decision No. 3570-11/2011/09. NEK began to prepare the project design documentation for the Safety Upgrade Programme back in 2012. The following year it filed the first applications for the implementation of the first two safety upgrade modifications (installation of a passive autocatalytic system for hydrogen recombination and the installation of a passive containment filtered venting system). These two modifications represent key solutions for severe accidents and were approved by the Slovenian Nuclear Safety Administration in October 2013.

- Phase 1 – Installation of passive autocatalytic hydrogen recombiners in the containment

The installation of passive autocatalytic hydrogen recombiners limits the concentration of explosive gases (hydrogen and carbon monoxide) in the containment in the event of a severe accident. The installed equipment does not require a power supply for its operation and therefore works even if the AC power supply to the power plant completely fails. The safety upgrade ensures the integrity of the containment in the event of a severe accident. The installation of autocatalytic recombiners took place in 2013.

- Phase 1 – Construction of the system for filtered venting of the containment

The installation of passive venting (relief) of the containment ensures a minimum release (less than 0.1%) of radioactive fission products of the core (with the exception of noble gases), which are released into the containment in the event of a severe accident, when the pressure in the containment rises above the design-basis level. In this way the integrity of the containment as a barrier preventing the uncontrolled release of radioactive material into the environment is preserved. A dry filter system was installed, consisting of five aerosol filters in the containment, an iodine filter in the auxiliary building, piping with a rupture disc, valves, an orifice, a nitrogen plant, a radiation monitor and the necessary instrumentation. The primary objective of the modification is to maintain the integrity of the containment by preventing it from collapsing in the event of severe accident that could result in uncontrolled pressure increase. The system was installed in 2013.

- Phase 2 – Flood safety of NEK facilities

In 2012, design solutions were prepared to ensure flood safety of NEK facilities up to an elevation of 157.530 m above sea level, including in the event that the downstream and upstream embankments of the Sava collapsed. Design solutions included passive and active flood protection elements. Passive elements include the watertight external walls of buildings, the replacement of external doors with watertight ones and the replacement of seals on penetrations through the external walls with watertight ones. Active flood protection is ensured with the installation of water barriers and check valves on the drainage systems. The new NEK flood protection is designed and dimensioned so as to provide functional protection even in case of earthquake of 0.6 g ground acceleration. The project was completed in 2017.

- Phase 2 – Construction of the emergency control room

The main reason for the construction of the emergency control room was to provide an alternative control location, which allows safe shutdown and cooling of the power plant if the main control room is evacuated and control of the status in the containment in the event of a severe accident with core damage. The construction of the control room was completed in 2019.
The new emergency control room provides an alternative location for shutdown and cooling of the power plant (if the main control room is lost); NEK is therefore equal to comparable nuclear power plants in northern Europe, which built similar bunkered emergency control rooms in the 1990s. More recent nuclear power plants already have this solution integrated in the basic design.
The emergency control room has additional instrumentation installed that operates independently of the main control room and is used for control of the power plant in the event of a severe accident.

- Phase 2 – Upgrade of the technical and operating support centres

Along with the construction of the emergency control room, an upgrade in the new technical support centre (TPC) was also carried out. The capacity of the existing underground shelter has been increased while the new operational support centre (OPC) building provides the conditions necessary for the long-term work and stay of a team of up to 200 people, even in the event of extreme earthquakes, floods and other unlikely emergencies. In addition to extra air filters, the building has a new diesel generator which provides the centre with an independent power supply source. The upgrade was completed in 2021.

- Phase 2 – Alternative cooling of the spent fuel pool

The project included the installation of a new spray system (fixed distribution of nozzles for spraying the spent fuel pool), a pool cooling system with a mobile heat exchanger (a new mobile heat exchanger for alternative cooling of the spent fuel pool) and a pressure relief damper in the fuel handling building (FHB). The upgrade of the system was completed in 2020.

- Phase 2 – Installation of bypass motor-operated relief valves of the primary system

This modification provides a flow path for the controlled relief of the primary system in design extension conditions if the existing relief valves are not available. Implementing the strategy for the coordinated relief and feed of the primary system ensures cooling of the core, thereby preventing damage to the core. The design modification was completed in 2018.

- Phase 2 – Alternative cooling of the reactor cooling system and the containment

The main aim of the design modification was to install an alternative system for long-term residual heat removal. The primary function of the new system is to remove residual heat from the reactor cooling system in design extension conditions by removing the coolant from the hot leg of the reactor cooling system, cooling via the heat exchanger and returning the coolant to the cold leg of the reactor cooling system, and removing the residual heat from the reactor cooling system by recirculating water from the containment sump back to the reactor cooling system. It is also possible to cool the containment by spraying. The design modification was completed in 2021.

- Phase 3 – Construction of the reinforced bunkered building (BB2) with additional water tanks for removal of residual heat from the reactor

The upgrade includes the construction of a new bunkered building 2 (BB2) with auxiliary systems and the connection of various new systems within the new building to the existing NEK systems, buildings and components. The BB2 building is designed to accommodate an alternative safety injection system (ASI), an alternative auxiliary feedwater system (AAF) and safety power supply to the BB2 building. The construction of the BB2 building, the installation of the Alternative Safety Injection System (ASI) and the Alternative Auxiliary Feedwater system (AAF) ensures the Alternative Ultimate Heat Sink (AUHS). For the construction of this building including all the installed systems (AAF, ASI etc.) a special building permit (No. 35105-68/2018/8 1093 and 35105-29/2018/6 1093-04 dated 24 July 2018) was obtained. Construction was completed in 2021.

- Phase 3 – Alternative auxiliary feedwater system (AAF)

This upgrade is part of the third phase of the Safety Upgrade Programme and includes the installation of an additional pump for filling the steam generators including all piping and valves which allow the new system to be connected to the existing auxiliary feedwater system. The new alternative system for filling the steam generators will in design extension conditions or in the event of the loss of existing auxiliary feedwater system, provide an alternative source of cooling water for one or both steam generators, allowing heat to be removed from the primary circuit and cooling of the reactor. The design modification was completed in 2021.

- Phase 3 – Alternative safety injection (ASI)

This upgrade, which is also part of the third phase of the Safety Upgrade Programme, includes the installation of an alternative safety injection system for injection of borated water into the reactor coolant primary circuit. The system installed in the new bunkered building BB2 consists of a tank containing 1,600 m^3 of borated water, a high-pressure pump and the main motor-operated valve, the accompanying piping connected to the existing NEK system and the equipment to support the system operation and control. The project was completed in 2021.

- Phase 3 – Spent fuel dry storage (SFDS)

Spent fuel dry storage constitutes a technological and safety upgrade within the existing NEK energy complex. In addition to the passive cooling method, better radiation safety and robustness, spent fuel dry storage also has other benefits, above all better protection against intentional and unintentional negative human influences or acts. While spent fuel dry storage is a temporary and safer form of storing spent fuel during NEK operation and also after its shutdown, it is not intended to serve as a way of disposing of spent fuel permanently and finally. The dry storage is under construction and is expected to be completed in the first half of 2023. The spent fuel dry storage is located in the technological part of NEK, west of the present spent fuel pool location.

- Phase 3 – Installation of high-temperature seals in the reactor coolant pump

The upgrade includes the installation of a new sealing insert in the reactor coolant pumps with high-temperature seals (HTS). The HTS enable the power plant to better respond to a potential loss of complete AC power supply in case of disruptions in the supply of sealing and cooling water for the reactor coolant pump seals, leading to leaking of the primary coolant. Installation of HTS therefore prevents the loss of primary coolant. The project was completed in 2021.

Existing utilities, energy and transport arrangements

The extension of NEK's operational lifetime does not change the communal, energy and transport arrangements, which remain the same as currently.

There is already a connection to the public water supply. Potable water is used for sanitary and fire safety needs (hydrants).

The cooling water and essential service water intakes are on the bank of the Sava, above the dam, which ensures a sufficient water supply in all conditions. The cooling water discharge is below the dam. In the event of insufficient water in the Sava, the condensate cooling water is cooled by cooling towers with forced draft cooling cells. The developer uses water from the Sava for process purposes on the basis of partial water permit no. 35536-31/2006 of 15 October 2009, decision no. 35536-26/2011-9 of 23 May 2013 and the decision amending water permit no. 35530-7/2018-2 of 22 June 2018, which gave the developer water rights for the direct use of water for process purposes (Sava and the well on the right bank) at a maximum rate of 29,000 l/s, i.e. a maximum 915,000,000 m^3/year, and is valid until 31 August 2039.
Water permit no. 35530-100/2020-4 of 14 November 2020 (valid until 31 October 2050) was acquired in 2020 for three wells on the nuclear island. They can provide 3 x 5 l/s and a total of up to 3 x 70,000 m^3/year.

Water permit no. 35530-48/2020-3 was granted on 9 September 2021 for requirements relating to the additional filling of tanks containing borated water and demineralised water, for cleaning and testing the well pump, and for emergency events. Water is pumped from well SPW006 BB2 at the maximum rate of 8.0 l/s and no more than 230 m^3/year. Water is taken from the Sava at the location determined by the coordinates GKY=540294, GKX=88198, in cadastral municipality 1321 Leskovec, land parcel no. 1246/6.
All wastewater (communal, process, rainwater) from NEK flows into the Sava via nine discharges. The developer obtained from the Slovenian Environment Agency an environmental protection permit concerning emissions into waters no. 35441-103/2006-24 of 30 June 2010, which was amended by decision no. 35441-103/2006-33 of 4 June 2012 and decision no. 35444-11/2013-3 of 10 October 2013.

There are several transformer stations on the site of the lifetime extension that provide electricity for users at NEK and are managed by the developer.

NEK is situated on the left bank of the Sava in Krško's industrial/energy zone. A local road leads up to the power plant and connects, via a bypass road, to the regional road R1 Krško – Spodnja Pohanca. The plant also has an industrial railway track, which connects it to Krško railway station. From its junction with the future main road to the entrance to the NEK site, the access road is 320 m long, is flanked by a railway line, and has parking spaces along it. At the end of the access road there are two car parks: one measuring approx. 9,000 m^2 and the other measuring approx. 5,200 m^2.

These are the existing parking spaces:
- 37 parking spaces parallel with the access road;
- 58 parking spaces arranged at an angle of 45° to the access road;
- 368 parking spaces at the northeastern side of NEK;
- 153 parking spaces on the eastern side of the power plant;
- new parking spaces on the sandy surface along the access road (approx. 60 parking spaces).

The facilities are heated by means of a heating plant which prepares hot water. The heating fluid is saturated steam from the auxiliary steam heating system. The heat exchanger heats the water to 110°C, which is the outlet temperature. The return heating water at the inlet to the heat exchanger has a temperature of 70°C.

For cooling the buildings in the non-technological part of NEK there is no central system. Basically each building has its own cooling unit.

While operating at full power, NEK requires approx. 35 MW of electricity for its own use. During poor hydrological conditions the production process uses around 40 MW of electricity.

NEK had 630 employees at the end of 2020.

The production of electricity depends on the fuel cycles – periods of uninterrupted operation at full power. These periods are followed by outages when the power plant is stopped so the nuclear fuel is changed (part of the spent fuel is replaced with fresh fuel), preventive equipment checks are carried out and parts replaced, the integrity of materials is verified, control tests are made and corrective measures to the existing state are taken. The outage to replace fuel usually lasts up to 30 days. The 31st fuel cycle which began when the power plant was connected to the grid on 28 October 2019, is an 18-month cycle.

<u>Area of impact of the lifetime extension</u>

The area in which the lifetime extension could cause an environmental burden capable of affecting

human health or property is set out in the Environmental Impact Assessment Report for the Extension of NEK's Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o. no. 100820-dn, October 2021, supplemented 8 November 2021 and 10 January 2022 (E-NET OKOLJE d.o.o., Linhartova cesta 13, 1000 Ljubljana), and in graphical form in Appendix 3;
During operation, the area is defined as the area within the NEK perimeter fence, which covers land in cadastral municipality 1321 Leskovec, land parcel no. 1197/44.

Information on the presence of protection, protected, degraded and other areas

The wider area of the lifetime extension is not at risk from erosion, and, since it lies on flat land, is also not in an area at risk of an avalanche.
The NEK area is located within the Vrbina floodplain, which is the transition point between the eastern edge of Krško Polje and the western edge of Brežiško Polje. According to the flood warning map (source: Environment Atlas), rare and catastrophic floods do not occur in the area around NEK, although they may occur north, east, and south of its boundary. According to the flood map (iKRPN), the entire riverbed of the Sava, which runs parallel to the southern boundary of the NEK area, is classed as an area of high flood risk.
The site of the lifetime extension is located away from areas protected by regulations governing nature preservation and cultural heritage conservation, and areas where it could affect them. The far southern part encroaches on the second water protection zone on the right bank.
For the Vrbina industrial zone, the spatial planning document determines level IV noise protection, while the nearby residential areas have level III noise protection. Noise measurements in 2020 showed that NEK does not cause excessive noise for the nearby residential estate.
For the industrial zone, the spatial planning document determines level II protection from electromagnetic radiation, while the nearby residential areas have level I protection from electromagnetic radiation, which requires additional protection from radiation. The last measurements taken in 2021 showed that, due to the presence of low-frequency sources of electromagnetic radiation from NEK operations, the area did not have excessive amounts of radiation and, moreover, that these sources were too far away to have an impact on nearby residential areas.
When operating, the emissions from NEK's ventilation system release radioactive materials into the air. The dose resulting from the total annual activity of emitted noble gases for 2020 amounts to approx. 0.012% of the annual limit, which is similar to 2019 and to previous years.
The chemical state of the Sava at the WB Sava Krško–Vrbina measuring point was evaluated as good in the 2014–2019 period, while the level of confidence was also high. Analyses of the chemical status parameter in biota were also carried out at this measuring point. The status was assessed as poor. The reason for the poor chemical status was the increased presence of mercury. NEK does not overburden the environment with the discharge of industrial wastewater because annual quantities of adsorbable organic halogens (AOX) are not exceeded and because the plant as a whole does not exceed thermal emission limits.
The average concentrations of strontium activity in other Slovenian rivers are similar to or higher than those measured in the Sava in the vicinity of NEK. The naturally occurring radionuclides of the uranium (U-238, Ra-226 and Pb-210) and thorium (Ra-228 and Th-228) decay series have been detected on a regular basis in all water samples. The values were similar to those measured in other Slovenian rivers.
In 2020 all the radioactive effects of NEK on the NEK fence (the estimate is approximately valid also at a distance of 500 m from the middle of the reactor) and 350 m downstream from the NEK dam were estimated to be less than 0.071 μSv annually on the nearby population.
The estimated value is small in comparison with the authorised dose limit for the population in the vicinity of NEK (the effective dose of 50 μSv annually at a distance of 500 m and more for contributions via all pathways). The estimated value of the radioactive impacts from NEK along the NEK perimeter fence is approx. 0.0029% of the typical, unavoidable natural background. The estimate also approximately applies at a distance of 500 m from the reactor shaft.

Environmental characteristics of the existing situation and the lifetime extension project

Use/consumption of natural resources

The use of natural resources by NEK includes the use of water (potable water from the public water network, water from the wells and river water from the Sava for process purposes). Potable water is used for sanitary and fire protection purposes while the river and well water are for process purposes. The use of water does not increase with the planned lifetime extension.

The project will not be carried out on an area of agricultural land. The lifetime extension will not reduce the size of the area containing best or other agricultural land.

The mining of mineral deposits is not a planned as part of the lifetime extension project. The planned lifetime extension is not expected to lead to deforestation or to arrangements that could potentially affect forest functions.

In the event of operations ceasing, the use/consumption of natural resources will be considerably reduced. The spent fuel pool and some other safety components will still have to be cooled - water will be withdrawn and returned to the Sava at the rate of approx. 1.6 m^3/s.

By-products and by-product management

There will be no by-products resulting from the lifetime extension.

Impact on soil

The extension of NEK's operational lifetime will not require any construction work, so there will also be no interventions in or on the soil. The manner in which wastewater is discharged will not change with the extension of NEK's operational lifetime. There will be no emissions of pollutants into the soil during operation as all wastewater from NEK is already being discharged into the Sava after appropriate treatment. All waste is appropriately stored and does not present a danger for soil contamination. There will be no emissions of soil pollutants during the cessation of operations of NEK.

Impact on flood safety

Extending NEK's operational lifetime will not have any effect on the flood safety of the buildings. Protection against floods was already implemented during the planning of the power plant and through the construction of embankments along the Sava, upstream and downstream of the power plant. The entrances and openings in the buildings are built above the altitude of anticipated 10,000-year floods. The power plant is safe in the event of a design basis flood, even without a protective embankment. After NEK operations come to an end, there will be no impact on the flood safety of the nuclear facility or of the area, as the structures and flood-protection embankments in that area will remain in the same condition as they were during operation.

Emissions of substances into the atmosphere

The emissions of NEK into the air are negligible, the only emissions come from the auxiliary boiler room and the emergency diesel generator (three generators). These sources operate for short periods of time during outages and equipment testing. Extension of the operation of the plant will not give rise to any new emissions of SO_2, NOx and PM_{10} or others, and the current level of emissions will not increase. The impact on air quality is negligible, which was verified by the modelling of dispersion in the atmosphere. The power plant has an indirect positive effect on air quality because the way it produces electricity means it avoids the emissions produced in plants that run on fossil fuels.

The operation of the cooling towers releases heat into the air, together with droplets and damp air, which in certain conditions forms a visible plume of steam. The effect of the cooling towers depends to a large extent on the weather conditions around the tower and the effect is local in nature. Due to climate change, the power plant will in future probably use the cooling towers to an even greater degree in order to keep the thermal load on the Sava within ΔT 3°C. The magnitude of the effect will remain within the existing limits, the only difference being that the impact could last longer.

After NEK operation comes to an end, pollutants will temporarily be released into the air from the auxiliary boiler room, which will be used as heating premises and for safety purposes (to prevent freezing). The total quantity of fuel used will be reduced as heat will no longer be needed to generate supplementary steam. Temporary emissions will occur as a result of the testing of the diesel generators, which will remain on site as an emergency source of electricity.

Impact on the climate, including greenhouse gas emissions

Nuclear power plants do not generate greenhouse gas emissions when they produce electricity. Instead, emissions are generated by on-site ancillary activities: three diesel generators for the emergency supply of electricity, auxiliary steam boilers, on-site transport and SF6 greenhouse gases. Following the extension of its operational lifetime, the power plant will generate approximately the same annual emissions as it currently generates. Total greenhouse gas emissions for the 2024–2043 period could reach approx. 23.46 kt CO_2-eq. This is negligible relative to national emissions (0.13% of total national emissions in 2018 and 0.28% of all emissions from the electricity and heat generation sector). Extending NEK's operational lifetime will also have a positive impact by contributing to the reduction of greenhouse gas emissions relative to other technologies used to produce electricity.
Should NEK cease operations, there will be no more major emissions of greenhouse gases.

Radiation impacts – ionising radiation

The estimate of the impact of ionising radiation on the existing situation is taken from the "Monitoring of radioactivity in the vicinity of NEK, Report for 2020" document (Inštitut Jožef Stefan, IJS-DP-13463, April 2021).

Liquid effluents in 2020

When NEK is in operation, environmental concentrations of discharged radionuclide activity (with the exception of H-3) are significantly below the limits of detection, or else it is difficult to separate any contribution made by these radionuclides from the background (C-14, Cs-137). Their impact on human beings and the environment is therefore evaluated indirectly from data on discharges into the atmosphere and liquid effluents. Public exposure is assessed using models that describe the spread of radionuclides via various pathways in the environment.
The model calculation, which is based on liquid effluents and data on the annual flow of the Sava, and takes into account the characteristics of the reference group (i.e. fishermen who fish in the reservoir up to 350 m downstream from the NEK dam, spend considerable amounts of time on the bank and consume fish from the river), has shown that the effective dose for an adult from discharges into the Sava was 0.006 μSv per year (time spent on the bank and the consumption of fish) in Brežice in 2020. The calculated annual effective dose for an adult 350 m from the NEK dam is 0.014 μSv. If the average habits of the reference person were taken into account, the effective dose received would be several times lower. H-3 accounts for the biggest single share of the total effective dose (44%), with the predominant pathway being the consumption of fish. Spending time on the bank accounts for most of the total dose load from discharges of Co-60 and Co-58. H-3 would contribute the most to the dose load from the consumption of Sava water (100%), which is an unlikely pathway into the human body. The construction of the Brežice hydropower plant and creation of the reservoir led to changes in the methods and pathways of public exposure. The estimate of the effects of discharged radionuclides is based on old assumptions and does not take into account all the hydraulic parameters and the configuration of the Sava channel, such as mixing at the dam, the uncertainty of flows, and the swelling of the Sava downstream into the groundwater (before the construction of the Brežice HPP reservoir). A study is being drafted that will result in a new model that reflects the current situation. It will also be used to calculate doses along this pathway and serve as a starting point for any alterations to the monitoring programme.
The highest estimated annual effective dose in the surrounding area of NEK in 2020 due to drinking water from the water supply system was calculated on the Krško/Brežice Polje, at the Brege pumping station (4.5 μSv for an adult reference person, 6.4 μSv for children and 26.9 μSv for infants). Practically all the load derives from naturally occurring radionuclides. Artificial radionuclides contribute a maximum of 1.2% to the load, primarily as a result of global contamination rather than NEK operations. This percentage is even smaller for children and infants. In comparison with the other two

pumping stations and with the Ljubljana water supply system, the impact of naturally occurring radionuclides is highest for Brege. There is a direct link at this pumping station between the surface and the groundwater in the case of the use of chemical agents in agriculture, as the measurements contained in the Report on the Quality of Drinking Water in the Public Water Supply Systems and on the Discharge and Treatment of Wastewater in the Municipalities of Krško and Kostanjevica na Krki in 2019 (Kostak, Krško, March 2020). The higher concentration of naturally occurring radionuclides (potassium K-40) in water, which is around three times higher for Brege than for Rore, is also evidence of this.
The estimated annual effective doses from artificial radionuclides in drinking water in the Brežice and Krško water supply system are far below the authorised dose limit (50 µSv), while the activity concentrations are below the derived activity concentration limits calculated by taking into account the fact that the value of the effective dose limit is 100 µSv per year.

<u>Atmospheric discharges in 2020</u>

Effective dose from emissions monitoring

When calculating doses, several conservative assumptions were made with regard to weather conditions (least favourable annual dilution factor per wind direction), level of discharge (ground discharge) and the permanent presence of an imaginary person at a distance of 500 m. The purpose of this calculation is to make a comparison with the administrative dose limit in the immediate vicinity of the power plant, not to ascertain the actual irradiation of the population, which is (understandably) significantly lower.
Given that the emission of the more typical fission products is negligible, the contributions of H-3 and C-14 (as C_xH_y) were more significant in relative terms, accounting for 93% of the total dose. The contribution made by discharged noble gases was 7% of the total dose, while other radionuclides were less important.
The dose is calculated for radiation from the cloud of noble gases and for internal irradiation resulting from the inhalation of other radionuclides. The effective dose is calculated by using the Lagrange model of annual dispersion for ground discharge, and amounts to 0.45 µSv at a distance of 500 m from the reactor shaft.

Effective dose from emissions monitoring

The following groups of radionuclides are considered when the impact of atmospheric discharges is being evaluated:

- noble gases that are exclusively significant with regard to external exposure during cloud passage;
- pure beta emitters, such as H-3 and C-14, that are biologically significant only in the case of entry into the organism via inhalation (H-3, C-14) and ingestion (C-14);
- beta/gamma emitters in aerosols (isotopes of Co, Cs, Sr, etc.) via pathways: inhalation, external radiation from deposition, ingestion of radionuclides deposited on plants;
- isotopes of iodine in various physical and chemical forms, significant in the case of inhalation during cloud passage and as a result of intake into the body with milk.

Tables 3 and 4 below provide an evaluation of atmospheric emissions using a model calculation of the dilution coefficients in the atmosphere for 2020 and for individual groups of radionuclides by most important pathway for adult inhabitants of Spodnji Stari Grad, which is the nearest settlement to the exclusion zone (Table 3), and at the NEK perimeter. The estimates also apply in approximate terms at a distance of 500 m from the reactor shaft (Table 4). There is a limit applying to additional public exposure at the edge of the exclusion zone (500 m from the reactor shaft). Furthermore, the total annual effective dose of the contributions from all pathways may not exceed 50 µSv per individual. The tables show that contributions to the annual effective dose for an adult inhabitant are 0.0079 µSv at the NEK perimeter and 0.0066 µSv in Spodnji Stari Grad.
The dilution factors for external radiation from cloud and inhalation have been assessed with the Lagrange model since 2007. This model includes the characteristics of the terrain in the vicinity of

NEK and a larger set of meteorological variables. The model uses all the measured data in the EIS ecological information system managed by NEK. For emissions, this is the flow of gases from the main NEK exhaust. The model also requires the speed of the discharged gases and the cross-section of the exhaust stack. A temperature of 25°C was determined as the temperature of the flue gases. The contribution made by radiation from deposition was, until 2010, further estimated using the Gaussian model, with consideration given to ground discharge. The atmospheric immersion estimate in 2020 is comparable to that of previous years in terms of data scatter.

Table 3: Public exposure to radiation of adults in Spodnji Stari Grad resulting from atmospheric discharges from NEK in 2020

Method of exposure	Pathway	Most significant radionuclides	Annual dose (mSv)
External radiation	Inversion (cloud) Radiation from deposition	noble gases (Ar-41, isotopes of Xe) aerosols (isotopes of I and Co, Cs-137)	3.6 E-7 7.2 E-16
Inhalation	Cloud	H-3, C-14, I-131, I-132, I-133	6.3 E-6
ingestion	Plant-based food	C-14	0[21]

[21]The result is below the measurement uncertainty.

Table 4: Public exposure to radiation (adults) at the NEK perimeter resulting from atmospheric discharges from NEK in 2020

Method of exposure	Pathway	Most significant radionuclides	Annual dose (mSv)
External radiation	Inversion (cloud) Radiation from deposition	noble gases (Ar-41, isotopes of Xe) aerosols (isotopes of I and Co, Cs-137)	5.6 E-7 4.7 E-15
Inhalation	Cloud	H-3, C-14, I-131, I-132, I-133	7.3 E-6
ingestion	Plant-based food	C-14	5.0 E-5

C-14 measurements were conducted on samples of wheat and corn at Institut Jožef Stefan in 2020. The measurement results show the expected slight increase in the specific activity of C-14 in samples at a distance of up to 1 km from the reactor shaft relative to the samples taken at the reference point in Dobova. The estimated annual effective dose from the ingestion of C-14 is therefore 5 E-5 mSv higher in the vicinity of NEK (up to 1 km from the plant) than at the control point in Dobova. When calculating the C-14 dose received in the vicinity of NEK, the conservative assumption was made that local residents consumed food from the immediate vicinity of the plant (close to the edge of the exclusion zone) two months a year and food from elsewhere (Dobova) for the other ten months. In the case of the calculation of the C-14 dose as well, due regard is paid to the fact that residents consume food produced in the Krško-Brežice area (from the NEK perimeter to Dobova).
The difference between the calculation of the C-14 dose and the dose received from the entry of other radionuclides into food lies in the fact that a weighted average of the specific activity of C-14 is taken into account with respect to the sampling location. This is not possible for other radionuclides because of the different sampling methods involved. The C-14 dose relates to food and not to a specific type of food, as the specific activity of C-14 (in Bq per kg of carbon) does not differ according to type of food. The ratio between the C-14 and C-12 isotopes is constant in all organisms and reflects the ratio between the two isotopes in the atmosphere. In the case of artificial C-14 discharges, the ratio

between the C-14 and C-12 isotopes may change in the atmosphere as well as in organisms, as C-14 isotopes replace C-12 isotopes in organic molecules.

Natural radiation

Measurements of external radiation in the vicinity of NEK in 2020 confirmed previous findings, i.e. that it was a typical natural environment such as is found elsewhere in Slovenia and around the world. The annual dose equivalent H*(10) of gamma radiation and the ionising component of cosmic radiation in the vicinity of NEK was, on average, 0.90 mSv outdoors. This is higher than the estimated annual effective dose for indoor premises of 0.83 mSv (1998). To this it is necessary to add the contribution of H*(10) neutron cosmic radiation, which is 0.07 mSv per year for the NEK area. The total effective dose of natural external radiation H*(10) in 2020 in the vicinity of NEK was therefore 0.97 mSv per year. The relevant annual effective dose (taking into account the conversion factors from the Radiation Protection 106 publication) is 0.81 mSv per year, which is lower than the world average of 0.87 mSv per year.

As the specific activity of naturally occurring radionuclides in food is comparable with average values around the world, we take the conclusions from UNSCEAR for the effective dose from food intake (UNITED NATIONS, Sources and effects of Ionizing Radiation, Report to the General Assembly with Scientific Annexes, United Nations Scientific Committee on the Effects of Atomic Radiation, UNSCEAR, YN, New York, 2000).

Individual contributions to the natural radiation dose are shown in Table C of the original document. The total annual effective dose is estimated at 2.39 mSv, which is comparable with previous years in terms of value scatter, as well as with the global average of 2.4 mSv per year.

Naturally occurring radionuclides in 2020

The measured activity of naturally occurring radionuclides (uranium and thorium chain, K-40, Be-7) does not differ markedly from the values measured at other locations in Slovenia or the values set out in the literature. This applies to the Sava, groundwater, water supply system and sediment, as well as to air and food. It is also the case that the values are comparable with those of previous years.

Chernobyl contamination, nuclear test explosions and the Fukushima accident (2020)

In 2020, as in previous years, the anthropogenic radionuclides Cs-137 and Sr-90, which originate from the Chernobyl disaster and from nuclear test explosions, are still measurable in the soil. There was no detectable impact in 2020 from the radionuclides discharged into the atmosphere after the accident at the Fukushima nuclear plant in Japan in 2011.

The contribution of Cs-137 to external radiation was estimated at less than 0.017 mSv per year, which is 2.5% of the average annual external dose from natural radiation in the vicinity of NEK. The estimate is comparable with the estimates of previous years.

The predicted effective dose resulting from the inhalation of radionuclides that are the consequence of general contamination (Cs-137 and Sr-90) is estimated at 2.7 E-7 mSv per year for an adult individual. Traces of Cs-137 and Sr-90 from nuclear tests and the Chernobyl disaster were measured in individual types of food. In 2020 the effective dose as a result of eating such food was estimated to be 3 E–4 mSv per year for Cs-137 and 1.3 E–3 mSv per year for Sr-90, which is a total of around 0.8% of the annual effective dose from naturally occurring radionuclides (excluding K-40) in food. The estimated dose is comparable to the figures from previous years.

The greatest contribution to the annual effective dose comes from C-14 that arrives in the food chain via natural pathways and as a result of the above-ground nuclear tests that took place in the 1960s.

Comparison with previous years (2020)

Table 5 shows the individual contributions to the annual effective dose from NEK emissions between 2016 and 2020 as they apply to an adult at the NEK perimeter. The estimates also approximately apply at a distance of 500 m from the reactor shaft. The exception is the dose from external irradiation, which is measured by TLDs. During the construction of NEK, the top layer of earth was removed and gravel strewn on the surface. As a result, the average annual environmental dose equivalent in the vicinity of NEK is 40% higher than that recorded at the NEK perimeter. Consequently, the average environmental dose equivalent for the area surrounding NEK is given.

Table 5: Summary of annual exposures of the population in the vicinity of NEK 2016–2020

		Annual effective dose E (mSv)				
Source	Pathway	2020	2019	2018	2017	2016
Natural radiation	gamma and ionising	0.76**	0.64**	0.70**	0.69**	0.68**
	cosmic radiation	0.06	0.08	0.09	0.08	0.1
	cosmic neutrons					
	ingestion (K, U, Th)	0.27	0.27	0.27	0.27	0.27
	inhalation (short-lived progeny of Rn-222)	1.30	1.30	1.30	1.30	1.30
	Total natural radiation	2.39	2.29	2.36	2.34	2.35
NEK direct radiation along the NEK perimeter	Direct radiation from NEK facilities	indetermina-ble	indetermina-ble	indetermina-ble	indetermina-ble	indetermina-ble
NEK	External radiation from cloud	5.6 E-7	1.2 E-6	9.4 E-7	7.1 E-7	6.9 E-7
atmospheric discharges* (at the NEK perimeter)****	external radiation from deposition (isotopes of I and Co, Cs-137)	4.7 E-15	2.7 E-12	2.1 E-12	1.2 E-12	5.8 E-12
	inhalation from cloud (H-3, C-14)	7.3 E-6	1.6 E-5	3.0 E-5	2.4 E-5	1.3 E-5
	ingestion (C-14)	5.0 E-5	8.0 E-5	8.0 E-5	1.0 E-4	1.0 E-4
NEK liquid effluents (Sava)	reference group (350 m below NEK dam)	1.4 E-5	1.2 E-5	8.0 E-6	8.0 E-6	2.7 E-4
	adult, Brežice	6.3 E-6	5.4 E-6	4.0 E-6	4.0 E-6	1.3 E-4
Chernobyl contamination Nuclear tests	external radiation**	< 1.7 E-2***	<1.3 E-2***	<2.3 E-2***	<3.3 E-2***	<4.0 E-2***
	ingestion of plant and animal food (excluding C-14)	1.6 E-3	1.0 E-3	1.5 E-3	1.4 E-3	Ingestion total: 1.4 E-3
	ingestion of plant-based food (C-14)	1.5 E-2	1.5 E-2	1.5 E-2	1.5 E-2	
	ingestion of fish	8.9 E-5	1.4 E-4	7.5 E-4	1.1 E-3	

* The totals for NEK contributions are not stated, since contributions are not all additive in that they do not relate to the same groups of the population.

** Estimate of the effective dose of external radiation from environmental dose equivalent of dose

H*(10), taking into account conversion factor E/H*(10) = 0.84 for 600 keV photons (Radiation Protection 106, EC, 1999).
*** This estimate does not take into account the fact that the population spends about 20% of its time outdoors and that the indoor radiation shield factor is 0.1. This is a conservative estimate.
**** The estimate also approximately applies at a distance of 500 m from the reactor shaft.

When we add the values for atmospheric and liquid effluents, we find that the impact of the monitored discharges from NEK on the population is significantly below the authorised dose limit. One should emphasise at this point that different population groups are involved, and that the total value is therefore only a rough estimate of the annual effective dose.

An analysis of the estimate annual effective doses received by reference groups from NEK emissions shows that the total value fell between 2005 and 2011, while since 2012 the annual effective dose per inhabitant at the NEK perimeter (the estimates also apply approximately to a distance of 500 m from the reactor shaft) has been slightly higher as a result of the impact of C-14 on the food chain during the growing period and the changed assumptions within the dose calculation. However, it still remains two orders of magnitude below the authorised dose limit. We observed an increase in the annual effective dose in 2013 and 2014. However, this could be attributed exclusively to the contribution of C-14 to liquid effluents, something that we had not taken into account in previous years.
In 2020, the total gives the second lowest value of the last 31 years (the lowest was in 2010). These low values can be attributed to the small controlled discharges from NEK (high-quality fuel) and the fact that no regular outage took place in 2020. When comparing the contributions in individual years, one should also take into account the fact that, since 2007, calculations of external radiation from cloud and inhalation have used the Lagrange model, which can give a lower exposure value, and that the values of the contribution to the dose made by the ingestion of C-14 (from atmospheric discharges) were, up until 2006, estimated on the basis of discharges and data from similar power plants.
We can therefore also state that the radiation effects of NEK are several orders of magnitude lower than global contamination and the effects of the use of radionuclides in medicine. The estimated value of the radiation effects (annual effective doses) of NEK on the population at the NEK perimeter (and approximately 500 m from the reactor shaft) is approx. 0.003% of the typical, unavoidable natural background.
Measurements were taken in the vicinity of NEK of other radionuclides that are mostly a part of global contamination (C-14, Sr-90, Cs-137) or of use in medicine (I-131), or are of cosmogenic origin (H-3, C-14). The contributions to the annual effective dose are collected, by medium for all artificial radionuclides received by the population (adults) from the closest settlements or reference locations, in Table 5, with a comparison with previous years also provided. In 2020 the largest contribution from external radiation came from the presence of Cs-137 in the soil (global contamination). The second largest contribution came from C-14 in food. We can also state that the total contributions are falling year by year, with reduced estimates of Cs-137 radiation in the soil making the biggest contribution to this fall. It is also found that all methods of public exposure were negligible in comparison with natural radiation, dose limits and authorised dose limits.

<u>Conclusions – 2020</u>
A summary of public exposure in the area around NEK for 2020 is given in Table 5, which shows the contributions of natural radiation, the impacts of NEK at the perimeter, and the residual impacts of Chernobyl contamination and nuclear test explosions:

- in 2020 all the radioactive effects of NEK at the NEK perimeter (the estimate is approximately valid also at a distance of 500 m from the middle of the reactor) and 350 m downstream from the NEK dam were estimated to be less than 7.14 E-5 mSv a year;
- the estimated value of the radiation effects from NEK along the NEK perimeter is approx. 0.003% of the typical, unavoidable natural background. The estimate also approximately applies at a distance of 500 m from the reactor shaft;

- the estimated value is small in comparison with the authorised dose limit for the population in the vicinity of NEK (the effective dose of 50 μSv annually at a distance of 500 m and more for contributions via all pathways);
- the sum total of all radiation effect contributions was the second lowest of the last 31 years. We can attribute these low values to the small controlled discharges from NEK (high-quality fuel) and the fact that no regular outage took place in 2020. Credit for the low impact of the nuclear power plant should also go to NEK employees, who are careful to control and limit discharges;
- the consumption of food (86.9%), leading to the intake of C-14, makes the biggest contribution to the total effective dose;
- the effective dose from inhalation accounts for 10.2% of the total effective dose. With regard to radionuclides, the biggest contribution comes from H-3;
- the effective dose from external radiation accounts for 2.9% of the total effective dose. With regard to radionuclides, the biggest contribution comes from Co-60; ¬ the sum of effective dose contributions calculated from the measurements of samples from the environment is falling year by year, with reduced Cs-137 radiation in the soil making the biggest contribution to this fall. This is a remnant of the atmospheric and precipitation depositions following the Chernobyl nuclear reactor disaster in 1986.

By extending the operational lifetime, emissions of radioactive material into the environment will be equal to the existing total. NEK is continuously upgrading and improving its safety and process systems which means that the burden on the environment is constantly decreasing. The estimated annual effective dose to an inhabitant most affected by NEK's impacts in 2020 was less than 0.1 μSv (0.071 μSv). Compared to the annual effective dose from natural background radiation in Slovenia, which amounts to approx. 2,500 μSv, the contribution of NEK is negligible, as well as several 100 times lower than the 50 μSv dose limit.
When the dry storage facility for spent fuel comes into use, the dose on the NEK fence near the storage facility will increase. However, the annual dose on the NEK fence following the storage of spent fuel will not exceed the 200 μSv limit (RETS 3.11.7).
The dose rate on the outside wall of the dry storage building will not exceed the limit of 3 μSv/h, as defined in point 3.2.b.2.1 of specification SP-ES5104 or the fourth point of the first paragraph of Article 4 of the Rules on radiation protection measures in controlled and monitored areas (SV8A, Official Gazette of RS, No. 47/18), which defines the limit average dose rate within eight hours for controlled areas. The surroundings of the dry storage building therefore do not need to be declared as a controlled area.

Regarding the measures below as set out in the environmental impact assessment report and stemming from the operating licence (Decision/approval to commence NEK operation; National Energy Inspectorate decision no. 31-04/83-5 dated 6 February 1984 and URSJV decision no. 3570-8/2012/5, amendment to the NEK operating licence dated 22 April 2013), the ministry explains that they are not laid down in the operative part of the environmental protection consent because the developer is required to implement them by the provisions already referred to:
- limit on the annual dose of external radiation on the NEK perimeter fence: 200 μSv.
- maximum permissible annual effective dose from emissions of radioactive material 500 m from the reactor centre: 50 μSv;
- limit on the annual activity of fission and activation products in liquid discharges: 100 GBq;
- limit on the quarterly activity of fission and activation products in liquid discharges: 40 GBq;
- limit on the annual activity of H-3 in airborne discharges: 45 TBq;
- limit on the annual activity of iodine in gaseous discharges: 18.5 GBq;
- limit on the annual activity in dust particles: 18.5 GBq.

The developer is already carrying out the following measures, and will continue to do so during the operation of the lifetime extension:
- filtration of liquid emissions;
- filtration of gaseous emissions;

- confinement of radioactive effluents in order to minimise radioactivity through radioactive decay;
- measures to ensure fuel integrity;
- adequate design and implementation of structural protection (adequate wall thickness, labyrinth design of rooms);
- installation of temporary shields for short-term activities that result in locally increased levels of external radiation;
- storage of radioactive waste and spent fuel at dedicated facilities designed for this purpose.

Similarly, the ministry has not used the operative part of the environmental protection consent to set down the measures envisaged for the operation of the dry storage of spent fuel, as these measures are included in building permit no. 35105-25/2020/57 of 23 December 2020 granted by the Ministry of the Environment and Spatial Planning, Spatial Planning, Construction and Housing Directorate, Dunajska cesta 48, 1000 Ljubljana for a facility with environmental impacts, i.e. the spent fuel dry storage facility at the NEK site.

After NEK ceases operating, the fuel will no longer be in the reactor, but stored safely in the spent fuel pool and/or in the dry storage for spent fuel.

Ionising radiation from dry storage will be present at the NEK perimeter, while the gaseous and liquid effluents will be considerably smaller or completely non-existent. To that end, it will be necessary to implement all protective measures to prevent the impact of ionising radiation on the environment.

<u>Impacts of waste</u>

<u>Radioactive waste:</u>

Table 1 shows the quantity of low- and intermediate-level waste (LILW) as at 31 December 2020:

Table 1: Inventory of processed LILW, located in the storage building – as at 31 December 2020

Type of waste	Designation	No. of packages	Gamma activity (Bq)*	Alpha activity (Bq)*	Volume (m^3)
Incineration products	A	[1]70	$5.14 \cdot 10^{9}$	$1.14 \cdot 10^{8}$	14.6
Dried spent ion-exchange resins from the secondary cycle	BR	[2]1	8.80·108	$1.33 \cdot 10^{6}$	0.2
Compressible waste	CW	[3]7	$1.95 \cdot 10^{8}$	$3.34 \cdot 10^{5}$	1.5
Dried evaporator concentrate	DC	9	$1.75 \cdot 10^{9}$	$1.70 \cdot 10^{5}$	1.8
Dried sediments	DS	1	$3.39 \cdot 10^{7}$	$6.30 \cdot 10^{3}$	0.2
Evaporator concentrate	EB	2	$2.28 \cdot 10^{8}$	$1.19 \cdot 10^{5}$	0.4
Spent filters	F	117	$1.10 \cdot 10^{11}$	$4.74 \cdot 10^{7}$	24.3
Other wastes	O	[4]7	$3.56 \cdot 10^{8}$	$1.28 \cdot 10^{6}$	1.5
Dried spent ion-exchange resins from the primary cycle	PR	1	$1.43 \cdot 10^{10}$	$9.69 \cdot 10^{6}$	0.15
Compacted waste 1988, 1989	SC	617	$1.29 \cdot 10^{10}$	$2.09 \cdot 10^{8}$	197.4
Spent ion-exchange resins	SR	689	$1.87 \cdot 10^{12}$	$3.75 \cdot 10^{9}$	143.3
TTCs containing compressed waste from 1994 and 1995, and pressings from ongoing supercompaction (2006, 2007, 2008, 2010, 2011, 2012, 2013 and 2014).	ST	1,853	$5.32 \cdot 10^{11}$	$6.73 \cdot 10^{8}$	1,601.0
TTCs into which standard non-compacted drums are inserted	TI	364	$1.23 \cdot 10^{13}$	$1.93 \cdot 10^{10}$	316.2
Total		3,738	$149 \cdot 10^{13}$	$2.41 \cdot 10^{10}$	2,302.6

* Alpha activity is determined on the basis of activity ratios of alpha emitters and radionuclide 137-Cs, as was found in the reference samples.

[1] An additional 19 packages located in the decontamination building will be relocated to the NEK LILW storage facility (4.0 m^3).
[2] An additional 53 packages located in the decontamination building ready for incineration (10.6 m^3).
[3] An additional 393 packages located in the WMB and DB, ready to be sent for incineration (81.7 m^3).
[4] An additional 28 packages located in the WMB prior to measurement and storage in the RWSB (5.8 m^3).
[5] An additional 80 ingots located in the decontamination building (8.8 m^3).

At the 13th meeting of the Intergovernmental Commission for Monitoring the Execution of the Treaty between the Governments of Slovenia and Croatia on the regulation of status and other legal relations connected with investments, exploitation and decommissioning of NEK (MDP) held on 30 September 2019, a decision was made, based on the report from the Coordination Committee, that a joint solution for the LILW waste repository is not possible. The total quantities of LILW to be shared between the Slovenian and Croatian parties, determined on the basis of the waste inventory in the NEK storage facility and the estimates of future LILW generation during NEK operation and decommissioning, are shown in Table 2:

Table 2: Total quantity of LILW to be shared between the Slovenian and Croatian parties.

Period of LILW generation	Source of data	Mass (t)	Volume (m^3)	Activity (Bq)[11]
1983–2018[12]	Inventory	4,877.4	2,294.9	5.98 E13
2018–2023	Estimate	264	163.4	1.44 E13
Total by 2023	Estimate	5,141.4	2,458.3	7.42 E13
2024–2043	Estimate	883.7	546.6	4.83 E13
Decommissioning of NEK	PO3[13]	2,860	2,842	/
Decommissioning of spent fuel dry storage	PO3	392	407	/

[11] Value excluding radioactive decay.
[12] Until 2020, some of the waste was further processed.
[13] Third Revision of the Krško NPP Radioactive Waste and Spent Fuel Disposal Program, Version 1.3, September 2019, Agency for Radwaste Management (ARAO), Ljubljana, Fund for Financing the Decommissioning of Krško NPP, Zagreb (PO3), Table 4-17.

Each party will manage its half of LILW in accordance with national strategies and programmes addressing radioactive waste management.
Under the basic scenario, the Slovenian half of the waste should be disposed in Vrbina in two phases: in the first phase, from 2023 to 2025, disposal of the currently stored LILW from operation and other sources; in the second phase, from 2050 to 2058, disposal of the remaining LILW from NEK's operation together with the LILW from decommissioning, at which time the procedures for the final closure of the repository will also be initiated. The LILW from other sources refer to the LILW that meets the acceptance criteria for waste disposal and originate from the central storage facility for radioactive waste.
The Croatian scenario envisages that the Croatian part of the operational LILW will be transported to Croatia to the centre for radioactive waste management (CRAO), which will be built in compliance with the Strategy. The priority location of the CRAO centre is Čerkezovac, the location of the military logistics complex, which the army does not intend to use in the future. Čerkezovac is located in the municipality of Dvor on the southern slopes of the Trgovska Gora massif.

Spent fuel:
All spent fuel at NEK is currently stored in the spent fuel pool, where 1,694 cells are available in

storage racks. A total of 1,323 fuel elements were stored in the spent fuel pool at the end of 2020, including two special containers with fuel rods and a fission chamber from 2017. The spent fuel elements will be relocated from the spent fuel pool to the storage in the course of four campaigns. Campaign I (2023, 592 fuel elements), Campaign II (2028, 592 fuel elements), Campaign III (2038, 444 fuel elements), Campaign IV (2048, remaining fuel elements).

<u>Management of other waste:</u>
There are around 36 existing types of waste (2020) that are generated in all production and support processes, 19 of which are hazardous types of waste. The total volume of waste generated in 2020 was around 2,302 tonnes, including 2,192 tonnes of construction waste from works performed in 2019. The hazardous waste amounted to approx. 12.3 tonnes. All waste, except for radioactive waste, is handed over for treatment to a contractor. NEK does not treat the other waste. Waste is separated by type at the source, while waste is stored temporarily in accordance with valid regulations. A closed area is used for the temporary storage of hazardous waste. Waste is removed regularly. Continuous records are kept of the quantities of hazardous waste in temporary storage. The company continuously implements various technical and organisational measures to reduce the quantities of generated waste and to improve the management thereof, i.e. improved waste separation at the source. NEK also holds the ISO 14001:2015 certificate.

The extended operational lifetime will not change the rate at which waste is created. The types and annual quantities of waste (including radioactive) produced by NEK will not change substantially as a result of NEK's extended operational lifetime relative to the existing status.
If NEK operation is extended to 2043, 3,005 m^3 (storage volume) or 6,025 t of operating LILW will be generated by the plant. If NEK operates until 2023, the respective figures will be 547 m^3 or 884 t lower, i.e. 2,458 m^3 or 5,141 t.
In addition to operating LILW, LILW resulting from decommissioning will be produced after NEK ceases operation. A portion of this LILW will be produced during the decommissioning process after the end of operation. There will be 2,860 t or 2,842 m^3 (storage volume) of such waste regardless of whether NEK continues to operate until 2023 or 2043. Some of the LILW from decommissioning will be produced during the decommissioning of the spent fuel dry storage (2103–2106). There will be 392 t or 407 m^3 of such waste. Small quantities of HLW will also be produced during the decommissioning process.
Pre-conditioning of waste for Vrbina LILW repository:
LILW packages will be taken by the competent organisations in Slovenia (ARAO) and Croatia (FOND). The division itself will take place in the waste manipulation building (WMB). Existing tools and equipment will be used for the process. In order to reduce the radiological pressures on those carrying out the activity, additional protection will be employed in the form of mobile protective walls, remote handling, etc. The WMB was designed precisely for the purpose of conditioning LILW before it is sent for processing (incineration, melting), activities that NEK is already carrying out, and for the final handover and packaging in special canisters for final takeover by ARAO and FOND.

Existing packages will be directly placed in the planned N2d, RCC or ISO IP2 transport canisters at the WMB. The building has been designed in such a way as to ensure radiological protection of the surrounding area and the environment, as well as provide adequate working conditions in the building itself (thickness of walls, closed ventilation filter system, implementation of a closed floor drainage system, etc.). Prior to the insertion of the packages into the canisters, the formal transfer of the ownership of the LILW from NEK to the receiving organisations (ARAO and FOND) will take place. The covering of the N2d and RCC canisters with filling mortar using mobile equipment is also planned. After the completion of the drying process and the hardening of the filling mortar, the canisters will be loaded onto lorries and taken from the NEK site, whereby all requirements for the transport of radioactive material will be observed. ARAO and FOND will be responsible for organising the transport.
That portion of the LILW that cannot be placed directly into RCC or N2d canisters and that will have to

be further processed will be placed in ISO IP2 transport canisters and taken from NEK to the competent receiving organisations. After the external contractor has processed and conditioned the LILW abroad, the waste will be returned for long-term storage in Croatia or Slovenia.

The environmental burden on account of spent fuel during the extended operational lifetime of NEK will be the same as the current burden in terms of scope and form, i.e. the burden in the final years of operation. The introduction of dry storage will change the technology of storing spent fuel from wet to dry. Dry storage is a safer way of storing spent fuel under the same environmental and radiation conditions as are prescribed in the existing operating licence. An environmental impact assessment was carried out for spent fuel dry storage and building permit no. 35105-25/2020/57 of 23 December 2020 granted for the facility by the Ministry of the Environment and Spatial Planning, Spatial Planning, Construction and Housing Directorate, Dunajska c. 48, 1000 Ljubljana.

Spent fuel is being temporarily stored in its existing state in the spent fuel pool located in the fuel handling building. Because the fuel is underwater, the aforementioned pool is considered wet storage where the water needs to be continuously cooled. Dry storage introduces a new, technologically safer way of storing spent fuel that leads to a gradual reduction in the number of spent fuel elements in the pool, which in turn significantly increases the level of nuclear safety. The planned construction of a dry storage facility ensures a safer and completely passive way of storing spent fuel. That facility will accommodate the storage of 2,600 fuel elements.

There was a total of 1,444 fuel elements stored at NEK at the end of 2020, of which:

- 1,323 in the spent fuel pool (SFP) inside the fuel handling building (FHB), including two special containers with fuel rods and a fission chamber from 2017, and
- 121 in the reactor pressure vessel (core) in the reactor building.

If NEK operates until the end of 2023, a total of 1,553 elements of spent fuel will be generated, and if it operates until the end of 2043, a total of 2,281 spent fuel elements are estimated to be generated. Due to the extension of the operational lifetime from 2023 to 2043, it is expected that there will be an extra 728 elements of spent fuel at NEK.

There are around 36 existing types of waste (2020) that are generated in all production and support processes, 19 of which are hazardous types of waste. The method of managing this waste does not change from the way it is managed currently.

After the cessation of NEK operation, the maintenance and emptying of fluid systems, and the decontamination of appliances and facilities will produce the same form and quantity of radioactive waste as during operation.

Due to the extension of the operational lifetime from 2023 to 2043, there will be an extra 547 m^3 or 884 t of low- and intermediate-level radioactive waste. Due to the extension of the operational lifetime from 2023 to 2043, an extra 728 spent fuel elements will be generated.

Regarding the measures set out in the environmental impact assessment report relating to waste management, the ministry explains that it has not set them as a condition in the operative part of the environmental protection consent because they are measures that derive from regulations and that are therefore binding on the developer. Similarly, the ministry has not used the operative part of the environmental protection consent to set down the measures envisaged by the spent fuel dry storage project, as these measures are included in building permit no. 35105-25/2020/57 of 23 December 2020 granted by the Ministry of the Environment and Spatial Planning, Spatial Planning, Construction and Housing Directorate, Dunajska cesta 48, 1000 Ljubljana for a facility with environmental impact, i.e. the spent fuel dry storage facility at the NEK site.

<u>Impact of noise emissions</u>

No new sources of noise emissions, such as ventilating or cooling devices, are envisaged as resulting from the extended operational lifetime. NEK's production capacity also remains unchanged, and the power plant will continue to operate 24 hours a day, every day of the year, even after the extension of the operational lifetime. Noise emissions during the operating period will be the same as the existing ones. Owing to climate change, there could be a rise in air temperature and a reduction in the flow rate of the Sava, which could lead to an increase in the operation of cooling towers. However, we estimate, on the basis of the trend of climate variables, that the number of days on which the cooling towers operate will not change significantly. There will be no noise emissions after NEK ceases to operate, or else only some temporary noise due to activities connected with the termination of the lifetime extension.

Environmental impact of electromagnetic radiation pollution

No new sources of electromagnetic radiation are envisaged (e.g. transformer stations) due to NEK's extended operational lifetime. Likewise, there are no plans to fit the existing transformer stations with new transformers or replace them with greater capacity transformers. Emissions of electromagnetic radiation will be the same as the present ones. The entire NEK site is classified as a level II electromagnetic radiation protection area, while nearby residential areas that are more sensitive to radiation are deemed level I electromagnetic radiation protection areas. The main sources of low frequency electromagnetic radiation on the NEK site are transformers and power lines. The developer operates several transformer stations. The 2020 report on measurements of low-frequency electromagnetic fields (Report on the initial measurements of electromagnetic radiation performed for RTP 400/110 kV Krško and the reconstructed part of the 400 kV switchyard at NEK, Elektroinštitut Milan Vidmar, Hajdrihova 2, Ljubljana, June 2014) shows that the limit values for Level II radiation protection were not exceeded at the NEK site or on the boundaries of the site. There will be no more sources of electromagnetic radiation once NEK ceases to operate.

Environmental impact of vibration pollution

The site of the lifetime extension covered by this report is at least 500 m away from the nearest residential building or other buildings that are sensitive to vibrations (e.g. cultural heritage structures, kindergartens, schools, etc.). Road transport associated with the activity flows along public regional and state roads, while local roads in densely populated areas are not used for the delivery of raw materials and ancillary materials, or the transport of products. The scale of road transport for operational needs is and will continue to be small, and will also flow along public regional roads outside densely populated areas. The production process inside NEK does not include machines, devices or activities that could be a significant source of vibrations in the environment. After NEK ceases operation, the majority of devices that may cause vibrations to the environment will stop operating. This means that the activities that cause vibrations at the NEK site will be significantly reduced.

Impact of light pollution

The extension of the operational lifetime does not change the effect of light shining out into NEK's surroundings. Light emissions into the environment will be identical to the present ones. As NEK's external lighting is an integral part of the technical systems for ensuring physical protection, NEK is not bound by the Decree on limit values for light pollution (Official Gazette of RS, Nos. 81/07, 109/07, 62/10, 46/13), but by the Rules on the physical protection of nuclear facilities and nuclear and radioactive material, and the transport of nuclear material (Official Gazette of RS, Nos. 17/13, 76/17 [ZVISJV-1]). Nevertheless, NEK continuously strives to comply with requirements for reducing light pollution, for example by using the appropriate, horizontally mounted lights with level glass, not turning lights upwards to a greater degree more than is envisaged in the design to achieve appropriate illumination levels, and installing modern energy-efficient solutions (LEDs, etc.) when lights are being replaced. After NEK ceases operating, light emissions into the environment will be identical to the present ones as the facility will still be subject to security control.

Impact on the landscape

Since its construction at the beginning of the 1980s, NEK has been a spatially dominant element of the Krško-Brežice plain and serves as a point of orientation for inhabitants and visitors. The NEK complex is bordered on three sides by intensive orchards, while a fully open view of the complex is only afforded from the south, i.e. the right bank of the Sava. The power plant cannot be seen in full from the majority of locations; primarily the reactor building, which stands out due to its height, is visible. The plant is visible from the slope in Libna, the Krško–Brežice regional road, from the main rail line, from the edge of Sp. Libna and the edge of Sp. Stari Grad, from the edge of Žadovinek, from the sloped area of Krško on the right bank, from the edge of Drnovo, from the sloped area of Leskovec, from the edge of Kerinov Grm and from the edge of Gorica. NEK is visible from the surrounding flat farmland, from roads on the left and right banks of the Sava, and from the Krško–Brežice motorway. The power plant is not visible or noticeable from other settlements and areas due to the lie of the land, distance and swaths of vegetation that lie between those areas and NEK. Also visible in addition to NEK buildings are the high-voltage power lines that connect to the Krško substation on the northwestern corner of the complex: DV 2 x 400 kV Beričevo–Krško, DV 400 kV Mihovci–Krško, DV 400 kV Zagreb–Krško, DV 110 kV Krško–Brežice, DV 110 kV Brestanica Krško and DV 110 kV Krško–Hudo.

The appearance of the plant will not change during the extended operating period. At the beginning of the extended operational lifetime, dry storage building for spent fuel will have already been built, while no other construction works are envisaged. Due to the increasingly common occurrence of either high or low levels of the Sava, it is expected that the cooling towers will operate more often, accompanied by steam emissions that will be visible from larger distances. The occasional appearance of steam will not have a significant effect on NEK's visibility in the surroundings. The planting of a forest belt alongside the low- and intermediate-level radioactive waste depository will further reduce the power plant's visibility from the east and southeast.

<u>Impacts on land</u>

The site of the lifetime extension is located in an area of building land on which mainly industrial buildings classified as E – energy infrastructure have been built. The purpose-specific and actual land use will not change with the planned extension of NEK's operational lifetime.

<u>Impacts on natural assets</u>

The direct use of natural resources in production encompasses the use of water from the public water network for sanitary needs and fire safety, and river water and groundwater, which is taken from wells and the Sava for technological needs on the basis of water permits. The river and underground water is used in supporting cooling processes and is not used as a raw material (is not incorporated in products). Following use and appropriate treatment, all water is returned to the environment, i.e. to the Sava. The water pumped from the three temporary wells returns directly into the Sava via the rainwater drainage system. The lifetime extension will not impact valuable natural features in the vicinity during operation.

If the lifetime extension is abandoned, there will be a considerable reduction in the use of natural resources in comparison with regular operation. The spent fuel pool will still have to be cooled, as will a number of other safety components (water will be abstracted and returned to the Sava at a rate of approx. 1.6 m^3/s). If the lifetime extension is abandoned, there will be no impact on the protected natural areas in the vicinity of the activity.

<u>Transboundary impacts</u>

NEK's current level of production does not surpass the limit values of substance emissions and radiation into the environment. It is not expected that the limit values will be exceeded during the planned lifetime extension. The area in which the lifetime extension causes an environmental burden that could affect human health or property will be limited to the narrower NEK site. Under normal operation, the lifetime extension will have no transboundary effects on the factors resulting from individual influences or their mutual effects.

The "Calculation of Doses at Certain Distances for Design-Basis (DB) and Beyond-Design-Basis (BDB) Accidents at NEK" study (FER-MEIS, 2021) dealt with the design-basis large-break loss of coolant accident (LB LOCA) and the design extension conditions (DEC-B). The results of the study show that the effective 30-day dose at a distance of 10 km from the power plant is 1.16 mSv, which is more than two times lower than the annual natural background dose in Slovenia (approx. 2.5 mSv). The thyroid gland dose (13.5 mSv) at a distance of 3 km from NEK is below the limit prescribed by law for iodine prophylaxis, which is 50 mSv for seven days (Decree on limit doses, reference levels and radioactive contamination, Official Gazette of RS, No. 18/18). The distance of NEK from the closest borders of neighbouring countries is: 10 km from the border with Croatia, more than 75 km from the border with Austria, more than 129 km from the border with Italy, and more than 100 km from the border with Hungary. The results of the study show that in the event of a Large-break Loss of Coolant Accident (LB LOCA) and Design Extension Conditions (DEC-B), which also represent the worst possible accident scenarios, there will not be a significant transboundary impact on the environment and human health and property.

Decision

Following a review of the complete documentation relating to the administrative matter, the ministry found that the lifetime extension was acceptable for the environment if all of the design and environmental protection conditions set out in the operative part of this environmental protection consent were observed and implemented, and all the mitigation measures set out in the laws and implementing regulations, the Ordinance on the municipal spatial plan for the Municipality of Krško (Official Gazette of RS, No. 61/15) and the Ordinance on the development plan for Krško nuclear power plant (Official Gazette of RS, Nos. 48/87, 59/97 and 21/20) were implemented consistently.

Conditions

Following an examination of all of the documents enclosed by the developer with the application for the environmental protection consent, it was established that the request for the environmental protection consent could be approved, which made it necessary, pursuant to the third paragraph of Article 61 of the ZVO-1, to determine the conditions that the applicant had to observe in order to prevent, reduce or eliminate adverse effects on the environment.

A) Protection of surface waters and groundwater

A1) Present state of the environment

NEK is located at the northwestern edge of the Krško Polje/Brežiško Polje, on the left bank of the Sava, a few kilometres downstream from the town of Krško. In the Krško area, the Sava enters a wide valley before reaching Brežice, then narrows again after the confluence with the Krka. After Brežice, the river opens towards Čatež and further downstream towards the Samobor basin in Croatia and the narrower aquifer between Medvednica and Samoborska Gora. From a hydrogeological point of view, the two aquifers are interconnected, with downstream extensions from Krško and across Čateško Polje towards the Samobor and finally Zagreb aquifers, where the Sava and its connected underground aquifers function as a kind of corridor between the Krško–Brežice and Zagreb aquifers. Numerous water pumping wells are in operation along this aquifer corridor in both Slovenia and Croatia.

The distribution of the hydraulic conductivity of alluvial deposits along the Sava shows the highest values (K = 4 cm/s) in the central part of the Krško Polje/Brežiško Polje, as well as in the central part of the Samobor basin. The hydraulic conductivity of the Sava alluvial deposits decreases as the aquifer narrows in the area of Brežice, at Čateško Polje, and at the transition from the Samobor to the Zagreb aquifer. Groundwater in the alluvial aquifer flows to the south and southeast under the hydrological conditions of low and medium water levels. The exception occurs at high water levels, when the Sava feeds the alluvial aquifer along its entire length.

NEK is situated on the left bank of the Sava in the area of the alluvial aquifer. A dam has been built next to the power plant on the Sava, raising the level of the river to allow gravitational supply of cooling water to NEK. The slowing of the river flow at the dam results in an increase in groundwater levels on the left and right banks upstream from NEK, and a groundwater recharge in all hydrological conditions (low, medium, and high water levels).

NEK was built on the left bank of the Sava in the form of an "island" and using a sealing curtain measuring 144 m x 192 m, within which NEK and all its installations are located. The top of the curtain is built at an elevation of 154.5 m a.s.l., while the bottom lies at 141.0 m a.s.l., amounting to a total depth of 13 m. NEK is therefore almost fully isolated from the highly water permeable Quaternary aquifer. The construction of the Brežice HPP caused the maximum water level of the Sava to rise to an elevation of 153.20 m a.s.l., compared to the maximum water level of 151.21 m a.s.l. recorded prior to the construction of the Brežice HPP.

As part of an inspection of the operation of the sealing curtain, carried out on the interior and exterior sides of the curtain, pairs of piezometric boreholes were drilled in 2009 and a parallel measurement of groundwater levels inside and outside the sealing curtain was performed. A potential difference Δh of 0.3 to 1.3 m was recorded on the two sides of the curtain.

Relative to NEK and the surrounding area enveloped by the sealing curtain, the negative groundwater gradient demonstrates that the groundwater is "bypassing" the protected area of NEK, and flowing without impact towards the Sava, which drains groundwater on its left bank.

All pairs of piezometers record a difference in the groundwater level; the smallest difference is recorded on the southeastern side of NEK, which may indicate that the resistance to the flow of groundwater is lowest at this part of the sealing curtain. In all cases, a slightly lower groundwater level was recorded within the sealing curtain, although surface and groundwater levels generally rose by around 1 m following the construction of Brežice HPP. In order to ensure that groundwater levels remain at levels seen before the construction of Brežice HPP, the Slovenian Water Agency issued water permit no. 35530-100/2020 (14 November 2020) in 2020 for the construction of three wells within the sealing curtain area with a maximum permitted pumping rate of 5.0 l/s at an individual well, or a total of 70,000 m^3/year per well. The wells have been constructed and pumping tests conducted. The thickness of the Quaternary aquifer at the locations of the wells is around 3.2 m, and the aquifer permeability is 2.3 x 10^{-3} m/s. In this way, the groundwater level within the sealing curtain area is maintained at the previous level.

Another well (depth approx. 13 m) has been in use within the NEK perimeter since 9 September 2021. Water is pumped from the well at a maximum rate of 8.0 l/s (230 m^3/year). The mean value of the permeability coefficient obtained through trial pumping is 1.4*10-2 m/s. In accordance with water permit no. 35530-48/2020-3 of 9 September 2021, the impact on the water regime is monitored by measuring the current and total quantities of water intake at least once a day. Measurements are also taken of the groundwater level at least once a day. The measurements must clearly show the groundwater level when the well is at rest and when pumping is taking place.

At the town of Krško, the Sava flows into the VTPodV_1003 Krška kotlina groundwater body, which covers the entire Krško Polje/Brežiško Polje. Its surface area is 96.76 km^2. It is approx. 9 km wide and 18 km long. According to the water management plan from 2016, VTPodV_1003 Krška kotlina is assessed as an extremely vulnerable groundwater body.

Three typical aquifers are defined within VTPodV_1003 Krška kotlina. The first is an intergranular alluvial aquifer, formed by the sediments of the Sava and Krka and their tributaries. These are extensive, local and moderately to highly productive aquifers. The second aquifer or group of aquifers formed in Pleistocene and Tertiary sediments under the alluvial deposits of the Sava. These are intergranular, extensive and local aquifers of low to moderate productivity. The third aquifer or group of aquifers are thermal aquifers formed in carbonate rocks in the bedrock of Tertiary strata. Aquifers in carbonate rocks are karstic/fissured aquifers. They can be extensive, local and of low to high productivity.

Within the VTPodV_1003 Krška kotlina water body, there is one larger groundwater pumping station, Brege (around 60 l/s), which supplies the town of Krško, as well as 8 smaller local pumping stations. The Drnovo pumping station is currently not operating due to the high levels of nitrates in the water. There are designated water protection areas for all potable water pumping stations. The water protection area of the largest pumping station at Brege extends to the Sava, upstream and downstream from the NEK dam.

The construction of the Brežice HPP reservoir changed the hydrological and hydrogeological conditions in VTPodV_1003 Krška kotlina. Water flow along the Sava towards Brežice has slowed down due to the construction of the dam, which slows the flow of water to an elevation of 153.20 m – the maximum level of the reservoir with a volume of around 3,120,000 m^3. All accompanying construction along the Brežice HPP dam and the upstream part of the reservoir serves the purpose of preserving the previous state of balance between the lake, groundwater, and the biosphere. Embankments have been built along the northeastern and southwestern sides of the lake to limit the uncontrolled expansion of the lake area into the Krško basin. Seepage through the embankments on both sides of the lake is controlled with drainage channels along the embankments, that is, gravitational drainage into the Sava downstream of the dam. The embankment next to NEK, reaching from the dam to the elevation of 154.5 m, has all the characteristics of a flood dyke with no water seepage into the left bank. A groundwater enrichment facility has been built upstream of the NEK dam on the right bank of the Sava, which treats groundwater flowing towards potable water pumping stations on the right bank of the river and the NEK pumping station. In this way, the wider area of NEK is protected from the projected high water levels of the Brežice HPP reservoir, the infiltration of Sava waters into the right bank, where important potable water pumping stations are located, is increased, and a connection to groundwater on both banks is ensured with levels elevated by around 1 m.

The surface water body into which wastewater from NEK is discharged, and which is used by the power plant for process and cooling purposes, is the Sava Krško–Vrbina water body. The quality of the Sava is assessed on the basis of regular monitoring conducted by the Slovenian Environment Agency. According to Slovenian Environment Agency data, the chemical status of the Sava at the WB Sava Krško–Vrbina in the 2009–2013 period was assessed as good, with a high degree of reliability. In terms of mercury in organisms, the status was assessed as poor, with a low degree of reliability (this parameter was assessed as poor for all water bodies except WB Krupa).

In the 2009–2015 period, the ecological status of the Sava at the WB Sava Krško–Vrbina was assessed as good, with a high degree of reliability. The same assessment was given to its ecological status with regard to the concentrations of specific pollutants.

In the River Basin Management Plan (RBMP) for the Danube River Basin District 2016–2021, the assessment of the status for this water body was in line with the monitoring results referred to above.

The assessment of the state of water bodies for the Danube River Basin Management Plan 2022–2027 (RBMP3), which is being drafted, is based on the monitoring data from the 2014–2019 period. The assessment of the chemical status includes the state of waters and the status of the biota. The former is assessed as good, the latter as poor (or, together, as poor with a high degree of reliability). With a medium level of reliability, the ecological status is assessed as good. The ecological status with regard to the levels of specific pollutants is assessed as very good. With regard to specific pollutants, the state of the Sava Krško–Vrbina water body was assessed as very good, with a high degree of reliability.

The increased values of mercury and BDE in biota are not linked to NEK operation. The Draft Danube River Basin Management Plan 2022–2027 states as follows:

“Assessments of the chemical status of surface waters for the biota matrix show that, in Slovenia as in all European countries, mercury and brominated diphenyl ethers (BDE) are the substances that cause poor chemical status of surface water bodies

because they fail to meet the EQS for biota. The previous water management plan indicated a poor chemical status as a result of the Environmental Quality Standard (EQS) being exceeded for mercury in biota in 98.6% of surface water bodies. Mercury and brominated diphenyl ethers are classed as persistent bioaccumulative toxic contaminants (PBT) and accumulate in organisms. A similar situation is to be found in all European countries that have carried out analyses of these substances in fish.

In Slovenia, monitoring was conducted in biota at 60 surface water bodies, in international profiles, in areas without any human impact, and in polluted areas. The EQS for organisms were exceeded at all measuring points at which analyses of mercury and brominated diphenyl ethers were conducted. In light of this, the poor chemical status for the parameters of mercury and brominated diphenyl ethers was extrapolated to all surface water bodies. A low confidence level is therefore attached to the poor chemical status determined for biota in all surface water bodies in Slovenia whose chemical status was determined by extrapolation."

Estimates indicate that the highest inputs of the contaminants concerned into the Danube RBD are the result of atmospheric depositions in the river basins of the Drava, Srednja Sava, Spodnja Sava and Savinja. Estimates further show that inputs of hydrogen and sulphur from atmospheric deposition fell between 2013 and 2015, with a slight increase observed in 2016. Data was available for 2015 and 2016 for the remaining selected contaminants. As a result, any increase or reduction in the input of contaminants into surface waters cannot be estimated with any degree of reliability.

Taking this into account and comparing the data estimates on the types and strengths of pressures from atmospheric deposition with an assessment of the status of surface water bodies, it is estimated that atmospheric deposition exerts a significant pressure that causes poor chemical status by breaching the environmental quality standard for mercury in biota.

The ecological status of the Krško–Vrbina water body is assessed as good and very good for specific elements of quality. As regards hydromorphological status, some elements have been assessed as exerting significant hydromorphological pressures on the water body: hydrological regime in the main flow and inflow, continuity of the main flow and the morphological conditions of the main flow.

The production process of NEK requires cooling water from the Sava, which is collected at two points upstream from the NEK dam:

- up to 1.606 m^3/s of water for the small cooling system (essential service water, ESW) is collected at the small pumping station at the far southeastern part of the NEK complex; and
- up to 25 m^3/s of water for the large cooling system (circulating water, CW) is collected at the pumping station behind the submersible wall upstream of the NEK dam.

Water from the ESW system returns to the Sava upstream from the dam at discharge V1, and water from the CW system through the CW discharge facility at the V7 location. Since the water for the CW system is heated as it passes through the condenser, NEK is obliged to ensure, in compliance with the environmental protection permit, that:

1. the limit emission value of transmitted heat in the 24-hour average for the removal of wastewater into the Sava via discharges V1 and V7 is equal to 1;
2. the synergetic action of the aforementioned discharges as well as other NEK discharges does not cause the Sava to exceed its natural temperature by more than 3°C at any period of the year;
3. the cooling water recirculation system via the cooling towers is activated in a timely manner so that the Sava does not exceed its natural temperature by more than 3°C;
4. if the combined cooling system is insufficient to fulfil this condition, NEK must reduce the power of the power plant in a timely manner (since the upgrading of the cooling towers, there has been no reduction in plant power);
5. the temperature of water discharged at discharge V7 does not exceed 43°C.

The quantity of the water abstracted from the Sava is stipulated in partial water permit no. 35536-31/2006-16 of 15 October 2009, which was amended by decision no. 35536-54/2011-4 of 8 November 2011 and decision no. 35530-7/2018-2 of 22 June 2018 in response to changes in the quantity of water abstracted from the Sava. The amendment of the water permit of 22 June 2018 sets out the total allowable amount of water offtake from the Sava at 29 m^3/s. The permitted annual quantity of offtake for process purposes (Sava and the well on the right bank) is 915,000,000 m^3.

As part of operational monitoring at NEK, the temperature of the Sava is regularly measured before the river enters NEK for process management requirements and in order to control the maximum temperature of discharges and control any rise in the ΔT after full mixing (3°C).

Measurements at Radeče were taken at Radeče water gauging station, which was the main national station for that section of the Lower Sava (Spodnja Sava) from 1909 to 1998. The station was discontinued in 1998 because it was located on the Vrhovo HPP reservoir. The data series can be continued by taking data on the Sava at Hrastnik and on the Savinja at Veliko Širje, where the stations of the national network are currently located. Measurements of the Sava before it enters the NEK complex are carried out at measuring point MM1 at the following location: Y=540280, X=88332, Z=150 m a.s.l., cadastral municipality 1321 Leskovec, land parcel no. 1246/6. The Brežice reservoir, which began operating in September 2017, does not significantly affect the operation of NEK in terms of the thermal load on the Sava. Studies of the thermal load on the Sava conducted prior to the construction of the reservoir (Interactions of energy buildings along and on the Sava from the perspective of the thermal load on the Sava, Revision A (IBE, 2012a)), and the measurements and analyses after the filling of the reservoir (Energy buildings along and on the Sava – Thermal analysis of the Sava in August 2012 (IBE, 2012b) and Analysis of river temperatures in the lower reaches of the Sava in July and August 2019 and the verification of past studies – Revision A (IBE, April 2020)) established the following:

- the average monthly temperatures of water flowing into the HPP chain (into the Vrhovo reservoir) have increased by between 1.5 and 2°C in the summer months over recent decades, while temperature peaks in the same period have increased by between 3 and 4°C. This means a significantly higher "natural temperature background" for NEK operation;
- HPP reservoirs along the lower Sava do not cause additional river warming relative to conditions before the damming;
- in critical summer conditions with low river flow rates and high air temperatures, HPP reservoirs significantly reduce daily variation in river temperature relative to conditions before damming, while also storing cooler water in the lower layers of the reservoirs due to thermal stratification;
- this is reflected in the Brežice HPP reservoir, where accelerated thermal emission from the reservoir into the atmosphere was detected, compared to the previous state;
- in view of these impacts, HPP reservoirs act as measure for mitigating the effects of climate change in terms of the thermal load on the Sava, which has a further positive effect on the operation of NEK during periods of reduced river flow and increased water and air temperatures.

A2) Expected impacts during operation and the conditions

<u>Surface waters</u>

Cooling (waste) water, which is primarily discharged via a flow cooling system (outlet V7-7), accounts for most of the wastewater that comes from NEK, while the cooling tower system (outlet V7-10) is used when the flow of the Sava is unfavourable with respect to the thermal load on the river. Some of the cooling wastewater comes from the safety supply (outlet V1-1). The proportion of total cooling water accounted for by cooling water in the cooling tower system is less than 5%.

The operational monitoring of wastewater in the 2015–2020 period shows that the results of analyses rarely exceeded the prescribed limit values. When they did so, this was most often on account of the parameters of undissolved substances and suspended substances. Limits were exceeded at the outlet of the main cooling water system, the outlet of the cooling towers and at the outlet of safety water. The power plant does not release substances into these systems which could be the cause of exceeding limit values for undissolved substances and suspended substances. In some years, individual readings have indicated exceedances of the emission limits for insoluble substances, sediments and chemical oxygen demand (COD) that were not caused by NEK operation but by the general quality of the Sava.

The fact that the composition of water at discharges depends on the composition of the river water is also shown by the monitoring of COD and BOD_5 (biochemical oxygen demand) values at three measuring points in and around the NEK site, where it is evident that the water contains a certain composition of these indicators before it enters the plant. Under the Decree on surface water status (Official Gazette of RS Nos. 14/09, 98/10, 96/13 and 24/16), the BOD_5 limit value (ESQ) is 5.4 mg/l for rivers with a good ecological status, while a COD value of 20.9 mg/l indicates a very good status. The concentration of these indicators in emissions from NEK generally meets the criteria for good river status.

Over a period of six years, discharges from the water preparation tank (outlet V7-11) have occasionally exceeded the limit values: once for COD (in 2015), once for BOD_5 (in 2017) and twice for toxicity (in 2016 and 2017). However, the quantities of those wastewaters are very small and amount to 4,000 m^3 annually (the maximum permitted quantity is 6,000 m^3/year). It was determined that NEK does not have a significant negative impact on water, more specifically the Sava Krško–Vrbina water body into which wastewater from the power plant is discharged. This also proves that the status of this water body is good. The assessment of the chemical status of water bodies between 2014 and 2019, which is used for the Management Plan 2022–2027, shows that the chemical status of the water body is good for the water matrix, poor for the biota matrix, and poor for the water and biota matrices together. The "poor" assessment is due to parameters that are not related to NEK emissions; instead, they result from general pollution, namely with mercury and diphenyl ethers (BDE). The ecological status of the water body is good for individual elements of the assessment and very good for "specific pollutants". The construction of wastewater treatment plants, as well as the treatment of wastewater in NEK's own plants and at the municipal treatment plants of industrial facilities in the area, have definitely helped that water body to achieve good status. NEK is authorised to use biocides to periodically clean the condensers, but they have not actually been used for many years. The system has been successfully cleaned mechanically by means of the Taprogge system of recycling rubber balls.

As regards the operation of the cooling system, NEK implements measures that were evaluated in accordance with BREF/BAT guidelines for cooling systems.

The extension NEK's operational lifetime will not result in changes in the discharge of wastewater relative to the current status. There is, however, the possibility of an increase in the proportion of cooling wastewater discharged from the cooling tower system due to climate change. Given the current good status of the water body into which wastewater from NEK is discharged, the ministry assesses that the impact will be small and that it will not change the good ecological and chemical status of water in that area.

<u>Groundwater</u>

A small part of the southernmost section of the site of the lifetime extension (in the vicinity of the dam) is located in the Drnovo WPA (protection regime II), as per the Decree on the protection of groundwater in the area of protection zones of the Krško pumping station-water supply system (Official Gazette of SRS, No. 12/85).

NEK's well on the right bank of the Sava cannot affect the quantity of water at the Brege pumping station, given that the formation of groundwater from the construction of the Brežice HPP reservoir increases the possibility of pumping water from the Brege well at the same installations.

NEK does not release harmful materials or polluted water directly into the ground, thereby potentially polluting the groundwater. The manner in which wastewater is discharged will not change with the extension of NEK's operational lifetime. There will be no emission of pollutants into the soil during operation, as all wastewater is already being disposed of in the appropriate manner. There will be no impact on the water protection area and stocks of potable water.

Emissions of substances and heat from NEK wastewater into waters are within the legally prescribed limits and will remain so during the power plant's extended operation.

The ministry estimates that the impact of the lifetime extension and the overall impact on surface waters and groundwater during operation will be "3" (impact not significant) as a result of the mitigation measures referred to in point II/1 of the operative part of this environmental protection consent that the developer will have to implement during extended operation to prevent excessive burdens resulting from the discharge of wastewater into the Sava (wastewater parameters below the limit values set out in the environmental protection permit with respect to emissions into water). In point II/1 of the operative part of the environmental protection consent, the ministry has ordered the developer to carry out the mitigation measures set out below.

The ministry has determined the measures referred to in points II/1.1, II/1.2 and II/1.5 of the operative part of this environmental protection consent in response to non-fulfilment of the requirements set out in the regulation, specifically the fourth paragraph of Article 31 of the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system (Official Gazette of RS, Nos. 64/12, 64/14 and 98/15). Pursuant to the provision referred to in the third indent of the first paragraph of Article 8 of the Decree (which also stems from the environmental impact assessment report), the limit emission proportion of transmitted heat for NEK is "1". The environmental impact assessment report (Table 62) shows that, in its current state, NEK achieves an emission proportion of transmitted heat of between 0.1 and 1, which means that the emission proportion of transmitted heat occasionally exceeds 80% of the value of the limit emission proportion (because it exceeds 0.8). The developer must therefore ensure continuous measurements of the temperature and flow rate of wastewater and continuous measurements of the temperature and flow rate of the watercourse. This is not (entirely) clear from the environmental impact assessment report. The environmental impact assessment report does mention, although it is not entirely clear, that NEK ensures that continuous measurements are taken of the flow rate of the Sava at the NEK dam, while Figure 44 shows that NEK does not take continuous measurements of the flow rate upstream from the offtake of Sava water for NEK (it is stated that the Q_total is calculated). As it is therefore not clear whether the requirements referred to in the fourth paragraph of Article 31 of the Decree on the emission of substances and heat when discharging wastewater into waters and the public sewage system are met, the measure of taking continuous measurements of the flow rate of the watercourse is added to points II/1.1 and II/1.2 of the operative part of the environmental protection consent. The measure referred to in point II/1.1 of the operative part has been determined for cases where the NEK dam is not operating and Brežice HPP is operating, while the measure referred to in point II/1.2 has been determined for cases where Brežice HPP is not operating and NEK dam is operating. As the environmental impact assessment report does not make clear whether the legislative requirements regarding the provision of continuous measurements of the wastewater flow rate have been met, as Figure 44 indicates that the data on the wastewater flow rate from the cooling of the condenser in the large CW cooling systems and the cooling water from the cooling towers of the large CW cooling system is calculated and not measured (regarding data on the wastewater flow rate from the small cooling system in the environmental impact assessment report, there is no clear indication as to whether it is measured or calculated), the obligation to ensure that continuous measurements are taken of wastewater is set down as a measure in point II/1.5 of the operative part of the environmental protection consent. As the fourth paragraph of Article 31 of the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system also imposes the obligation to ensure that continuous measurements are taken of wastewater temperature, the ministry also imposed, in point II/1.5 of the operative part of the environmental protection consent, the obligation to take these measurements, as both sets of data (on flow rate and temperature) are key to establishing the average daily emission proportion of transmitted heat and the average daily temperature increase of the Sava (ΔT), which are imposed as a condition in points II/1.10 and II/1.11 of the operative part of the environmental protection consent.

The obligation to install measuring equipment to enable the continuous establishment of the quantity of water abstracted at the offtake point on the Sava is set out in partial water permit no. 35536-31/2006-16 of 15 October 2009. As that water permit is only valid until 31 August 2039 and an assessment of the environmental impacts has been drawn up for the period up to 2043, the ministry has imposed the condition of ensuring the implementation of continuous measurements of the flow rate of the offtake of Sava water for NEK (point II/1.3 of the operative part of the environmental protection consent).

Regarding the requirements to ensure and implement continuous measurements of the temperature of the watercourse (Sava) before it arrives at NEK, the environmental impact assessment report states that those measurements are being performed at the site defined using the Gauss-Krüger coordinates Y=540280 and X= 88332 on land in cadastral municipality 1321 Leskovec, land parcel no. 1246/6, which is the site of the measuring point MM1 referred to in environmental protection permit no. 35441-103/2006-24 of 30 June 2010 issued by the Slovenian Environment Agency, Vojkova 1b, 1000 Ljubljana. The ministry has established that 'in the environmental permit, MM1 is the measuring point intended for the operational monitoring of wastewater from the small HW cooling system prior to this wastewater being discharged into the Sava. It is therefore is not used to measure "fresh" Sava water. It is also evident from the environmental protection permit that wastewater emissions are monitored at MM1 after heat exchange. Therefore, in the ministry's opinion, this measuring point is not suitable for measuring the temperature of the input water, as its temperature at the MM1 measuring point has, because of use in the small cooling system, changed (i.e. is higher) relative to the temperature of the Sava at the NEK offtake. As the measuring point is insufficient to meet the requirements set out in the fourth paragraph of Article 31 of the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system regarding the provision of continuous measurements of watercourse temperature, the ministry has, in point II/I.4 of the operative part of the environmental protection permit, determined the point at which the developer must ensure that continuous measurements are taken of the temperature of the Sava input water. The data derived from these measurements is important/required for establishing the average daily increase in the temperature of the river or for demonstrating that, at the point at which it is completely mixed, the temperature of the Sava is not more than 3°C higher than its natural temperature measured at the NEK offtake point.

Owing to the fact that the obligation referred to in the second indent of the first paragraph of Article 11 of the Rules on initial measurements and operational monitoring of wastewater (Official Gazette of RS, Nos. 94/14 and 98/15), which in point 1.13 of the operative part of the environmental protection permit imposes an obligation to ensure that the flow rate/quantity of wastewater is measured during sampling at the MM1, MM3 and MM4 measuring points (i.e. for wastewater from the small SW cooling system, wastewater from the cooling of the condenser in the large CW cooling system and the cooling water from the cooling towers of the large CW cooling system), the ministry has set down this obligation as a measure in point II/1.6 of the operative part of the environmental protection consent. The environmental impact assessment report does not show whether this obligation has been met and, moreover, according to the report on the operational monitoring of wastewater for NEK for 2020 (NLZOH, no. 2172-72-172/20, 24 March 2021), no steps have been taken to ensure that measurements are taken of the flow rate of that wastewater at the time it is sampled by an authorised operational monitoring contractor, as "there are no technical conditions in place for the implementation of measurements of flow rate at the time of sampling using mobile devices". This basically means that the measuring points are not properly set up at all. As a result of the non-fulfilment of the requirements referred to in Article 14 of the Rules on initial measurements and operational monitoring of wastewater, the ministry has also imposed the measure referred to in point II/1.7 of the operative part of the environmental protection consent in relation to the proper setting-up of measuring points.

The environmental impact assessment report does not define the quantity of wastewater at discharges V2 (flushing of the rotating rakes), V3 (discharge from fire protection pumps), V4 (essential service water), V5 (flushing of the travelling screens) and V6 (pumping during an outage) into the Sava, while the report on the operational monitoring of wastewater for NEK for 2020 states that a total of 190,000 m^3 of wastewater entered the Sava from these discharges in 2020. The second paragraph of Article 31 of the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system provides that if a plant has several discharges with a total annual quantity not exceeding 100,000 m^3 and the total annual quantities of process wastewater from all discharges from the plant do exceed 100,000 m^3, the operator of the plant is obliged to ensure that continuous measurements are taken of the quantity of wastewater for every 100,000 m^3 of process wastewater at one of the discharges with the highest annual quantity of process wastewater released. As a total of more than 100,000 m^3 of wastewater was released from discharges V2 to V6 in 2020, the environmental impact assessment report does not make clear that continuous measurements of the flow of wastewater would be performed at the discharge (V2, V3, V4, V5 or V6) from which the highest annual quantity of wastewater was released. As a result of the non-fulfilment of this obligation, the ministry has imposed this obligation as a measure in point II/1.8 of the operative part of the environmental protection consent.

The ministry has imposed the measure referred to in point II/1.9 of the operative part of the environmental protection consent because it appears from the environmental impact assessment report that NEK's presentation of the actual average daily values of the emission proportion of transmitted heat and the actual daily average temperature rise of the Sava (ΔT, which is the difference between the average daily temperature of the Sava at the NEK offtake point and the average daily temperature of the Sava at the point at which it is completely mixed with wastewater from NEK) is not entirely reliable when the Sava flow rate is low, or else that the calculation does not fully reflect the actual situation. This is because, in such conditions, some of the condenser cooling water occasionally returns to the pumping station of the large CW cooling system (recirculation) instead of flowing into the Sava via the MM3 measuring point. This leads to deviations in the ΔT calculation or the calculation of the emission proportion of transmitted heat. By ensuring that continuous measurements are taken of the temperature of the Sava at the point at which it is completely mixed, NEK will demonstrate the compliance of its measurements (including when the Sava flow rate is low) with the requirements set out in points II/1.10 and II/1.11 of the operative part of the environmental protection consent, thereby monitoring the impact NEK has on the thermal pollution of the watercourse. It appears from the environmental impact assessment report that the point of complete mixing is situated downstream from Brežice HPP, approximately at the location of the old steel bridge in Brežice. The measure therefore imposes a requirement to determine the mixing point at this macro-location, install suitable measuring equipment at the location, ensure that continuous measurements are taken of the temperature of the Sava and record the results of these measurements.

The ministry has determined the measure referred to in point II/1.10 of the operative part of this environmental protection consent as a measure for monitoring NEK's impact on the thermal pollution of the Sava, specifically pursuant to the third indent of the first paragraph of Article 8 of the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system, with due regard to point 3 of the first paragraph of Article 11 of the same Decree, as the Sava at the NEK site is, under the Rules on the designation of surface water sections important for freshwater fish species (Official Gazette of RS, Nos. 28/05 and 8/18), defined neither as salmonid nor as cyprinid water, which means that a limit emission proportion of transmitted heat of 1 applies to NEK. The measure takes account of the cumulative impact of all wastewater from NEK and not only the impact of the V1 and V7 discharges (as set out in the environmental protection permit). In addition, it is linked to establishing the emission proportion of transmitted heat at the point of complete mixing (which is not addressed in the environmental protection permit). The ministry has imposed determination of the proportion as a measure in point II/1.9 of the operative part of the environmental protection consent.

The ministry has determined the measure referred to in point II/1.11 of the operative part of the environmental protection consent in order to protect the Sava watercourse and monitor the impacts of NEK operation thereon, with due regard to point 7 of Article 4 of the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system in conjunction with the third indent of the first paragraph of Article 8 of that Decree. The measure is also linked to the implementation of continuous measurements of the temperature of the Sava at the point of complete mixing (which is not addressed in the environmental protection permit). The ministry has imposed determination of the temperature as a measure in point II/1.9 of the operative part of the environmental protection consent.

The ministry has imposed the measures set out in points II/1.12 and II/1.13 of the operative part of the environmental protection consent on the basis of the statements made in the environmental impact assessment report to the effect that electricity generation will be reduced if NEK is unable to ensure an average daily emission proportion of transmitted heat of 1 or below and an average daily increase in the temperature of the Sava (ΔT) of 3°C or less, and that in cases where the Sava flow rate (at Krško HPP) is less than 100 m^3/s, NEK would operate the cooling towers in order to ensure adequate cooling of the condenser turbine. Both measures have been imposed with the aim of ensuring compliance with the requirements set out in points II/1.10 and II/1.11 of the operative part of the environmental protection consent.

In point II/1.14 of the operative part of the environmental protection consent, the ministry imposed the measure of the sampling of Sava water at the NEK offtake point and determining the parameters of insoluble and suspended substances on the basis of the findings in the environmental impact assessment report: that on days when the Sava flow rate is very high or it increases quickly, NEK excessively pollutes the river by discharging wastewater with excessively high levels of these two parameters, which could be the result of turbidity or the high levels of insoluble substances and suspended substances at the NEK offtake. By sampling Sava water at the offtake and analysing the insoluble substances and suspended substances, with the simultaneous sampling of these parameters in wastewater at the discharge from NEK into the Sava, the developer will be able to demonstrate that the excessive levels of these two parameters at the discharge from NEK is not the fault of the plant, but the consequence of the presence of the parameters at the NEK offtake, thereby showing that NEK does not affect the quality of the Sava with regard to these two parameters.

As the environmental impact assessment report envisages steps to ensure that the limit values are preserved for the wastewater parameters as set out in the environmental protection permit, but not the monitoring of the presence of boron in wastewater from NEK (boron does not have a set limit value in the environmental protection permit), even though this requirement is included in point 1.3 of the operative part of the environmental protection permit, the ministry has imposed the obligation on NEK to perform its own measurements of boron in the wastewaters in which it could appear and to keep records of the results of these measurements as a measure in point II/1.15 of the operative part of the environmental protection consent.

Regarding the additional water protection measures set out in the environmental impact assessment report in relation to the expansion of the cooling tower system with the aim of reducing the abstraction of water from the Sava, reducing thermal load and increasing resilience to climate change, the ministry explains that it has not set them as a condition in the operative part of the environmental protection consent as these cooling towers have already been constructed. Four new cooling cells (a new cooling tower – CT3) were installed and all the electrical cooling tower equipment replaced. The expansion that took place in 2008 increased the power of the cooling towers by 36%.

After NEK operation comes to an end, the use of water will decrease significantly relative to regular operation. The spent fuel pool will still have to be cooled, as will a number of other safety components, and water will be abstracted and returned to the Sava at a rate of approx. 1.6 m^3/s. Pumping from the well on the right bank of the Sava and from the BB2 well will decrease. Wells that maintain the level of groundwater will remain operational. Areas where wet works may be done will be equipped with drainage pits. Sampling will be carried out before the pits are emptied. If the limit values for discharge are exceeded, wastewater will be purified, solidified or processed in some other appropriate way, while the radioactively contaminated portion will be disposed of as LILW. The ministry estimates that the impact of the lifetime extension and the overall impact on surface waters and groundwater will be “4” (impact not significant) if the extension is abandoned.

<u>Impacts on the thermal pollution of the Sava</u>

The developer obtained from the Slovenian Environment Agency an environmental protection permit

concerning emissions into waters no. 35441-103/2006-24 of 30 June 2010, which was amended by decision no. 35441-103/2006-33 of 4 June 2012 and decision no. 35444-11/2013-3 of 10 October 2013. The operational monitoring of wastewater is carried out in accordance with this permit. It is evident from the reports on the operational monitoring of wastewater for NEK that the plant does not place an excessive thermal load on the Sava.
Thermal pollution of the river caused by NEK will remain at the current level following the extension of its operational lifetime to 2043. This means that its operation will continue to comply with the environmental protection permit, which provides that:

- the limit emission share of transmitted heat is 1; and
- the temperature of the Sava does not exceed the river's natural temperature by more than 3°C when mixed with cooling water from NEK.

In accordance with the environmental protection permit, NEK may not heat the Sava at the point of complete mixing by more than 3°C. If this limit is approached, NEK must begin to partly close the tertiary circuit and decrease the thermal load on the river. This is achieved by gradual activation of the cooling towers. In the case that this is not enough, NEK reduces the reactor power as required.
Extending NEK's operation will not increase the thermal load on the Sava. The impact shall be maintained at the present level.
The ministry estimates that the impact of the lifetime extension and the overall impact on the thermal load of the Sava during operation will be "3" (impact not significant) as a result of the mitigation measures referred to in point II/1 of the operative part of this environmental protection consent that NEK will have to implement during extended operation to prevent excessive burdens resulting from the discharge of wastewater into the Sava (wastewater parameters below the limit values set out in the environmental protection permit with respect to emissions into water).

After NEK operations come to an end, there will be no more need for cooling water for the technological process of electricity generation. Abandoning the lifetime extension would therefore result in significantly reduced thermal pollution of the Sava from NEK. The ministry estimates that the impact of the lifetime extension and the overall impact on thermal pollution of the Sava will be "4" (impact not significant) if the extension is abandoned.

B) Impact of climate change on the lifetime extension

B1) Present state of the environment
Krško is located in a temperate continental climate zone. The wider Krško area is characterised by relatively hot summers and mild winters. Average January temperatures are below zero and average July temperatures are almost 20°C.
The future course of climate change depends on actual greenhouse gas emissions, which are described by different scenarios of possible greenhouse gas concentration, or Representative Concentration Pathways (RCP). The scenarios are based on human activity-related emissions of CO_2, CH_4, N_2O and other air pollutants.
The following is a summary of climate scenarios for the first (2011–2040) and second (2041–2070) 30-year period under the moderately optimistic scenario RCP4.5 that assumes significant emission mitigation actions, compared to the 1981–2010 average.

- Air temperature changes:
  - 2011–2040: On average, Slovenia will warm by 1°C at the annual scale. A temperature rise of approx. 1 degree is expected in all seasons except spring, where the projected rise is under 0.5°C;
  - 2041–2070: by the middle of the 21st century, Slovenia will warm by 2°C at the annual scale. As in the previous 30-year period, this period shows a fairly steady rise in summer, autumn and winter temperatures, and a slightly less pronounced rise in spring temperatures;
- Changes in precipitation:
  – 2011–2040: no significant changes in annual precipitation are expected, although there are slightly more pronounced precipitation change signals at the seasonal scale. The most significant change is projected for winters, when an increase in precipitation is likely;

– 2041–2070: by the middle of the century, changes in precipitation will intensify. At the annual level, precipitation is projected to increase in the eastern half of the country, while for the western half of the country the precipitation increase signal is weaker. Changes at the seasonal scale are expected to be greater than those at the annual scale. The winter precipitation increase signal will continue to strengthen relative to the preceding 30-year period, and the eastern half of the country is also expected to experience more precipitation in the autumn. For summer, the precipitation change signal shows a decrease, particularly in the southern half of the country, whereas in spring, the signal is the least pronounced, indicating a slight increase in precipitation in the western part of the country;

- Changes in potential evapotranspiration:
  – 2011–2040: major changes in potential evapotranspiration are not expected in the near future, with the clearest change signal indicating an increase in potential evapotranspiration in autumn;
  – 2041–2070: by the middle of the century, changes in potential evapotranspiration will be more pronounced. An increase at the annual scale is projected, which will be most pronounced in the southwest of the country. At the annual scale, changes will be primarily driven by the increase in potential evapotranspiration in summer and autumn, while the increase in spring and winter will be less significant.

According to climate projections for the 21st century, the following changes in hydrological conditions can be expected in Slovenia (Climate change estimates for Slovenia until the end of the 21st century – Summary of temperature and precipitation averages, Slovenian Environment Agency, http://meteo.arso.gov.si/uploads/probase/www/climate/text/sl/publications/povzetek -podnebnih-sprememb-temp-pad.pdf):

- under all emission scenarios, no major changes in mean annual flow rates are expected in Slovenia compared to the 1981–2010 period, with the exception of the northeast, where flow rates could increase by up to 30% by the end of the century under the moderately optimistic scenario (RCP4.5). Under the pessimistic emission scenario (RCP8.5), the increase in the northeast of Slovenia could reach up to 40% by the middle of the century;
- compared to the 1981–2010 period, mean annual peaks will rise throughout the country, on average between 20 and 30% under all emission scenarios. This increase will intensify from the near future towards the end of the century. The increase in peaks will be most significant in the northeast of the country, reaching up to around 30% under the moderately optimistic emission scenario. Under the pessimistic emission scenario, the increase will range from 20 to 40% at almost all gauging stations at the end of the century. Under the moderately optimistic and pessimistic scenarios, changes in moderately low flow rates are spatially uneven, showing a significant increase of around 20% only in parts of the northern half of Slovenia;
- under all emission scenarios, an increase in annual 100-year-flood levels is expected for all periods in the future relative to the 1981–2010 period, throughout the majority of the country. Under the RCP2.6 emission scenario, the largest increase is projected in the eastern part of the country and the rivers of the Adriatic basin. Under the RCP4.5 and RCP8.5 emission scenarios, the increase in 100-year-flood levels is not as significant as in RCP2.6 scenario. Larger increases are expected in the northeast of the country.

B2) Expected impacts of climate change on the lifetime extension

Section 5.6 (Impacts of climate change on the lifetime extension) of the environmental impact assessment report analyses the impacts of climate change on NEK operation in terms of efficiency, total electricity generation, the availability of electricity for users and the associated environmental impacts. The analysis relates to the normal operation of the power plant, which is defined by six possible statuses: power operation, start-up, hot standby, hot shutdown, cold shutdown and refuelling. The analysis comprises seven modules:

- Module 1: Sensitivity analysis;
- Modules 2a and 2b: Assessment of exposure;
- Modules 3a and 3b: Vulnerability analysis (electricity production);
- Module 4: Risk assessment (changes in electricity production and environmental impacts);

- Module 5: Definition of the ability to adjust;
- Module 6: Assessment of the ability to adjust;
- Module 7: Inclusion of an adjusted action plan in the lifetime extension.

During the evaluation of impact it was found that NEK’s production of electricity is sensitive to three climatic variables: access to water from the Sava, the temperature of the Sava and the extreme outdoor temperature.

The power plant takes water from the Sava for the cooling of its condensers, the turbine cycle and the safety components. In periods of reduced flow of the Sava, the power plant uses its cooling towers to discharge some of its heat through the recirculation cycle. In this way the power plant maintains a temperature difference of no more than ΔT 3°C regardless of the state of the Sava. This will remain unchanged in the power plant’s future operation as well.

In 2008, the nuclear power plant supplemented its cooling facilities with the construction of a third block of cooling towers. This has strengthened the plant’s resistance to changes that could in the future be connected with a reduction in the river’s flow and a rise in air and water temperatures. The construction of a system of hydro power plants on the lower reaches of the Sava has moderated variations in the river’s flow and temperature which favourably affects the stability of production.

An analysis of the impact of climate changes on safety are analysed in accordance with legislation and the regulations governing nuclear safety and protection against ionising radiation. Extreme weather conditions in combination with other natural and other occurrences are an integral part of the safety analysis of power plants. The periodic safety review, which is compulsory every ten years, includes an analysis of the effect of climate change, and the Updated Safety Analysis Report (USAR) is constantly updated regarding all important safety aspects.

After studying the impact of climate change on the lifetime extension, the ministry finds that, in view of the existing measures and the standard review of operations carried out as part of the periodic safety review process, the climate changes associated with extreme weather conditions have no significant impact on the lifetime extension. The ministry assesses that the impact of the lifetime extension and the overall impact of climate change on the lifetime extension during operation will be “3” (impact not significant) as a result of the mitigation measures referred to in point II/I of the operative part of this environmental protection consent. With due regard to the URSJV’s opinion, the ministry has, in the operative part of this environmental protection consent, also required the constant monitoring of extreme weather events and their detailed analysis. If the effects of extreme weather events exceed the design bases of the structures, systems or components of the power plant, those SSCs must be upgraded on the basis of an analysis, or protected against the effects of such extreme events. In periods not longer than the interval between two consecutive periodic safety reviews, the cumulative impact of extreme weather events, including combinations of such events, must be subjected to an in-depth analysis.

NEK is already implementing the following measures and will have to continue to do so during its operational lifetime:

- if the flow rate of the Sava is less than 100 m^3/s, NEK includes the cooling towers, which employ circulation to cool a portion of condenser water;
- the structures, systems and components of the power plant are dimensioned to withstand extreme weather events and meteorological parameters with highly conservative margins, in view of nuclear legal framework requirements, global practices and Best Available Techniques (BAT);
- the periodic safety review, which is performed every 10 years, includes a deep analysis of the impact of extreme weather events on the safety of the power plant. Two reviews will be performed in the period to come (2021-2023 and 2031-2033);
- measures from the environmental protection consent related to limitation of the thermal load and water collection through the use of a combined cooling system (flow system and cooling towers). In all river flow conditions of the Sava, the power plant maintains a temperature difference of no more than ΔT 3°C, which will not change in the power plant’s future operation. In 2008, NEK supplemented its cooling facilities with the construction of a third

block of cooling towers;

- NEK has preparation procedures in place for the event of hydrological conditions that may affect the plant's operation: activation of cooling towers at high water levels due to the risk of inflow of debris (branches, plastic etc.);
- NEK has procedures in place for cooperation with other energy facilities on the Sava (Agreement on measures and obligations to ensure unchanged, safe and uninterrupted operation of NEK during the operation of hydropower plants on the lower Sava with additional monitoring activities on the Sava);
- on-site measurements of meteorological parameters are carried out at the automatic station with the 70-metre-tall meteorological tower and the use of SODAR for high-altitude atmospheric measurements. The measurements are reported on a yearly basis.

As a result of the climate changes that the environmental impact assessment report predicts will take place during the period leading up to the end of the NEK lifetime extension, the frequency or impact of extreme weather events could increase. NEK must therefore monitor such events particularly carefully, analyse them in detail and take the appropriate steps set out as a condition in the operative part of the URSJV opinion. The basis for addressing extreme events and planning power plant structures, systems and components so that they are able to withstand those events are requirements set out in the Rules on radiation and nuclear safety factors (Official Gazette of RS, Nos. 74/16 and 76/17 [ZVISJV-1])), particularly Annex 1, Chapter 5.

Should NEK cease operation, climate change will no longer have any significant impact on production. The impact of climate change from the perspective of power plant safety will be lower if lifetime extension is terminated than it was during the plant's operation. In terms of safety, water will still have to be secured for the cooling of spent fuel. The ministry estimates that the impact of the lifetime extension and the overall impact of climate change on the lifetime extension will be "4" (impact not significant) if it is abandoned.

C) Impacts on biodiversity and nature reserves

C1) Present state of the environment

The information on flora and fauna (except fish) and habitat types in the area under consideration is based primarily on the findings of a study carried out in 2008 as part of the background documentation for the development of the Brežice and Mokrice hydropower plants. This study was published as Pregled živalskih in rastlinskih vrst, njihovih habitatov ter kartiranje habitatnih tipov s posebnim ozirom na evropsko pomembne vrste, ekološko pomembna območja, posebna varstvena območja, zavarovana območja in naravne vrednote na vplivnem območju predvidenih HE Brežice in HE Mokrice ["Survey of animal and plant species and their habitats and mapping of habitat types with particular regard for species of Europe-wide importance, important ecological areas, special protection areas, protected areas and valuable natural features in the area of influence of the planned Brežice and Mokrice hydropower plants"] (Editors: Govedič, M., A. Lešnik & M. Kotarac). Published by the Centre for Cartography of Fauna and Flora in conjunction with the Lutra Institute for the Conservation of Natural Heritage, the Research Centre of the Slovenian Academy of Sciences and Arts, the National Institute of Biology, VGB Maribor and the Biology Department of the Biotechnical Faculty at the University of Ljubljana (hereinafter: CKFF, 2008).

<u>Flora and habitat types</u>

The area of the lifetime extension comprises the built area inside the NEK complex enclosure, the car park, the access road, the dam on the Sava and the pumping well on the right bank of the river. Located in the immediate surroundings of the NEK complex are areas of intensive orchards (HT 83.22 Shrub and low stem tree orchards). The area on the left bank of the Sava is for the most part under the influence of intensive agriculture (orchards, fields) and the Vrbina industrial zone. There are therefore no habitat types of greater nature conservation significance within the narrower area of controlled use (650 m) on the left bank of the Sava.

In the wider area of controlled use (1,500 m) to the north and east of the Vrbina industrial zone, we still find some preserved extensive meadows (HT 34.322 Medio-European moderately dry grasslands with dominant species *Bromus erectus*). Such grasslands were once common on carbonate gravel deposits by rivers but today are almost no longer found because they have been converted into fields or intensive meadows. The Decree on habitat types (Official Gazette of RS, Nos. 112/03, 36/09 and 33/13) lists them among habitat types that are in danger of disappearing in the European Union, and they have been defined as priority natural habitat types by EU regulations governing the conservation of wild fauna and flora. We can identify them by the presence of erect brome (*Bromus erectus*), a characteristic component of turf, while other common grass species include quaking grass (*Briza media*), heath false brome (*Brachypodium pinnatum agg.*), cat grass (*Dactylis glomerata*) and furrowed fescue (*Festuca rupicola*). This habitat type also typically features orchids (*Orchidaceae*).
Riparian woody vegetation (HT 44.132 Eastern European white willow forest with poplars) still survives along the Struga stream. This habitat type is also listed by the Decree on habitat types among habitat types that are in danger of disappearing in the European Union, and they have been defined as priority natural habitat types by EU regulations governing the conservation of wild fauna and flora.
The Sava flows past the NEK complex on its south side. The banks of the river directly adjoining the NEK complex are covered with tall herbaceous species (HT 37.7 Nitrophilous woodland edge fringes and humid riverside tall herbaceous cover), while upstream and downstream we find HT 44.132 Eastern European white willow forest with poplars and HT 44.42 remnants of medio-European oak-ash-elm groves in a narrow belt along the bank. On the right bank of the Sava, the original riparian woody vegetation has, for the most part, been cleared. In this area, which is also a designated Natura 2000 Special Area of Conservation (known as Vrbina SAC), there is a mosaic of various habitat types. Here we find extensive meadows (HT 34.322 Medio-European moderately dry grasslands with dominant species *Bromus erectus* and HT 34.323 Medio-European moderately dry grasslands with *Brachypodium pinnatum agg.*) and moderately cultivated meadows (HT 38.221 Xero-mesophile medio-European lowland hay meadows on relatively dry soils and slopes with *Arrhenatherum elatius* the dominant species). In places the area is overgrown with tree and shrub species (HT 31.8121 Medio-European *thermophilous basiphilous* thickets with wild privet and blackthorn, HT 31.8D Shrubby deciduous forests and areas overgrowing with deciduous tree species). Also present is the black locust (*Robinia pseudoacacia*), a non-native tree species – HT 83.324 Locust tree populations and stands.
Numerous orchid species thrive in medio-European moderately dry grasslands with *Bromus erectus* the dominant species. Species recorded in this area include the green-winged orchid (*Orchis morio*), bug orchid (*Orchis coriophora*) and early spider-orchid (*Ophrys sphegodes*). All three species are included as vulnerable species in the Red List of Vascular Plants (Rules on the inclusion of endangered plant and animal species in the Red List, Official Gazette of RS, Nos. 82/02 and 42/10). Also recorded in the wider area is *Pulsatilla nigricans*, which is likewise included in the Red List as a vulnerable species (Bioportal, 2020. http://www.bioportal.si/ February 2020). According to data from 2008, a further nine orchid species occur in the wider area, including, from the Red List, *Phleum paniculatum* (rare species), *Agrostemma githago* (vulnerable species), *Ballota nigra* (little-known species), *Fragaria viridis* (vulnerable species), *Muscari botryoides* and *M. comosum* (both vulnerable species) and *Orobanche teucrii* (little-known species). Some orchid species, the perennial bunchgrass *Chrysopogon gryllus*, the sedge *Carex liparocarpos* and the flowering plant *Seseli annuum* have very large populations in the wider area of the Vrbina SAC (CKFF, 2008).

Fauna
Mammals (Mammalia)

Bats (Chiroptera)
The immediate surroundings of the NEK complex also include habitats suitable for bats. Humid forest or forest fringe areas maintaining large numbers of arthropods, particularly insects, are particularly important feeding areas for bats. Insects are the principal source of food for the bats present in the

area. Other favourable bat feeding areas are riverbanks with old-growth tree cover such as the banks of the Sava and the surroundings of the Struga stream, as well as the overgrown area on the right bank of the Sava. Many bat species (e.g. Kuhl's pipistrelle, serotine bat) roost in cracks and crevices in buildings. Tree bats (e.g. noctule bats, Daubenton's bat) roost in tree hollows and cracks in older deciduous trees, which in the area in question can be expected to be found in habitat types such as Eastern European white willow forest with poplars and remnants of medio-European oak-ash-elm groves. Many bat species in Slovenia hibernate in caves and other underground spaces. All bats are classified as endangered species (Rules on the inclusion of endangered plant and animal species in the Red List) and are protected by the Decree on protected wild animal species (Official Gazette of RS, Nos. 46/04, 109/04, 84/05, 115/07, Constitutional Court Decision of 13 March 2008, 96/08, 36/09, 102/11, 15/14 and 62/19). Within the wider surroundings of the area in question, bats have been observed in St Anne's Church in Leskovec (greater horseshoe bat – *Rhinolophus ferrumequinum*) and the bell tower of St Rupert's Church in Krško (Greater mouse-eared bat – *Myotis myotis*). The calls of the long-eared bat (*Plecotus* sp.) have been recorded in Krško, while calls of Daubenton's bat (*Myotis daubentonii*) are particularly numerous by the Sava. Calls of the common noctule (*Nyctalus noctula*) have been recorded here in the autumn. The common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle *(Pipistrellus pygmaeus*), Kuhl's pipistrelle (*Pipistrellus kuhlii*) and serotine bat (*Eptesicus serotinus*) have been recorded on the banks of the Sava and in settlements in the wider area. Individual specimens of the Mediterranean horseshoe bat (*Rhinolophus euryale*) can be expected on the bank of the Sava in the surroundings of Krško, while Geoffroy's bat (*Myotis emarginatus*) can likewise be expected in the vicinity of bodies of water (CKFF, 2008).

Otter (Lutra lutra)

The otter is constantly present in the area of the Sava. Its tracks or other signs of its presence have been recorded in riverside and riparian habitats. Gravel pits also constitute an important part of its habitat. Tributaries, particularly their mouth sections, are an extremely important part of the otter's habitat since they provide a sufficient variety of fish species for the otter's diet and also an adequate quantity of food. The area of the NEK complex and its immediate surroundings do not represent a favourable otter habitat, and signs of otter presence have not been observed in the surroundings of NEK (CKFF, 2008).

European beaver (*Castor fiber*)

The area of the Sava in the immediate vicinity of NEK does not represent a suitable beaver habitat, although the Sava, particularly its lower course, is an important corridor for the recolonisation of past beaver habitats across Slovenia (CKFF, 2008). Traces of beaver activity have already been observed near Krško, although these probably do not indicate the presence of a family.

Large carnivores

Owing to human settlement and traffic impact, the role of the Krško/Brežice Basin is limited to that of a transitional microhabitat (albeit an important one) for the wolf (*Canis lupus*) and brown bear (*Ursus arctos*). Both species are permanently present in the hills of the Gorjanci/Žumberak range and also occasionally appear in the Krško/Brežice Basin. It is assumed that wolves pass from the Gorjanci through the forest of Krakovski Gozd and the Krško/Brežice Basin to Bohor and Orlica, and then continue on towards the northeast. Individual bears moving towards the north cross the Sava near Sevnica and continue on towards Bohor and Orlica. In order to cross the river, they need a natural riverside area with banks that are at least partly accessible and passable (CKFF, 2008).

Red deer (*Cervus elaphus*)

The Krško/Brežice Basin represents a passage or functional connection between the Gorjanci in the south and the Posavje Hills and Bohor and Orlica in the north. Today's habitat conditions are favourable for deer, above all because of the state of conservation of riparian vegetation and other habitat types offering ample food and protection (surviving islands of forest of various sizes, field boundaries, etc.). At present, the area between Krško and Brežice is still permeable enough to allow deer to pass between the Gorjanci and Bohor and on towards the Pohorje, which ensures gene flow among population units in its margins. While deer are good swimmers, they prefer to cross running waters in shallows, in places with suitably shaped banks and riverbank vegetation, in which they generally remain for a short while after crossing the watercourse. Owing to relatively natural river flow dynamics, there are still sufficient shallows, banks, isolated rocks and overgrown riverbank areas between Brežice and Obrežje to allow deer to cross and provide them with cover (CKFF, 2008).

Other mammals

The Krško/Brežice Basin represents a central optimal habitat type for the European hare (*Lepus europaeus*). The wild boar (*Sus scrofa*) is another occasional presence here, crossing from the SE parts of the Gorjanci to agricultural land (fields). Thanks to the presence of stands of forest, other mammals present in the Krško/Brežice Basin include roe deer (*Capreolus capreolus*), badger (*Meles meles*), beech marten (*Martes foina*), European pine marten (*Martes martes*) and fox (*Vulpes vulpes*). Riverside habitats along the Sava are a very important feeding area for the European polecat (*Mustela putorius*) The stoat (*Mustela erminea*) is also likely to be present in fields, meadows and humid habitats, while the least weasel (*Mustela nivalis*) is probably present in open flat plains (CKFF, 2008). Numerous species of shrew and other small mammals are found across the wider area (Kryštufek, B. 1991. *Sesalci Slovenije* (Mammals in Slovenia), Natural History Museum of Slovenia, Ljubljana, 294 pp.).

Birds

The Sava is a habitat for numerous bird species, with the common sandpiper (*Actitis hypoleucos*) and common kingfisher (*Alcedo atthis*) among the species that nest here. The commonest species in the agricultural cultural landscape of the wider area are the Eurasian skylark (*Alauda arvensis*), the house sparrow (*Passer domesticus*) and the Eurasian blackcap (*Sylvia atricapilla*), while the area is also an important feeding ground for the rook (*Corvus frugilegus*) and a nesting area for vulnerable species such as the common nightingale (*Luscinia megarhynchos*), the Eurasian skylark (*Alauda arvensis*), the crested lark (*Galerida cristata*) and the northern lapwing (*Vanellus vanellus*). In areas of alternating dry meadows and shrubland, the commonest species besides the Eurasian blackcap are the great tit (*Parus major*) and the common pheasant (*Phasianus colchicus*), while the barred warbler (*Sylvia nisoria*) and European turtle dove (*Streptopelia turtur*) populations are important from a nature conservation perspective. Of the owls, the long-eared owl (*Asio otus*) and the tawny owl (*Strix aluco*) have been recorded in the wider area (CKFF, 2008).

Amphibians

The site of the lifetime extension itself and the areas of intensive orchards in the immediate vicinity of the NEK complex do not represent a suitable habitat for amphibians. Suitable habitats for amphibians are located above all in the surroundings of the Struga stream, oxbows, channels, gravel pits and the mosaic of forest habitats on the left and right banks of the river. The European tree frog (*Hyla arborea*), the agile frog (*Rana dalmatina*), the common frog (*Rana temporaria*), the common toad (*Bufo bufo*), the Eurasian water frog (*Pelophylax* sp.), the Italian crested newt (*Triturus carnifex*), the smooth newt (*Lissotriton vulgaris*), the alpine newt (*Ichthyosaura alpestris*) and the European green toad (*Bufotes viridis*) are all found in the wider surrounding area (CKFF, 2008).

Reptiles (Reptilia)

Only the common wall lizard (*Podarcis muralis*) can be expected within the anthropogenic habitats of the site of the lifetime extension. We can expect to find the sand lizard (*Lacerta agilis*) in humid areas near water that are partly overgrown by shrubs or tall herbaceous cover. Large numbers of European green lizards (*Lacerta viridis*) have been recorded in the area of shrubland on the right bank of the Sava opposite NEK. The river itself and the riparian zone are an important habitat for the dice snake (*Natrix tessellata*), while we can also expect the grass snake (*Natrix natrix*) to be present by bodies of water (especially standing water). We can expect the slow worm (*Anguis fragilis*) to be generally distributed across extensively cultivated areas of farmland and shrubland, where we can also expect the rarer Aesculapian snake (*Zamenis longissimus*). Shrubland also provides a habitat for the smooth snake (*Coronella austriaca*).

Fish (Pisces) and crustaceans (Crustacea)

The Struga stream is not subject to fishery management and is not entered in the fisheries register. The section of the Sava that flows past the NEK area belongs to the Sava 19 fishing district (the Sava from the mouth of the Blanščica to Turški Brod). The Fishing Registry (2018), maintained by the Fisheries Research Institute of Slovenia, gives 40 species of fish for the Sava 19 fishing district (https://webapl.mkgp.gov.si/apex/f?p=136:62:10783274489156::NO:RP:P62_ID_REVIR:41, May 2019).

An ichthyological study of the Brežice HPP reservoir in 2019 confirmed the presence of 27 fish species, of which 24 were native and three were non-native species (stone moroko (*Pseudorasbora parva*), pumpkinseed (*Lepomis gibbosus*) and Prussian carp (*Carassius gibelio*)) (Monitoring of fish in the Brežice HPP reservoir and its tributaries in 2019. Fisheries Research Institute of Slovenia, Spodnje Gameljne, May 2020).

Invertebrates (Invertebrata)

Molluscs (Mollusca)

Of the mollusc species important from a nature conservation perspective, specimens of the narrow-mouthed whorl snail (*Vertigo angustior*) have been found in the upper course of a tributary of the Struga stream. The big-ear radix (*Radix auricularia*) has been observed at the Stari Grad gravel pit. No other protected or endangered species of mollusc have been observed in the immediate vicinity of NEK. The area of grassland and shrubland on the right bank of the Sava is also important for molluscs, and the variety of mollusc species here is extremely high (CKFF, 2008).

Butterflies and moths (Lepidoptera)

Inventories of butterflies have been carried out in the area of dry meadows and shrubland on the right bank of the Sava, although we can also expect the observed species of butterflies in dry meadows and shrubland in the area around the Vrbina industrial zone and the Struga stream. The large copper (*Lycaena dispar*) was recorded in meadows on the right bank of the Sava in 2001, while studies carried out in 2008 recorded 58 species there, including the southern festoon (*Zerynthia polyxena*), Nickerl's fritillary (*Melitaea aurelia*), Assmann's fritillary (*Melitaea britomartis*), the southern small white (*Pieris mannii*), the northern blue (*Plebeius idas*), the mallow skipper (*Carcharodus alceae*), the feathered footman (*Spiris striata*) and the small bagworm moth (*Ptilocephala plumifera*). The area is also important as a favourable habitat for a number of other grassland and shrubland xerothermophilous species of diurnal lepidoptera such as the scarce swallowtail (*Iphiclides podalirius*), the black hairstreak (*Satyrium pruni*), the sloe hairstreak (*S. acaciae*) and the spotted fritillary (*Melitaea didyma*) (CKFF, 2008). Caterpillars of the eastern eggar (Eriogaster catax) were also observed there in 2018 (Bioportal, 2020. http://www.bioportal.si/ February 2020).

Dragonflies and damselflies (Odonata)

The exuvia of a green snaketail (*Ophiogomphus cecilia*) has been found in the riparian vegetation of the Sava 800 m below the NEK dam. The green snaketail is a lowland river species and its larvae live on quieter stretches, buried in the sandy bottom. It is protected by the Decree on protected wild animal species as a species whose members are protected and habitats safeguarded. It is classified as a vulnerable species on the Red List of dragonflies and damselflies of Slovenia. The Sava is also a habitat of the common clubtail (*Gomphus vulgatissimus*), which also appears as a vulnerable species on the Red List of dragonflies and damselflies of Slovenia. Since there are no waterways apart from the Sava and the Struga stream in the direct vicinity of the site of the activity, the species variety of dragonflies and damselflies in this area is considerably lower than in more distant gravel pits and oxbow lakes. The goblet-marked damselfly (*Erythromma lindenii*) has been observed at the Stari Grad gravel pit, while the eastern willow spreadwing (*Chalcolestes parvidens*), southern emerald damselfly (*Lestes barbarus*), variable damselfly (*Coenagrion pulchellum*) and dainty damselfly (*Coenagrion* *scitulum*) have been observed at the abandoned gravel pit by the Močnik stream in Vrbina (CKFF, 2008).

Beetles (Coleoptera)
The surviving natural arboreal vegetation along the Struga stream represents a habitat for the European stag beetle (*Lucanus cervus*), where medium-large densities of this beetle were identified during a study in 2008 (CKFF, 2008). A potential habitat for this species is also represented by the arboreal vegetation along the Sava. Individual older trees along the Struga and Sava represent a potential habitat for the hermit beetle (*Osmoderma eremita*) and the marbled rose chafer (*Liocola lugubris*). Gravel beds in the Sava are a potential habitat for the carabid beetles *Bembidion friebi* and *Lionychus quadrillum* (CKFF, 2008). Specimens of the weaver beetle (*Lamia textor*), a rare non-flying species that lives predominantly in stands of softwood deciduous trees, were found in overgrown meadows 1.1 km southeast of the NEK dam in 2018 (Bioportal, 2020. http://www.bioportal.si/ February 2020).

Important ecological areas and valuable natural features
In the area of the lifetime extension, there is one important ecological area (IEA) as defined by the Decree on important ecological areas (Official Gazette of RS, Nos. 48/04, 33/13, 99/13 and 47/18): the Sava river from Radeče to the state border (ID 63700). This IEA comprises a stretch of the Sava that crosses the flat Krško/Brežice Polje from Krško to the mouth of the Sotla, where the river creates an extensive flood plain. It is an area with a great diversity of habitats in a relatively small space. Surviving gravel beds, sections of eroded walls, occasionally flooded channels, oxbow lakes, water meadows and fragments of lowland floodplain forest provide a habitat for numerous protected and threatened species. Among the fish are the asp, the streber, the Danubian longbarbel gudgeon and the Balkan loach. Nine species of amphibians are present and there is also a varied avian fauna. Fragments of softwood floodplain forest connected to the remnants of poplar plantations and zones of riparian vegetation along the Močnik and Struga streams are a habitat for saproxylic beetles (scarlet flat bark beetle, hermit beetle and European stag beetle) and the narrow-mouthed whorl snail. The surviving fragments of once extensive dry grassland on the right bank in the Vrbina area are important orchid sites (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).

Valuable natural features
The nearest valuable natural features, as determined by the Rules on the designation and protection of valuable natural features (Official Gazette of RS, Nos. 111/04, 111/04, 70/06, 58/09, 93/10 and 23/15), are:

- Libna – linden tree next to the church (ID 7860). Linden tree by St Margaret's Church in Libna, east of Krško. A valuable botanical natural feature of local importance situated approx. 1,270 m north of the lifetime extension.
- Stari Grad – gravel pit (ID 7861). Aquatic biotope, stopover site for migrating birds and nesting area for endangered bird species SE of Krško. A valuable ecological and zoological natural feature of local importance situated approx. 1,415 m east of the lifetime extension.

Protected areas
Within the 2,000-metre area of remote impact under the Rules, there is one Natura 2000 area as defined by the Decree on Special Protection Areas (Natura 2000 sites) (Official Gazette of RS, Nos. 49/04, 110/04, 59/07, 43/08, 8/12, 33/13, 35/13 – corrigenda, 39/13 – Constitutional Court decision, 3/14, 21/16, 47/18), i.e. the Vrbina SAC (SI3000234), which is approx. 350 m from the site of the activity. Under Article 20 of the Rules, the area of remote impact established for the specific activity affecting the environment may differ at any time from the area of remote impact of an activity affecting the environment referred to in Annex 2 of those Rules if this is based on findings from the field, detailed data on implementation of the activity and other actual circumstances. In addition to the remote impact within a radius of 2,000 m as defined by the Rules, remote impact is also possible

downstream along the Sava. It is assumed that the area of remote impact downstream along the Sava stretches 8 km downstream of the discharges from NEK, where the Sava has been declared a Natura 2000 area (Lower Sava SAC, SI3000304).

Vrbina SAC (SI3000234)
Three smaller areas of calcareous dry grasslands with orchid sites are defined on the right bank of the Sava on the flood plain between Krško and Brežice, while on the left bank, in Vrbina, there are fragments of softwood floodplain forest connected to the remains of poplar plantations and zones of riparian vegetation along the Močnik and Struga streams, which are a habitat for saproxylic beetles (scarlet flat bark beetle, hermit beetle and European stag beetle) and the narrow-mouthed whorl snail (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).

<u>Qualifying species:</u>

- scarlet flat bark beetle – *Cucujus cinnaberinus* (1086)

The scarlet flat bark beetle is a small beetle measuring between 11 and 15 mm with an elongated, parallel, flattened body. The head, prothorax and elytra are bright red, while the legs and antennae are black. The head is wrinkled and the prothorax and elytra are ribbed. The species prefers to live under the rotting damp bark of deciduous trees (oak, poplar, maple and beech) or conifers (spruce, fir and pine). In both developmental phases it feeds predatorily, while the larvae also partly feed on wood detritus. The larvae are frequently found together with larvae of woodboring beetles, on which they also feed. Development lasts two years or more. The species is threatened by the forestry management method in which old and dying trees are removed (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).

- European stag beetle – *Lucanus cervus* (1083)

It is among the largest beetle species in Europe. Sexual dimorphism is very pronounced in this species. The male is usually bigger and grows to between 25 and 75 mm. The female is usually smaller and grows to between 30 and 50 mm. This large size range is the consequence of differences in the quality of food available to the larvae. The body is elongated, broad and partly flattened. The females have small jaws, while male's jaws are transformed into an antler-like formation, which is the origin of the name 'stag beetle'. The head, prothorax and legs are black or dark brown, while the colour of the elytra varies from dark brown to chestnut red. Development is tied to various species of deciduous trees, among which oaks predominate. Female stag beetles lay their eggs on or next to tree stumps or old or fallen trees. The larvae feed on dead or rotting tree roots and pupate in soil (at a depth of 15–20 cm). The full process of development takes place very slowly and can last up to five years. Adult beetles, which only live a few weeks, are mostly active at dusk and feed on a variety of plant secretions. In our assessment, the species is not yet endangered in Slovenia, although it has been placed on the Red List because of the excessive zeal of collectors (particularly for very large specimens of male stag beetles). An unsuitable forestry management intervention from the point of view of the species is cutting trees too low (just above the ground) (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).

- hermit beetle – *Osmoderma eremita* (1084)

The hermit beetle is a relatively large (20–35 mm) species of chafer, dark brown to purple in colour and difficult to confuse with other chafers. Larvae develop in deep tree hollows, for the most part in deciduous trees (oak, willow, fruit trees, lime tree, ash), where there is a larger quantity of decaying wood on which the larvae can feed. Development takes two to three or even four years, depending on the nutritional quality of the decaying wood on which they feed. Adult males only live a few days (10–20), while females can live up to a month or two. They feed on plant material and drink sweet tree sap. They are not very mobile and for the most part stay close to their place of development (hence the name "hermit"). For this reason, the proximity or density of tree hollows is important for their survival. As a result of human activity, this density is greatest in anthropogenic environments such as old tree avenues, riparian willow communities or tall orchards. One threat factor is therefore the abandoning of certain customs – e.g. the removal of large, old willow trees from riverbanks, changes in the method of agriculture and the disappearance of tall orchards. (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).

- narrow-mouthed whorl snail – *Vertigo angustior* (1014)

The shell of this tiny snail is 1.8 mm high and 0.9 mm wide, sinistral, with five whorls, a finely ribbed surface, red-brown in colour and glossy. The species is found in tall herbs in marshy meadows and valley groves, in sedges and among mosses in bogs, and in the leaf litter of waterside shrubs and bushes. It frequently lives on the boundaries of different habitats, for example the boundary between reed beds and marsh or in the transitional zone between grassland and salt marsh. It can also live in completely dry environment such as dry forests. It is sensitive to rapid changes in humidity in its habitat, to changes in grazing conditions (it tolerates grazing to a certain extent) and to physical disturbances. In areas liable to flooding, it is important that higher sections of bogs and reed beds are preserved, since these represent flood refuges. (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).

<u>Qualifying habitat types:</u>

- 621017 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*)

This habitat type consists of meadows or pastures on limestone, dolomite or, more rarely, flysch, or on sand and old gravel beds. Growing sites are dry, light and warm. The substrate is neutral or slightly basic, with few nutrients. They do not tolerate fertilisation, except on very arid soil, where they also do well with moderate fertilisation. They grow on the slopes of hills (except north-facing slopes) where the soil is shallow and the ground is bare in places. They do not tolerate high levels of moisture or stagnation of water. They need extensive pasture or mowing 1–2 times a year, first after the majority of meadow plants have finished flowering, without fertilisation, with hay drying in the meadow, and are not damaged by pasture at the end of the season (August–October). In Slovenia, this habitat type appears in scattered form on suitable surfaces (unfertilised, particularly calcareous soils, sunny slopes). Threats include fertilisation of meadows, hay baling, conversion of meadows into fields, overgrowing with woody species and, in places, hill walking and infrastructure developments. (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).
– 6510Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) Lowland hay meadows thrive on moderately fertilised, damp to moderately dry soils. They are mown 2–3 times a year. In the traditional cultural landscape, they usually appear as part of a mosaic that also includes dry and damp meadows. They are found across Slovenia but are rare in the Slovenian part of the Istrian peninsula and on the Karst plateau. They are not present in high mountain areas. Three forms of this habitat type are present in Slovenia: damp, dry and mesophilic. The last of these is, for the time being, least at risk, while dry grassland is most at risk from overgrowing, and damp grassland from drying out and intensification of meadows (conversion into fields, oversowing with grass mixtures, baling, overfertilisation, over-frequent mowing). (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/).

Lower Sava SAC (SI3000304) – approx. 8 km from the site of the activity.
The Sava from the mouth of the Krka to the national border represents a connecting habitat for Danube roach populations from the Sotla and Krka rivers. (Nature Conservation Atlas (Slovenian Environment Agency); http://www.naravovarstveni-atlas.si/web/). Following the decision of a biogeographical seminar held in Ljubljana in June 2014 to ensure the connectivity of the Danube roach population between the Krka and the Sotla, the section of the Sava between the mouth of the Krka and the national border with Croatia was defined as a new area for the species *Rutilus pigus*. The Danube roach that live in Slovenia actually belong to the species *Rutilus virgo* (common name: cactus roach), once defined as the subspecies *Rutilus pigus virgo*. Today this is defined as a species in its own right that inhabits the Danube basin, unlike *Rutilus pigus*, which naturally inhabits the northern part of the Adriatic basin. Lake populations of *Rutilus pigus* inhabit deep open lakes in Italy, while river populations inhabit tributaries of the Po. The distributions of the two species do not overlap

and *Rutilus pigus* does not live in Slovenia. The species *Rutilus pigus* is, however, defined as a qualifying species for all Natura 2000 areas in Slovenia on the reference list of Natura 2000 species, since this name derives from the Habitats Directive and, in the case of Slovenia, covers the species *Rutilus virgo* (interpretation of the Institute of the Republic of Slovenia for Nature Conservation (ZRSVN)).

<u>Qualifying species:</u>

- Danube roach – *Rutilus pigus* (1114)

The cactus roach is 60 cm long with a laterally flattened body that is silver in colour, passing to grey-green on the back. The mouth is inferior. It lives in moderately rapid flowing medium to large watercourses. At spawning time it also finds its way into smaller watercourses with submerged aquatic plants and/or a gravel bed. Even at this time it prefers faster flowing waters. It spawns from April to May in tributaries and backwaters and usually deposits roe on plants or the stream bed. Males develop large white breeding tubercles on the back and head during spawning. The cactus roach feeds on aquatic plants and aquatic invertebrates. In Slovenia it is found in all watercourses of the Danube basin. The largest populations are in the basin of the Ljubljanica, the lower course of the Sava, the Mirna, the Krka and the Kolpa. It is an endemite of the Danube basin. In terms of ecological characteristics, the Danube roach is classified as a rheophilic, potamic, lithophilic or litho-phytophilic and invertivore fish which, according to some sources, migrates for short distances and, according to others, migrates more than 150 km.

C2) Expected impacts during operation and the conditions

<u>Flora and habitat types</u>

During operation, safety requirements will dictate the need to maintain tree and shrub vegetation in the NEK buffer zone (prevention of overgrowth). The impact will be direct, medium-term and localised, and will only entail preserving the current situation. Because NEK will operate with its existing infrastructure, there will be no other direct impacts on vegetation and land habitat types. During operation, NEK does not emit ionised radiation into the environment that could have a significant impact on the flora in the area surrounding the power plant. Safety systems prevent the uncontrolled release of radioactive material into the environment. The design of safety systems provides safety functions in all operational states, even in the event of specific equipment failure. The release of radioactive material into the environment is prevented by four successive safety barriers. The basic objective of the first three barriers is to prevent radioactive material from passing to the next barrier, while the fourth barrier prevents radioactive material from being released directly into NEK's surroundings. As the annual dose on the NEK perimeter fence will not exceed the limit of 200 μSv as a result of the extension of operational lifetime, the ministry estimates an insignificant impact.

A sustained impact on the vegetation and types of habitat in the vicinity of NEK could occur in the event of a serious accident resulting in the discharge of radioactive material into the environment. Numerous safety upgrades have been implemented at NEK. For this reason, the possibility of damage to the core is very small. NEK was designed to withstand so-called design basis accidents and to manage them using its safety systems. NEK can use the DEC-A equipment to prevent the reactor core meltdown. The DEC-B equipment, however, was intended for managing the occurrence of a very unlikely core meltdown and focuses on protecting the final barrier before release, i.e. the integrity of the containment. The passive filter system serves to relieve the pressure in the containment, while environmentally harmful substances remain trapped in the filters. Direct release into the environment is therefore unlikely. The ministry estimates that the impact of the lifetime extension and the overall impact on flora and habitat types during operation will be "4" (impact not significant).

<u>Fauna</u>

Impacts on fauna will not change relative to the current situation. The duration of those impacts will, however, be extended. During operation, NEK does not emit ionised radiation into the environment

that could have a significant impact on the fauna in the area surrounding the power plant. Safety systems prevent the uncontrolled release of radioactive material into the environment. The design of safety systems provides safety functions in all operational states, even in the event of specific equipment failure. The release of radioactive material into the environment is prevented by four successive safety barriers. The basic objective of the first three barriers is to prevent radioactive material from passing to the next barrier, while the fourth barrier prevents radioactive material from being released directly into NEK's surroundings. As the annual dose on the NEK perimeter fence will not exceed the limit of 200 μSv as a result of the extension of operational lifetime, the ministry estimates an insignificant impact.
The entire exterior of NEK is illuminated for the purpose of ensuring physical protection, i.e. security. As NEK's external lighting is an integral part of the technical systems for ensuring physical protection, NEK is not bound by the Decree on limit values for light pollution, but by the Rules on the physical protection of nuclear facilities and nuclear and radioactive material, and the transport of nuclear material. Light pollution primarily impacts insects that are active at night, i.e. stag beetles (*Lucanus cervus*), which are attracted by artificial light sources and remain fixated on light instead of searching for food or a mate. The illumination of NEK will not change with the extension of its operating lifetime. According to the cataloguing of beetles (CKFF, 2008), the densest populations of stag beetles are on the left bank of the Sava, in a wooded area around 2.5 km from the NEK complex. The impact will be insignificant.
NEK uses water from the Sava. NEK returns used water to the Sava, and therefore has no impact on the river's hydrological regime. Only emissions of substances and heat by NEK represent potential impacts on the Sava. Such impacts are of a long-term nature (over the entire operational lifetime) and remote. During operation, NEK occasionally releases liquids from discharge tanks into the environment in a controlled manner. Liquids with low activity levels are discharged into the Sava via the essential service water channel which is located upstream from the power plant's dam. Radioactive liquids from waste monitoring tanks and the steam generator blowdown system are released via that channel. Liquid radioactive waste from NEK is treated in a treatment plant that comprises reservoirs, pumps, filters, an evaporator and two demineralisers. Blowdown water from the steam generators is treated separately. Tritium (H-3) is regularly present in liquid effluents from NEK. Tritium is an isotope that emits non-penetrating beta radiation, but it is only slightly radiotoxic (the limit value for tritium in potable water is 100 Bq/l). In 2020 the average monthly activity concentration of H-3 in Krško before NEK (natural background) was slightly below 0.6 kBq/m^3. The long-term average (since 2002) of monthly H-3 activity concentrations in Brežice is 4.0 kBq/m^3. The average over several months (since July 2017) of monthly H-3 activity concentrations at the sampling station in front of the Brežice HPP dam is 2.9 kBq/m^3. The concentrations of tritium activity in Jesenice na Dolenjskem are lower as a result of the additional dilution of the Sava by the Krka and the Sotla. The long-term monthly average of H-3 activity concentrations in Jesenice na Dolenjskem is 2.4 kBq/m^3. In 2020 it was below 1 kBq/m^3, which is well below the limit value for potable water (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). The total annual C-14 activity discharge into the Sava was 0.3 GBq in 2020. However, measured C-14 activities in the Sava waters and in fish were lower than current atmospheric activities. I-131 was not detected in liquid effluents from NEK in 2020. Average concentrations of I-131 in the Sava in Brežice are similar to those in the Sava in Ljubljana (3.4 Bq/m^3). The presence of I-131 in the Sava is attributed to discharges from hospitals into the rivers that flow into the Sava upstream from the NEK dam (Ljubljanica, Savinja). I-131 was not detected in fish samples in 2020. The annual liquid discharge of Cs-137 from NEK into the Sava in 2020 was 0.9 MBq. This contribution cannot be distinguished from the non-homogeneously distributed global contamination. In 2020 the activity of radioactive strontium (Sr-90) discharged into the Sava was 0.04 MBq. However, the contribution of NEK cannot be distinguished from the non-homogeneously distributed global contamination. Other fission and activation products (Co-58, Co-60, Mn-54, Ag-110m, Cs-134, Sb-125) appear regularly in liquid effluents from NEK. The total activity of these radionuclides in 2020 was at least six orders of magnitude lower than for tritium. In the last few years, none of the radionuclides listed have been detected in the environment. Therefore, when the nuclear plant in Krško is in operation, the

concentrations of discharged radionuclide activity in the environment, with the exception of the very low-radiotoxic H-3, are significantly below the limits of detection (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). A significant impact on the fauna in the Sava is therefore not expected.

The pretreatment of water results in wastewater in the counter-flow rinsing of filters for the mechanical treatment of raw water, and in the cleaning of membranes and the reverse osmosis system. Waste water accumulates in the wastewater pool (PW wastewater pool) at outlet no. 11, with final outflow from discharge 7. If the system is rinsed using corrosive chemicals, water from the wastewater pool is pumped into a neutralisation tank where the pH value is continuously measured and pH balanced before water is discharged into the Sava. That path is temporary and only used very occasionally, while water quantities are small. For this reason, a significant impact on the fauna in the Sava is not expected in the future. Before being discharged into the Sava, wastewater from NEK is treated at a small municipal treatment plant (SMTP) with a capacity of 700 PE. The SMTP has primary and secondary treatment systems. A total of 10,000 m^3 of wastewater was treated at the treatment plant in 2020, while the measured values of COD and BPK_5 at the discharge from the SMTP were well below the permitted limit values (Report on the operational monitoring of wastewater for NEK (for 2020), NLZOH, Centre for the Environment and Health, Department for the Environment and Health, Novo Mesto, Division for Soil and Water, no. 2172-72-172/20, 24 March 2021, and Reports on the operational monitoring of wastewater for NEK (for 2015, 2016, 2017, 2018, 2019 and 2020), NLZOH, Centre for the Environment and Health, Department for the Environment and Health, Novo Mesto, Division for Soil and Water). The yearly quantity of and burden from municipal wastewater from NEK will not change due to the extension of the power plant's operational lifetime, as there is no plan to connect any new users. A significant impact on the fauna in the Sava is therefore not expected.

NEK did not introduce biocides into any system in 2020. The quality of water from the Sava improved significantly following the closure of the VIPAP cellulose plant. For this reason, NEK is not planning to introduce biocides into the tertiary coolant circuit in the future. No impact on the fauna in the Sava is therefore expected.

The thermal load could have an impact on fauna in the watercourse indirectly through the impact on oxygen content or directly due to the impact on organisms, as life processes evolve more rapidly at warmer temperatures, while different organisms function optimally at different temperatures. A change in water temperature could lead to a change in the biocenosis of the river. The impact of temperature on macroinvertebrates is somewhat less on the lower course of rivers than it is on the middle and upper courses. Maximum temperatures in the summer months have the most significant impact on fish, as they could lead to deteriorating oxygen conditions or even the overheating of organisms at extremely high temperatures (in excess of 30°C). Fish can avoid this impact to some extent by moving to cooler, better-oxygenated parts of the river.

NEK uses water from the Sava for cooling the condensers and turbines, and for cooling safety components. Safety components are cooled via the component cooling system. That system represents an additional safety barrier against the potential discharge of radioactive material and is cooled by the reserve service water system, which extracts water from the Sava. The discharge from that system is at point V1. The average temperature at discharge V1 in July 2020 was 22.16°C. The impact of that discharge is localised and, because it accounts for a low proportion of transmitted heat, is insignificant.

The secondary coolant circuit system (for the condenser and turbine) also uses water from the Sava, which is returned in a heated state at point V7-7 to discharge V7. The most significant impact of the thermal load is localised at discharge point V7. The warmer water that flows from discharge V7 primarily remains near the surface due to lower density. Taking into account the temperature scheduling model at Brežice HPP's reservoir (Analysis of changes in the radiological and thermal impacts of NEK on the environment since the construction of HPP Brežice. Final report. Inštitut Jožef Stefan, Environmental Sciences Department, Faculty of Civil and Geodetic Engineering, Department of Fluid Mechanics, IBE d.d., September 2007), this is an area several 100 m downstream from discharge V7, but not along the entire width of the riverbed, where the mixing of water occurs. In 2020 the daily average of the proportion of transmitted heat accounted for by discharge V7 never exceeded the limit value set out in the environmental protection permit. NEK routinely carries out measurements that ensure that the requirements from the applicable environmental protection permit are met. The environmental protection permit stipulates that NEK must ensure that the synergetic action of the discharge of industrial cooling waters and other discharged wastewaters does not cause the Sava to exceed its natural temperature by more than 3 K at any time during the year. NEK must activate the cooling water recirculation system in a timely manner via the cooling towers to prevent the temperature of the Sava from exceeding its natural temperature by more than 3 K. If the combined cooling system is insufficient to fulfil this condition, the power of the power plant must be reduced accordingly. According to data from NEK, the average temperature of the Sava at the point of full mixing in July and August 2020 was 22–23°C. Between 2010 and 2020, the average temperature of the Sava at the point of full mixing rarely exceeded 27°C in one day (four times in July 2015, once in August 2017 and four times in August 2018), but it never exceeded 28°C, which is the limit for an excessive thermal load on cyprinid waters according to the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system (Official Gazette of RS, Nos. 64/12, 64/14 and 98/15). To mitigate the impact of thermal pollution, NEK will have to continue to comply with the provisions of the environmental protection permit. A significant impact from NEK's operational lifetime extension is not expected as long as the provisions of the environmental protection permit are observed.

The foaming of water occurred in the Sava following discharges in 2017. The appearance of foam on the Sava downstream from the release point of NEK was examined in the document "Joint final report on investigations and analysis at the Brežice HPP, Krško HPP, Arto-Blanca HPP and Boštanj HPP reservoirs, and studies of the causes of water foaming, Limnos d.o.o., 10 September 2017". The report found that organic pollution of the Sava upstream from NEK contributed significantly to the appearance of foam, which was proven by the high values of BOD_5 and COD at sampling locations upstream from NEK. The result of organic pollution is the increased quantity of bacteria that produce CO_2, which in turn cause the foaming of water. Water that is used to cool the condenser and turbine is released into the Sava at discharge V7 unchanged, except that it is warmer. There are therefore no substances in NEK discharges that might contribute to foaming. However, following discharge from NEK, the release of gases (CO_2) is more intense due to the drop and mixing of water. Carbon dioxide is more soluble in cold water and is released into the atmosphere when it comes into contact with warmer water. For this reason, foam can appear on the water's surface. It therefore seems that foam on the Sava is a natural phenomenon and the result of the bioproduction processes of microorganisms in the river. The sampling of algae in foam in discharge from NEK indicated the presence of primarily green algae and diatoms, while traces of cyanobacteria, which can produce toxins, were rare. Foam is therefore not expected to pose a direct danger to water organisms. Certain types of algae that cause algal bloom were also present in samples taken, but this phenomenon did not occur during the study. Following the filling of the reservoir at Brežice HPP, foaming was no longer so evident and has not reoccurred in recent years. Given the results of the assessment of the ecological status of the Sava in the area of the Brežice HPP reservoir, the saprobic condition, which is based on benthic invertebrates, was good in 2018 (website of HESS, 2019). As evident from the national monitoring of the ecological status of the Sava in Jesenice na Dolenjskem, the ecological status of the Sava was assessed as good in the period 2012–2019. The trophic conditions and saprobic conditions for phytobenthos, macrophytes and benthic invertebrates were actually assessed as "very good" in 2016 and 2018, which leads the ministry to believe that the potential localised appearance of foam has no significant impact on the Sava ecosystem. If foam should reappear on the Sava, an analysis of its content could be performed and its decomposition monitored.

Monitoring of the Sava (Cotman, M., 2020. Report on the non-radiological monitoring of the Sava in 2019. Final report. National Institute of Chemistry, Centre for Validation Technologies and Analytics, Ljubljana), which is carried out at three points (at the offtake point for cooling water at NEK, upstream from NEK on the right bank of the Sava and in Brežice at the road bridge), indicates that organic pollution was down slightly in 2019 relative to the long-term trend. The highest measured value of COD in 2019 was in November at the sampling location upstream from NEK on the right bank of the Sava (10.63 mg/l). The highest measured value of BOD_5 in 2019 was in March, likewise at the

sampling location upstream from NEK on the right bank of the Sava (1.60 mg/l). According to the Decree on surface water status, the limit value of BOD_5 for the very good ecological status of rivers is between 1.6 and 2.4 mg/l. According to the Decree on the quality required of surface waters supporting freshwater fish life (Official Gazette of RS, Nos. 46/02 and 41/04 [ZVO-1]), the recommended value for salmonid waters is less than 3 mg/l, while the value for cyprinid waters is less than 6 mg/l. Cyprinid fish species, for which the measured parameters are completely appropriate, are predominant in the Sava downstream from NEK. According to the Rules on the designation of surface water sections important for freshwater fish species (Official Gazette of RS, Nos. 28/05 and 8/18), the aforementioned section of the Sava is not designated as important for freshwater fish species. For this reason, monitoring of the quality of water that supports freshwater fish life is not envisaged in this area. According to Article 8 of the Decree on the quality required of surface waters supporting freshwater fish life, that monitoring is the responsibility of the ministry responsible for environmental protection.
Periodic national monitoring of the ecological status of rivers is carried out downstream of discharges from NEK on the Sava–border section water body (SI1VT930), where the measuring point is located in Jesenice na Dolenjskem. The ecological status was assessed as moderate in 2009 and 2011 (the phytobenthos and macrophytes parameter of trophic condition was assessed as moderate in 2009, while the phytobenthos and macrophytes parameter of saprobic condition was assessed as moderate in 2011), while the ecological status was assessed as good in 2010 and in the period 2012–2019. The trophic condition and saprobic conditions for phytobenthos, macrophytes and benthic invertebrates were actually assessed as "very good" in 2016 and 2018. The operation of NEK therefore does not have a significant impact on the ecological status of the Sava.
A sustained impact on fauna in the vicinity of NEK could occur in the event of a major accident resulting in the release of radioactive material into the environment. Numerous safety upgrades have been implemented at NEK. For this reason, the possibility of core damage is very small. NEK was designed to withstand so-called design basis accidents and to manage them using its safety systems. NEK can use the DEC-A equipment to prevent the reactor core meltdown. The DEC-B equipment, however, was intended for managing the occurrence of a very unlikely core meltdown and focuses on protecting the final barrier before release, i.e. the integrity of the containment. The passive filter system serves to relieve the pressure in the containment, while environmentally harmful substances remain trapped in the filters. Direct release into the environment is therefore unlikely.
The ministry estimates that the impact of the lifetime extension on fauna during operation will be "3" (impact not significant) as a result of the mitigation measures referred to in point II./I of the operative part of this environmental protection consent that NEK is already implementing and will have to continue to implement during extended operation in order to prevent excessive burdens resulting from the discharge of wastewater into the Sava (wastewater parameters below the limit values set out in the environmental protection permit with respect to emissions into water).

A chain of hydro power plants (Vrhovo, Boštanj, Arto-Blanca, Krško and Brežice) has been built on the lower course of the Sava. The completion of that chain is planned with Mokrice HPP in the Lower Sava SAC. The potential cumulative impact on the temperature of the Sava as a result of NEK's heat discharges and Sava's slower flow rate in HPP reservoirs has been examined in the study "Thermal loads on the Sava" (interactions of energy buildings along and on the Sava from the perspective of the thermal load on the Sava – Revision A. IBE 2012). The study found that the increase in the Sava's temperature most likely results from a natural rise in the temperature of river water and not from the construction of HPPs. This analysis was completed in 2012, before Krško HPP was built, so another thermal analysis of the Sava was conducted for the extended HPP chain, which also included the above-average warm summer of 2019 (Energy buildings along and on the Sava. Analysis of river temperatures in the lower reaches of the Sava in July and August 2019 and the verification of past studies – Revision A. IBE, April 2020). Measurements in this latest study showed that there was a drop in the temperature of the Sava between NEK and the discharge from HPP Brežice of 0.54°C in July 2019. The HPP Brežice reservoir therefore has a cooling effect on water that flows into the Lower Sava SAC. According to the latest IBE study, increases in the mean monthly temperatures of the

Sava in the Čatež area have been lower over the last 18 years than they were previously. The conclusion is therefore that the chain of HPPs does not increase the mean temperatures of the river. The study also anticipates that the mean monthly temperature in the flow-through reservoir of the planned Mokrice HPP during the summer will only rise by a minimal degree (around 0.1 to 0.2°C) relative to the current situation. No cumulative or synergetic impact is therefore expected on the temperature of the Sava from heat discharges from NEK and the slow flow rate of the Sava in existing HPP reservoirs and the planned Mokrice HPP flow-through reservoir.
The ministry estimates that the overall impact on fauna during operation will be "3" (impact not significant) as a result of the mitigation measures referred to in point II./I of the operative part of this environmental protection consent that NEK is already implementing and will have to continue to implement during extended operation to prevent excessive burdens resulting from the discharge of wastewater into the Sava (wastewater parameters below the limit values set out in the environmental protection permit with respect to emissions into water).

<u>IEAs and valuable natural features</u>
Important ecological area: Sava from Radeče to national border (ID 63700)
One part of the important ecological area is the section of the Sava on the Krško-Brežice plain, from Krško to the mouth of the Sotla. The activity in question physically affects the area in the form of a dam on the Sava. Following the construction of Brežice HPP, the water level in the area of NEK rose by 3 m. As a result, the regulation of the water level at the NEK dam is no longer required and the sluice gates are always raised. The NEK dam is now entirely passable for fish. NEK also discharges wastewater into the Sava. Based on national monitoring, the ecological status of the Sava downstream from NEK is assessed as good. NEK operates in compliance with the environmental protection permit. To mitigate the impact of thermal pollution, NEK will have to continue to comply with the provisions of the environmental protection permit. A significant impact from NEK's operational lifetime extension is not expected as long as the provisions of the environmental protection permit are observed.

VNF Libna – linden tree next to the church (ID 7860)
During operation, NEK does not emit ionising radiation into the environment that could have a significant impact on VNF in Libna (linden tree next to the church). Measurements of radioactivity in the vicinity of NEK indicate that the impact is already insignificant in apples harvested in the direct vicinity of NEK. That impact is even less due to the great distance between the VNF in Libna (linden tree next to the church) and NEK.

VNF Stari Grad – gravel pit (ID 7861)
NEK stands right next to the Sava and uses water from the river for cooling. During operation, it releases some radioactive material in a controlled manner into the Sava, which in part feeds the underground aquifers of the Krško-Brežice plain. The quantities of synthetic radionuclides from NEK's liquid and atmospheric discharges into the groundwater are negligible compared to the contribution from synthetic radionuclides from general contamination and naturally occurring radionuclides arising from natural radiation (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). The impact on water at the VNF in Stari Grad (gravel pit) is therefore insignificant.

The ministry estimates that the impact of the lifetime extension and the overall impact on valuable natural features during operation will be "4" (impact not significant). The ministry estimates that the impact of the lifetime extension and the overall impact on IEAs during operation will be "3" (impact not significant) as a result of the mitigation measures referred to in point II./I of the operative part of this environmental protection consent that NEK is already implementing and will have to continue to implement during extended operation to prevent excessive burdens resulting from the discharge of wastewater into the Sava (wastewater parameters below the limit values set out in the environmental protection permit with respect to emissions into water).

Protected areas

A Supplement Assessing the Acceptability of the Impacts on Protected Areas for the Extension of NEK's Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o., order no. 1456-20 VO, October 2021, updated January 2022 (AQUARIUS d.o.o. Ljubljana, cesta Andreja Bitenca 68, 1000 Ljubljana) has been drawn up in accordance with the Rules, and is appended to the environmental impact assessment report.

Vrbina SAC (SI3000234)

During operation, NEK does not emit ionised radiation into the environment that could have an impact on the Vrbina SAC. Safety systems prevent the uncontrolled release of radioactive material into the environment. The design of safety systems provides safety functions in all operational states, even in the event of specific equipment failure. The release of radioactive material into the environment is prevented by four successive safety barriers. The basic objective of the first three barriers is to prevent radioactive material from passing to the next barrier, while the fourth barrier prevents radioactive material from being released directly into NEK's surroundings. The annual dose on the NEK perimeter fence will not exceed the limit of 200 μSv as a result of the extension of operational lifetime. The ministry therefore does not expect impacts from ionising radiation on the Vrbina SAC after NEK's operational lifetime is extended.

Light pollution primarily impacts insects that are active at night, which are attracted by artificial light sources and remain fixated on light instead of searching for food or a mate. That impact is of a long-term nature and remote. For the qualifying species of stag beetle (*Lucanus cervus*), the Management Programme for Natura 2000 Areas (MPN) sets the objective of maintaining the current state without permanent light bodies. The illumination of NEK will not change with the extension of its operating lifetime, meaning the current state will be maintained. There will therefore be no impact on the aforementioned conservation objective. According to the cataloguing of beetles (CKFF, 2008), the densest populations of stag beetles in the Vrbina SAC are on the left bank of the river, around 2.5 km from the NEK complex. Due to that distance, the impact on stag beetles will be negligible. No impact on other qualifying species from light pollution is expected.

A sustained impact on habitat types and qualifying species in the Vrbina SAC could occur in the event of a serious accident resulting in the discharge of radioactive material into the environment. Numerous safety upgrades have been implemented at NEK. For this reason, the possibility of core damage is very small. NEK was designed to withstand so-called design basis accidents and to manage them using its safety systems. NEK can use the DEC-A equipment to prevent the reactor core meltdown. The DEC-B equipment, however, was intended for managing the occurrence of a very unlikely core meltdown and focuses on protecting the final barrier before release, i.e. the integrity of the containment. The passive filter system serves to relieve the pressure in the containment, while environmentally harmful substances remain trapped in the filters. Direct release into the environment is therefore unlikely.

Lower Sava SAC (SI3000304)

The Lower Sava SAC is around 8 km downstream from discharges from NEK. Only emissions of substances and heat into the Sava represent a potential impact from NEK on the Lower Sava SAC and the qualifying species of cactus roach. During normal operation, NEK occasionally releases liquids from discharge tanks into the environment in a controlled manner. Liquids with low activity levels are discharged into the Sava via the essential service water channel which is located upstream from the power plant's dam. Radioactive liquids from waste measurement tanks and the steam generator blowdown system are released via that channel. Liquid radioactive waste from NEK is treated in a treatment plant that comprises reservoirs, pumps, filters, an evaporator and two demineralisers. Blowdown water from the steam generators is treated separately. NEK regularly monitors the content of radioactive material in the tissues of fish. That monitoring is included in the Programme of measurements of radioactivity in the vicinity of NEK. Those measurements are performed by external contractors (Inštitut Jožef Stefan, Institut Ruđer Bošković and the Institute of

Occupational Safety), and the results are presented in annual reports on the monitoring of radioactivity in the vicinity of NEK. Tritium (H-3) is regularly present in liquid effluents from NEK. Tritium is an isotope that emits non-penetrating beta radiation, but it is only slightly radiotoxic (the limit value for tritium in potable water is 100 Bq/l). In 2020 the average monthly activity concentration of H-3 in Krško before NEK (natural background) was slightly below 0.6 kBq/m^3. The long-term average (since 2002) of monthly H-3 activity concentrations in Brežice is 4.0 kBq/m^3. The average over several months (since July 2017) of monthly H-3 activity concentrations at the sampling station in front of the Brežice HPP dam is 2.9 kBq/m^3. The concentrations of tritium activity in Jesenice na Dolenjskem are lower as a result of the additional dilution of the Sava by the Krka and the Sotla. The long-term monthly average of H-3 activity concentrations in Jesenice na Dolenjskem is 2.4 kBq/m^3. In 2020 it was below 1 kBq/m^3, which is well below the limit value for potable water (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). The total annual C-14 activity discharge into the Sava was 0.3 GBq in 2020. However, measured C-14 activities in the Sava waters and in fish were lower than current atmospheric activities.

I-131 was not detected in liquid effluents from NEK in 2020. Average concentrations of I-131 in the Sava in Brežice are similar to those in the Sava in Ljubljana (3.4 Bq/m^3). The presence of I-131 in the Sava is attributed to discharges from hospitals into the rivers that flow into the Sava upstream from the NEK dam (Ljubljanica, Savinja). I-131 was not detected in fish samples in 2020 (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). The annual liquid discharge of Cs-137 from NEK into the Sava in 2020 was 0.9 MBq. This contribution cannot be distinguished from the non-homogeneously distributed global contamination (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). The activity discharge of radioactive Strontium (Sr-90) into the Sava in 2020 was 0.04 MBq in 2020. This contribution cannot be distinguished from the non-homogeneously distributed global contamination (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). Other fission and activation products (Co-58, Co-60, Mn-54, Ag-110m, Cs-134, Sb-125) appear regularly in liquid effluents from NEK. The total activity of these radionuclides in 2020 was at least six orders of magnitude lower than for tritium. In the last few years, none of the radionuclides listed have been detected in the environment (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). Therefore, when the nuclear plant in Krško is in operation, the concentrations of discharged radionuclide activity in the environment, with the exception of the very low-radiotoxic H-3, are significantly below the limits of detection (Monitoring of radioactivity in the vicinity of NEK, Report for 2020, Inštitut Jožef Stefan, IJS-DP-13463, April 2021). The impact from radioactive effluent on cactus roach and the Lower Sava SAC is therefore assessed as negligible.

The pretreatment of water results in wastewater in the counter-flow rinsing of filters for the mechanical treatment of raw water, and in the cleaning of membranes and the reverse osmosis system. Waste water accumulates in the wastewater pool (PW wastewater pool) at outlet no. 11, with final outflow from discharge 7. If the system is rinsed using corrosive chemicals, water from the wastewater pool is pumped into a neutralisation tank where the pH value is continuously measured and pH balanced before water is discharged into the Sava. That path is temporary and only used very occasionally, while water quantities are small. For this reason, the impact on cactus roach and the Lower Sava SAC is estimated to be not significant even if the lifetime of NEK is extended.

Before being discharged into the Sava, wastewater from NEK is treated at a small municipal treatment plant (SMTP) with a capacity of 700 PE. The SMTP has primary and secondary treatment systems. A total of 10,000 m^3 of wastewater was treated at the treatment plant in 2020, while the measured values of COD and BPK_5 at the discharge from the SMTP were well below the permitted limit values. The quantity of and burden from municipal wastewater from NEK will not change due to the extension of the power plant’s operational lifetime, as there is no plan to connect any new users. For this reason, no impact on cactus roach and the Lower Sava SAC is expected.

NEK did not introduce biocides into any system in 2020. The quality of Sava water improved significantly following the closure of the VIPAP cellulose plant. For this reason, NEK is not planning to introduce biocides into the tertiary coolant circuit in the future. Therefore, no impact on cactus roach

and the Lower Sava SAC is expected, even after NEK's operational lifetime is extended.
NEK uses water from the Sava for cooling the condensers and turbines, and for cooling safety components. Safety components are cooled via the component cooling system. That system represents an additional safety barrier against the potential discharge of radioactive material and is cooled by the reserve service water system, which extracts water from the Sava. The secondary coolant circuit system (for the condenser and turbine) uses water from the Sava. However, if sufficient cooling is not possible with water from the Sava, NEK uses cooling cells/towers (two batteries per six cells and one battery per four cells). It therefore only takes a portion of required water directly from the Sava, while the remaining water is recirculated through the cooling cells where it is air-cooled. Waste cooling water is not treated before it is discharged into the Sava. NEK routinely carries out measurements that ensure that the requirements from the applicable environmental protection permit are met. The environmental protection permit stipulates that NEK must ensure that the synergetic action of the discharge of industrial cooling waters and other discharged wastewaters does not cause the Sava to exceed its natural temperature by more than 3 K at any time during the year. NEK must activate the cooling water recirculation system in a timely manner via the cooling towers to prevent the temperature of the Sava from exceeding its natural temperature by more than 3°C. If the combined cooling system is insufficient to fulfil this condition, the power of the power plant must be reduced accordingly. In 2020 the daily averages of the emission proportion of transmitted heat at discharges from the large and small cooling system and the total emission share of transmitted heat did not exceed the limit value set out in the environmental protection permit. To mitigate the impact of thermal pollution, NEK will have to continue to comply with the provisions of the environmental protection permit. Periodic national monitoring of the ecological status of rivers is carried out downstream of discharges from NEK on the Sava–border section water body (SI1VT930), where the measuring point is located in Jesenice na Dolenjskem. The ecological status was assessed as moderate in 2009 and 2011 (the phytobenthos and macrophytes parameter of trophic condition was assessed as moderate in 2009, while the phytobenthos and macrophytes parameter of saprobic condition was assessed as moderate in 2011), while the ecological status was assessed as good in 2010 and in the period 2012–2019. The trophic condition and saprobic conditions for phytobenthos, macrophytes and benthic invertebrates were actually assessed as "very good" in 2016 and 2018, which indicates that the Sava is not organically polluted at that point. Monitoring of the Sava (Cotman, M., 2020. Report on the non-radiological monitoring of the Sava in 2019. Final report. National Institute of Chemistry, Centre for Validation Technologies and Analytics, Ljubljana), which is carried out at three points (at the offtake point for cooling water at NEK, upstream from NEK on the right bank of the Sava and in Brežice at the road bridge), indicates that organic pollution was down in 2019 relative to the long-term trend. The highest measured value of COD in 2019 (10.63 mg/l) was in November at the sampling location upstream from NEK on the right bank of the Sava. The highest measured value of BOD_5 in 2019 (1.60 mg/l) was in March, likewise at the sampling location upstream from NEK on the right bank of the Sava. According to the Decree on surface water status (Official Gazette of RS, Nos. 14/09, 98/10, 96/13 and 24/16), the limit value of BOD_5 is between 1.6 and 2.4 mg/l if a river is to be regarded as having a "very good" ecological status. According to the Decree on the quality required of surface waters supporting freshwater fish life, the recommended value for salmonid waters is less than 3 mg/l and the value for cyprinid waters is less than 6 mg/l. Heat discharges from NEK therefore do not cause any deterioration in the living conditions of cactus roach, which is a cyprinid species, in the Lower Sava SAC. A significant impact from NEK's operational lifetime extension is not expected as long as the provisions of the environmental protection permit are observed.
A sustained impact on the environment and Lower Sava SAC could occur in the event of a serious accident resulting in the discharge of radioactive material into the environment. Numerous safety upgrades have been implemented at NEK. For this reason, the possibility of core damage is very small. NEK was designed to withstand so-called design basis accidents and to manage them using its safety systems. NEK can use the DEC-A equipment to prevent the reactor core meltdown. The DEC-B equipment, however, was intended for managing the occurrence of a very unlikely core meltdown and focuses on protecting the final barrier before release, i.e. the integrity of the containment. The passive filter system serves to relieve the pressure in the containment, while environmentally harmful

substances remain trapped in the filters. In the event of the accidents discussed (DBA and DEC-B) there will be no liquid effluent released into the Sava. All cooling water will be contained inside the containment vessel and auxiliary building, which is designed for systems and components that contain radioactive material (contaminated radioactive water).

A chain of hydro power plants (Vrhovo, Boštanj, Arto-Blanca, Krško and Brežice) has been built on the lower course of the Sava. The completion of that chain is planned with Mokrice HPP in the Lower Sava SAC. An IJS study (IJS, 2006. Analysis of changes in radiological and thermal impact by NEK on the environment after the construction of HPP Brežice. Inštitut Jožef Stefan, Faculty of Civil and Geodetic Engineering, Inženirski Biro Elektroprojekt, 2006) produced the opinion that eutrophication could occur from an increased concentration of phosphates in the Sava from the construction of Brežice HPP on account of the slowed flow rate of the river and higher temperatures in the surface layer of the water in the HPP Brežice reservoir. This could reduce the quality of the Sava. NEK has no effluents that could increase the nutrient content of the Sava and does not represent a source of eutrophication. According to calculations in the study by IBE (2019), the confinement time in the planned Mokrice HPP reservoir will be the shortest of all reservoirs on the lower course of the Sava, while the flow rates will be highest, meaning a reduced possibility of eutrophication in the Lower Sava SAC. The potential cumulative impact on the temperature of the Sava as a result of NEK's heat discharges and Sava's slower flow rate in HPP reservoirs has been examined in the study "Thermal loads on the Sava" (interactions of energy buildings along and on the Sava from the perspective of the thermal load on the Sava – Revision A. IBE 2012). The study found that the increase in the Sava's temperature most likely results from a natural rise in the temperature of river water and not from the construction of HPPs. This analysis was completed in 2012, before Krško HPP was built, so another thermal analysis of the Sava was conducted for the extended HPP chain, which also included the above-average warm summer of 2019 (Energy buildings along and on the Sava. Analysis of river temperatures in the lower reaches of the Sava in July and August 2019 and the verification of past studies – Revision A. IBE, April 2020) (IBE, 2020. Analysis of river temperatures in the lower reaches of the Sava in July and August 2019 and the verification of past studies, IBE, April 2020). Measurements in this latest study showed that there was a drop in the temperature of the Sava between NEK and the discharge from HPP Brežice of 0.54°C in July 2019. The Brežice HPP reservoir therefore has a cooling effect on water that flows into the Lower Sava SAC. According to the latest IBE study, increases in the mean monthly temperatures of the Sava in the Čatež area have been lower over the last 18 years than they were previously. The conclusion is therefore that the chain of HPPs does not increase the mean temperatures of the river. The study also anticipates that the mean monthly temperature in the flow-through reservoir of the planned Mokrice HPP during the summer will only rise by a minimal degree (around 0.1 to 0.2°C) relative to the current situation. According to calculations in the study by IBE (2019), the confinement time in the planned Mokrice HPP reservoir will be the shortest of all reservoirs on the lower course of the Sava, while the flow rates will be the highest, meaning a reduced possibility of eutrophication. Given that no significant deterioration in the parameters of ecological status has been detected in the Brežice HPP reservoir (HESS, 2019. Quality of surface water in the reservoirs of hydropower plants on the lower reaches of the Sava, 30 August 2019https://www.he-ss.si/objava/kvaliteta-povrsinske-vode-v-akumulacijskih bazenih hidroelektrarn-na-spodnji-savi.html (cit. 13 January 2021)) and that it is evident from the national monitoring of the ecological status of the Sava in Jesenice na Dolenjskem that there was also no deterioration in the downstream ecological status of the Sava following the construction of the chain of HPPs, it is possible to conclude that there will be no significant deterioration in the ecological status in the case of the Mokrice HPP reservoir. No significant cumulative impact on the Lower Sava SAC is therefore expected.

The ministry estimates that the impact of the lifetime extension and the overall impact on protected areas during operation will be "3" (impact not significant) as a result of the mitigation measures referred to in point II./I of the operative part of this environmental protection consent that NEK will have to continue to implement during extended operation to prevent excessive burdens resulting from the discharge of wastewater into the Sava (wastewater parameters below the limit values set out in the environmental protection permit with respect to emissions into water).

After NEK ceases operation (see Section 2.18), the fuel will no longer be in the reactor, but stored safely in the spent fuel pool and/or in the dry storage for spent fuel. Cooling of the reactor will therefore no longer be required and heat emissions into the Sava will greatly decrease. However, the spent fuel pool will still have to be cooled by means of the essential service water system. The impact of the discharge from this system is localised, and in view of its low emission share of transmitted heat, negligible. Operation of cooling towers will no longer be needed. NEK will still ensure control over nuclear materials, and the impact of ionising radiation will be insignificant. The ministry estimates that the impact of the lifetime extension and the overall impact on the natural environment will be “4” (impact not significant) if the extension is abandoned.

D) Impacts on material assets

D1) Expected impacts during operation

The extension of NEK’s operational lifetime will not have a significant impact in terms of increasing existing burdens on the environment. The state will remain unchanged. During operation the annual dose on the NEK perimeter fence from all contributing factors, including the spent fuel dry storage, will not exceed the radiation load that currently applies to the NEK perimeter fence, which is 200 μSv for external radiation.

The extension of NEK’s operational lifetime is not expected to result in excessive environmental burdens or impacts that could cause a deterioration in living conditions, consumption or the use of buildings and land outside of the NEK site. The developer has performed an activity in the Vrbina industrial zone, in which other industrial buildings are present, for decades. The industrial zone is therefore not the only source of environmental burden in that area, but is one of the most significant. That facility is not classified as an activity or installation that can cause large-scale environmental pollution and does not pose a minor or major threat to the environment. NEK is a nuclear facility. Its presence in the area could therefore pose a direct threat of an environmental or other accident that could impact material assets, i.e. land and buildings in the vicinity. However, on account of the technology used and the implementation of protective measures, the possibility of an accident has been reduced to the lowest possible level. In accordance with the Rules on the physical protection of nuclear facilities and nuclear and radioactive materials, and the transport of nuclear materials, NEK buildings are classified in categories I, II and III. The facility will therefore be protected in accordance with requirements for physically controlled areas and physically controlled facilities. Reporting on stored fuels will be carried out in accordance with the Decree on the safeguarding of nuclear materials (Official Gazette of RS, Nos. 34/08 and 76/17 [ZVISJV-1]).

The ministry estimates that the impact of the lifetime extension and the overall impact on material assets during operation will be “3” (impact not significant) as a result of the mitigation measures referred to in points II./1 ~~and 2~~ of the operative part of this environmental protection consent and the other measures referred to in the environmental impact assessment report which NEK is already implementing in order to reduce impacts on the surrounding area (and which it will have to continue to implement during extended operation).

If the lifetime extension is abandoned, the environmental burden from emissions of pollutants and other burdens will be significantly reduced relative to regular operation. The ministry estimates that the impact of the lifetime extension and the overall impact will be “4” (impact not significant) if the extension is abandoned.

E) Impacts on the risk of environmental and other accidents

E1) Expected impacts during operation

Extending NEK’s operational lifetime means prolonging its operation by 20 years (2023–2043) under the same environmental and radiation conditions as specified in the existing operating licence.

Although NEK was designed for a minimum period of 40 years, the power plant has carried out all the necessary analyses and upgrades to ensure that it is able operate for another 20 years. On the basis of a series of studies and analyses, the Slovenian Nuclear Safety Administration confirmed in decision no. 3570-6/2009/32 of 20 June 2012 that the state of equipment at NEK was appropriate, despite aging, and that all safety margins and operating functions were guaranteed.

The ability to extend the operational lifetime is based above all on the following facts:

- the power plant has built-in materials and equipment that provide sufficient safety reserves;
- all equipment that affects the reliability of operation has been replaced;
- the operation of the power plant is stable;
- a safety upgrade has been carried out to comply with the requirement of the Ionising Radiation Protection and Nuclear Safety Act and the lessons learnt from all major nuclear accidents to date, which is reflected in ENSREG, the Slovenian national post-Fukushima plan;
- NEK has a comprehensive aging management programme (AMP) in place to monitor the aging of all passive structures and components (reactor pressure vessel, concrete, underground pipelines, steel structures, electrical cables, etc.).

Safe and reliable operation in all conditions is NEK's top priority. Since it began operating, NEK has carried out a series of modernisations that have increased the site's safety and efficiency.

The following missions have taken place at NEK in the last ten years:

- a special safety review (EU stress tests) in 2012;
- ENSREG – Topical Peer Review Ageing Management in 2018, and OSART (Operational Safety Review Team) organised by the IAEA in 2017; and
- WANO Peer Review in 2014 and 2018.

NEK operates in accordance with all Slovenian laws and within the operating limits set out in the Ionising Radiation Protection and Nuclear Safety Act (Official Gazette of the RS, Nos. 76/17 and 26/19), the water permits, the environmental protection permit, NEK technical specifications, etc. The extension of the operational lifetime will enable NEK to remain in operation for a further 20 years, i.e. until 2043, within the exact same limits, and not exceed any existing legal requirements or restrictions.

The continual upgrades and modifications that are being carried out ensure a level of safety that is significantly higher than when the plant was first built. As a result of the modernisations and upgrades completed and the safety systems and safety functions in place, NEK will not pose a risk of environmental or other accidents during its extended operational lifetime.

NEK has built-in systems and components for preventing and mitigating the consequences of accidents, as well as predefined statuses of the power plant. A probabilistic safety assessment was also drawn up.

NEK also formulated an emergency classification based on predetermined threat levels, and a methodology and guidance on how to classify an incident to the appropriate threat level according to its actual or anticipated consequences at the plant and in the environment.

NEK is a nuclear facility. Its presence in the area could therefore pose the direct threat of an environmental or other accident. However, on account of the technology used and the implementation of protective measures, the likelihood of an accident is reduced to the lowest possible level.

The crucial document for the operation of NEK is the operating licence which relates directly to the NEK Updated Safety Analyses Report (USAR), and contains the conditions and limits for the power plant's safe operation.

NEK operates in accordance with the following: the approval to commence NEK operation, National Energy Inspectorate decision no. 31-04/83-5 of 6 February 1984, the amendment to the NEK operating licence, Slovenian Nuclear Safety Administration decision no. 3570-8/2012/5 of 22 April 2013, and the NEK Updated Safety Analysis Report (USAR).

In all operational states, NEK ensures a controlled chain reaction in the reactor, the continuous discharge of thermal energy from the reactor, and safety barriers that prevent the release of radioactive material. Ensuring the comprehensive safety of NEK and in-depth defence requires both numerous safety measures to ensure safe operations and continuous preparedness for conditions that deviate from the power plant's normal operational state.

NEK plans for and maintains preparedness for emergencies in accordance with Slovenia's protection

and disaster relief concept, and the principles of ensuring the nuclear safety of the power plant. NEK is responsible for managing emergencies at the power plant.
The main purpose of planning and maintaining preparedness is to ensure the protection, health and safety of power plant employees and the population in the surrounding areas by preventing emergencies, eliminating or mitigating the consequences of emergencies and ensuring conditions for the re-establishment of the normal state of the power plant.
The steps taken to ensure preparedness and manage emergencies at the plant are set out in the NEK protection and disaster relief plan (NEK PDRP, Revision 38). The NEK PDRP and the protection and rescue plans in the event of a nuclear disaster of the municipalities of Krško and Brežice, the Posavje region and the Republic of Slovenia represent an organisationally and functionally integrated system that ensures the coordinated management of emergencies at the power plant and in the environment, and between the power plant and the environment.
Measures that will be implemented in the event of an emergency at the power plant include operational-technical measures in the power plant’s technological process, notification of the general public, professional and administrative institutions about an emergency, and the proposal of immediate protective measures for the population, if required, and radiological and other protective measures at the site of the power plant. The organisational structure of the power plant and the aforementioned measures are set out in the NEK PDRP, which is coordinated with local municipalities, and the national protection and disaster relief plan in the event of a nuclear or radiological accident.
The ministry estimates that the impact of the lifetime extension and the overall impact on the risk of environmental and other accidents during operation will be “3” (impact not significant) as a result of the mitigation measures referred to in points II./1 ~~and 2~~ of the operative part of this environmental protection consent and the other measures referred to in the environmental impact assessment report which NEK is already implementing in order to reduce impacts on the surrounding area and prevent accidents (and which it will have to continue to implement during extended operation).

After NEK ceases operating, the fuel will no longer be in the reactor, but stored safely in the spent fuel pool and/or in the dry storage for spent fuel. The decommissioned area will still have limited access, be marked out and considered a radiologically monitored area. All activities associated with activity termination will be carried out in accordance with the requirements of regulations, the management system and written work procedures and instructions. After NEK ceases operation, measurements of radiation parameters and all the protective measures that prevent radiation leakage into the environment will continue to be implemented.
The ministry estimates that the impact of the lifetime extension and the overall impact on the risk of environmental and other accidents will be “3” (impact not significant) if the extension is abandoned, as a result of the statutory mitigation measures NEK is already implementing, the other non-statutory mitigation measures that NEK implements in order to minimise impacts on the surrounding area and prevent accidents, and mitigation measures for other components of the environment (water, waste, ionising radiation).

F) Impact on the population and human health

F1) Expected impacts during operation and the conditions

NEK’s current level of production does not surpass the limit values of substance emissions and radiation into the environment. It is not expected that the limit values will be surpassed during the planned extension of operational lifetime of NEK either. The limit value is the prescribed level whose aim is to avoid, prevent or reduce harmful effects on human health or the environment as a whole. NEK implements, and will continue to implement after the changes, all the measures to reduce burdens and prevent pollution of the environment and the impact on human health, which stem from regulations. Regular monitoring is also carried out in keeping with applicable prescriptions and permits.
Changing the current activity (operational lifetime extension) will not cause changes to natural and

other conditions for life and habitation near the site of the extension and further afield.
During the extended operational lifetime, there will be regular monitoring throughout NEK, which is already being carried out now – measurements of river water pumping for process purposes, measurements and analyses of wastewater discharged into the sewage system, and measurements of radiation.

The ministry estimates that the impact of the lifetime extension and the overall impact on the population and human health during operation will be “3” (impact not significant) as a result of the mitigation measures referred to in points II./1 ~~and 2~~ of the operative part of this environmental protection consent and the other measures referred to in the environmental impact assessment report that NEK is already implementing in order to reduce impacts on the surrounding area (and which it will have to continue to implement during extended operation).

If the lifetime extension is abandoned, emissions of substances and radiation will be significantly lower than described for the period of operation. The fuel will no longer be in the reactor, but stored safely in the spent fuel pool and/or in the dry storage for spent fuel. After NEK ceases operation, measurements of radiation parameters and all the protective measures that prevent radiation leakage into the environment will continue to be implemented.
The ministry estimates that the impact of the lifetime extension and the overall impact on the population and human health if the extension is abandoned is “3” (impact not significant) as a result of the statutory mitigation measures that NEK is already implementing, the other non-statutory mitigation measures that NEK implements in order to minimise impacts on the surrounding area and prevent accidents, and mitigation measures for other components of the environment (water, waste, ionising radiation).

Monitoring the status of impact mitigation factors and measures

Waters
Wastewater collected in the CTF drain sump must be sampled and analysed in the event of leakage from the HI-STORM concrete storage overpack (which also contains glycol in winter). The drain sump is a deepened space in the spent fuel dry storage building that is part of the reception area in which full, multi-purpose containers are moved from one overpack to another. In any HI-STORM leakage event, the water collected in the drain sump should be sampled and analysed in line with the provisions of the Rules on initial measurements and operational monitoring of wastewater (Official Gazette of RS, Nos. 94/14, 98/15) and the Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system.

<u>Use of water for process purposes</u>
Method: measurements of amount of water abstracted*
Methods: in accordance with legislation and water permits
Location: sampling locations specified in water permits
Timetable: continuous
* Partial Water Permit no. 35536-31/2006-16 of 15 October 2009, and the Decision on the Modification of the Water Permit no. 35536-54/2011-4 of 8 November 2011, Decision no. 35536-26/2011-9 of 23 May 2013, Decision no. 35530-7/2018-2 of 22 June 2018, Water Permit no. 35530-100/2020-4 of 14 November 2020, and Water Permit no. 35530-48/2020-3 of 9 September 2021.

<u>Wastewater</u>
Method: measurements of pollution parameters and wastewater quantities performed by an authorised wastewater monitoring contractor
Methods: in accordance with the Rules*, the Decree**, and the environmental protection permit***
Locations: measuring points in accordance with the environmental protection permit***
Timetable: operational monitoring in accordance with the Decree* and the environmental protection

permit**

* Rules on initial measurements and operational monitoring of wastewater (Official Gazette of RS, Nos. 94/14 and 98/15)
** Decree on the emission of substances and heat in the discharge of wastewater into waters and the public sewage system (Official Gazette of RS, Nos. 64/12, 64/14 and 98/15)
*** Environmental protection permit concerning emissions into waters issued by the Slovenian Environment Agency, no. 35441-103/2006-24 of 30 June 2010, which was amended by decision no. 35441-103/2006-33 of 4 June 2012 and decision no. 35444-11/2013-3 of 10 October 2013.

In order to determine whether the concentrations of sedimentary matter and undissolved substances are due to the power plant or to elevated concentrations in the Sava, measurements of parameters at the entrance to the system should be carried out if the conditions in the Sava at the time of sampling clearly indicate elevated concentrations of sedimentary matter and undissolved substances. The measurements at the inflow must be carried out at the same time as the measurements at outlets V1-1, V7-7 and V-7-10, at the inflow with coordinates y=540294, x=88198.

Air
Due to the possibility that the auxiliary boilerhouse may operate for more than 300 hours per year, which falls under the regime of monitoring emissions set out in the Decree on the emission of substances into the atmosphere from medium-sized combustion plants, gas turbines and stationary engines (Official Gazette of RS, Nos. 17/18 and 59/18), a one-off measurement of emissions must be performed by an authorised laboratory (dust, smoke number, CO, NOx, SO_2).

Noise
Method: measurements performed by an authorised contractor
Methods: in accordance with the Rules*
Locations: determined by the authorised contractor in accordance with the Rules*
Timetable: once every three years in accordance with the Rules*

* Rules on the initial measurement and operational monitoring of noise from noise sources and on the conditions for implementation (Official Gazette of RS, No. 105/08)

Electromagnetic radiation
Method: measurements performed by an authorised contractor
Methods: in accordance with the Rules*
Locations: determined by the authorised contractor in accordance with the Rules*
Timetable: once every three years in accordance with the Rules*

* Rules on initial measurements and operational monitoring of sources of electromagnetic radiation and on the conditions for implementation (Official Gazette of RS, Nos. 70/96, 41/04 [ZVO-1] and 17/11 [ZTZPUS-1]).

Ionising radiation
NEK carries out very extensive monitoring of radioactive emissions and immissions as defined in the Radiological Effluent Technical Specification (RETS), Revision 10.
The document describes the systems for monitoring liquid and airborne emissions, locations, and frequency of monitoring. NEK monitors radioactive emissions in all systems where radioactivity might occur during operation. Sampling points, monitoring frequency, and type of analysis for liquid and gaseous emissions are described in Tables 3.11-1 and 3.11.-2, respectively.

Table 6: Programme of measurements of liquid emissions:

Type of discharge	Sampling frequency	Minimum analysis frequency	Type of analysis	LLD[(1)] (B_q/m^3)
1. Occasional one-off discharge[(2)] Waste monitor tank (WMT) no. 1	P Each individual tank	P Single discharge	Main gamma emitters[(3)], I-131, H-3	1.9×10^4 3.7×10^4 3.7×10^5
Waste monitor tank (WMT) no. 2	P Each individual tank	M	Dissolved and captured gases (gamma emitters)	3.7×10^5
Turbine building, condensate transfer tank (CTT)	P Each individual tank	M Composite[(4)]	H-3 Total alpha activity	3.7×10^5 3.7×10^3
Drain tank in the component-cooling building	P Each individual tank	Q Composite[(4)]	Sr-89, Sr-90, Fe-55 C-14	1.9×10^3 3.7×10^4 1.9×10^3
1. Continuous discharges[(5)]	Continuous[(5)] For ESW P, S – SGBD Sampling	W composite[(5)] ESW W composite[(4)] SGBD	Main gamma emitters[(3)], H-3	1.9×10^4 3.7×10^5
Steam generator blowdown (SGBD) system discharges	P-SGBD Sampling	P composite[(4)] SGBD	Dissolved and captured gases	3.7×10^5
Essential service water (ESW) discharges	P-SGBD Sampling	M – composite[(4)] SGBD	H-3 Total alpha activity	3.7×10^5 3.7×10^3
	P-SGBD Sampling	M – composite[(4)] SGBD	Sr-89, Sr-90, Fe-55	1.9×10^3 3.7×10^4

Note: sampling frequencies: S – at least once every 12 hours, P– prior to every discharge, M – monthly, Q – quarterly, Note: for 1.c, 1.d, and 2b, only major gamma emitters and H-3 (for H-3 in ESW composite samples, the minimum analysis frequency is monthly).

(1) LLD – lower limit of detection

(2) A one-off discharge is a discharge of liquid waste in a limited quantity. Prior to sampling for analysis, the discharge must be isolated and the contents mixed to ensure a representative sample.

(3) The main gamma emitters to which the LLD refers are: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141. Ce-144 must also be measured; the LLD is 1.85 x 105 Bq/m^3. There are other radionuclides that may occur in addition to the ones listed above, and they must also be identified and reported. Such radionuclides are e.g. Cr-51, Zr-95, Ag-110m, Sb-124, I-131, I-133, I-135 and Ba-140.

(4) A composite sample is a sample that is proportional in quantity to the discharged liquid and is obtained using a sampling method that ensures it is representative.

(5) Continuous discharges are discharges of liquid waste that do not have a predetermined volume and flow continuously, e.g. from a system during discharge.

(6) In order for the samples to be representative of the quantities and concentrations in the discharge, they must be collected continuously in proportion to steam flow. Prior to analysis, all samples must be mixed to ensure that the composite sample is representative of the discharge.

Table 7: Programme of measurements of gaseous emissions

Type of discharge	Sampling frequency	Minimum analysis frequency	Type of analysis	LLD(1) (B_q/m^3)
1. Gas decay tank	P Individual tank One-off sample	P Individual tank	Main gamma emitters(2)	3.7 x 10^6
2. Containment	P; W One-off sampling each discharge and venting(3)	P; W One-off sampling each discharge and venting(3)	Noble gases Main gamma emitters(2)	3.7 x 10^6
3.a Discharge from the ventilation channel(6) (including FHB and AB)	W(3)(4)	W(3)	Main gamma emitters(2)	3.7 x 10^6
	Continuously(3) or at a minimum W	W(3) Noble gas spectrometry	Main gamma emitters(2)	3.7 x 10^4
	Continuously Continuously	M M	H-3 (oxide) C-14	3.7 x 10^3 3.7 x 10^1
3.b Discharge from the fuel handling building (FHB) ventilation channel	M(5)	M	Main gamma emitters(2)	3.7 x 10^6
3.c Discharge from the condensate ejector(6)	W One-off sampling	W	Main gamma emitters(2)	3.7 x 10^6
4.a Ventilation channel (plant vent)(6) 4.b Fuel handling building (FHB) 4.c Auxiliary building (AB) 4.d. RW repository 4.e Decontamination building(6)	Continuously	W(7) Sampling of charcoal filters	I-131	0.037
	Continuously	W(7) Sampling of particulates	Main gamma emitters(2)	0.37
5.a Ventilation channel (plant vent)(6) 5.b Decontamination building(6)	Continuously	M Composite, Sampling of particulates	Total alpha activity	0.37
	Continuously	Q Composite, Sampling of particulates	Sr-89, Sr-90	0.37
Containment	Continuously	P, W Charcoal filter	I-131	0.037
	Continuously	P each discharge W, sampling of particulates	Main gamma emitters(2)	0.37

Note: sampling frequencies: S – at least once every 12 hours, P – prior to each discharge, W – weekly, M – monthly, Q – quarterly.

(1) LLD – lower limit of detection

(2) The main gamma emitters to which LLD refers are: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135 and

Xe-138 in discharges of noble gases, and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141 and Ce-144 in discharges of iodine and particulates. There are other radionuclides that may occur in addition to the ones listed above, and they must also be identified and reported.
(3) Sampling and analysis must also be carried out after a forced shutdown, start-up, or a change in thermal power if the change exceeds 15% of the rated thermal power in one hour.
(4) Single H-3 samples from the ventilation system must be taken at least once every 24 hours when the refuelling channel is filled with water or during the purge of the containment.
(5) Single samples must be taken from the spent fuel pool exhaust at least once every seven days when spent fuel is in the pool.
(6) The ratio between the flow of air that is being sampled and the flow of air already sampled must be known for all periods when doses or dose rates are calculated.

Samples should be changed at least once every 7 days and analysed no later than 48 hours after replacement or removal from the sampler. Sampling must also be carried out at least once every 24 hours for at least seven days after each shutdown, start-up, or a change in thermal power if the change exceeds 15% of the rated thermal power in one hour. Samples should be analysed no later than 48 hours after sampling. If samples are collected for 24 hours and then analysed, the LLD may be greater by a factor of 10. This requirement does not apply if:
(1) analyses show that the equivalent dose concentration of I-131 in the reactor coolant did not increase by more than a factor of 3 and
(2) noble gas monitors show that the activity in the effluents did not increase by more than a factor of 3.

At the same time, extensive monitoring of radioactivity in immissions is carried out in the vicinity of NEK. The monitoring includes all transmission routes by which a person can receive a dose:

- the Sava (water, sediments, and aquatic biota);
- water supply network and boreholes;
- pumping stations and catchments;
- precipitation and depositions;
- air;
- external radiation;
- soil;
- food – milk, fruit, garden crops and field crops.

A detailed programme with sampling locations, sampling frequency, and required types of analyses is described in Table 3.12.-1 in RETS. Table 8 refers to a programme of measurements from the existing table in RETS and the additional measurements that will be included in the new revised RETS (request for amendment 21-2, Revision 02, RETS Change package: Modernisation of RETS with valid legislation and harmonisation with the actual sampling state as of 31 August 2021).

Table 8: Programme of monitoring radioactivity in the vicinity of NEK – immissions

1. Water, Sava

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using gamma-ray spectrometry	1. Krško – 4 km upstream from NEK	- water and suspended solids - filter	composite sample collected over 31	once every 92 days	4
				once every 92 days	4
	2. Above the Brežice HPP dam,			once every 31 days	12

	7.2 km downstream from NEK*	residue	consecutive days	once every 31 days	12
	3. Brežice – 7.8 km downstream from NEK			once every 31 days	12
				once every 31 days	12
	4. Jesenice na Dol. – 17.5 km downstream from NEK			once every 31 days	12
				once every 31 days	12
Tritium (H-3), specific analysis with scintillation spectrometer	1. Krško	aqueous distillate	composite sample collected over 31 consecutive days	once every 31 days	12
	2. Above the Brežice HPP dam*			once every 31 days	12
	3. Brežice			once every 31 days	12
	4. Jesenice na Dol.			once every 31 days	12
Strontium Sr-90/Sr-89, specific analysis (radiochemical isolation of Sr-90/Sr-89, detection with proportional counter)	1. Krško	- water and suspended solids - filter residue	composite sample collected over 31 consecutive days	once every 92 days	4
				once every 92 days	4
	2. Above the Brežice HPP dam*			once every 31 days	12
				once every 92 days	4
	3. Brežice			once every 31 days	12
				once every 92 days	4
	4. Jesenice na Dolenjskem			once every 31 days	12
				once every 92 days	4

* Measurements from the operational radioactivity monitoring programme to account for the construction of Brežice HPP, started in July 2017 in the vicinity of NEK.

2. River Sava – water, sediments and aquatic biota

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using gamma-ray spectrometry	1. Left bank, 0.5 km upstream from NEK	one-off sampling: - water and suspended solids - sediments, - fish	once every 92 days	once every 92 days	12
	2. Left bank at Brežice, 4–7.8 km downstream from	one-off sampling: - water and	once every 92 days	once every 92 days	12

	NEK	suspended solids - sediments, - fish			
	3. Above the Brežice HPP dam, 7.2 km downstream from NEK	one-off sampling: - water and suspended solids - sediments, - fish	once every 92 days	once every 92 days	12
	4. Right bank at Jesenice, 17.5 km downstream from NEK	one-off sampling: - water and suspended solids - sediments, - fish	once every 92 days	once every 92 days	12
	5. Two samples on both banks of the reservoir between river profiles 120 and 121	one-off sampling: water	once every 31 days	once every 31 days	24
		one-off sampling: sediments	once every 31 days	once every 31 days	24
	6. Replacement habitat RH1	one-off sampling: water	once every 92 days	once every 92 days	4
	7. Brežice HPP reservoir	fish	once every 182 days	once every 182 days	2
	8. Podsused	one-off sampling: sediments fish (2 samples)	once every 92 days once every 182 days	once every 92 days once every 182 days	4 2
Strontium Sr-90/Sr-89, specific analysis	1. Left bank, 0.5 km upstream from NEK	one-off sampling: - water and suspended solids - sediments, - fish	once every 92 days	once every 92 days	12
	2. Left bank at Brežice, 4-7.8 km downstream from NEK				12
	3. Above the Brežice HPP dam, 7.2 km downstream from NEK				12
	4. Right bank at Jesenice, 17.5 km downstream from NEK				12
	5. 2 samples on both banks of the reservoir between the river profiles	one-off sampling: water	once every 31 days	once every 31 days	24
		one-off sampling:	once every 31 days	once every 31 days	24

	120 and 121	sediments			
	6. Replacement habitat RH1	one-off sampling: water	once every 92 days	once every 92 days	4
	7. Brežice HPP reservoir	fish	once every 182 days	once every 182 days	2
	8. Podsused	one-off sampling: sediments	once every 92 days	once every 92 days	4
Tritium (H-3), specific analysis with scintillation spectrometer	1. Left bank, 0.5 km upstream from NEK	aqueous distillate	once every 92 days	once every 92 days	4
	2. Left bank at Brežice, 4–7.8 km downstream from NEK		once every 92 days	once every 92 days	4
	3. Above the Brežice HPP dam, 7.2 km downstream from NEK		once every 92 days	once every 92 days	4
	4. Right bank at Jesenice, 17.5 km downstream from NEK		once every 92 days	once every 92 days	4
	5. Two samples on both banks of the reservoir between river profiles 120 and 121		once every 31 days	once every 31 days	24
	6. Replacement habitat RH1		once every 92 days	once every 92 days	4
	7. Podsused[47]		once every 182 days	once every 182 days	2
C-14	5. 2 samples on both banks of the reservoir between the river profiles 120 and 121	one-off sampling: - water and suspended solids	once every 92 days	once every 92 days	8
	7. Brežice HPP reservoir	one-off sampling: fish	once every 182 days	once every 182 days	2

Note: Gamma-ray spectrometry and strontium analysis in water and in solid samples. Podsused is a location in Croatia where H-3 in the water is also analysed.
* Measurements from the operational radioactivity monitoring programme to account for the construction of Brežice HPP, started in July 2017 in the vicinity of NEK.

3. Water supply systems, boreholes

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope	1. Krško (water	individual	once every	once every	4

analysis using gamma-ray spectrometry	supply system)	sample	92 days	92 days	
	2. Brežice (water supply system)				4
	3. Inside the NEK perimeter fence, borehole 0071				4
	4. Medsave borehole (Croatia)[47]	one-off water sampling	once every 31 days	once every 31 days	12
	4. Šibice borehole (Croatia)[47]		once every 31 days	once every 31 days	12
Strontium Sr-90/Sr-89, specific analysis	1. Krško (water supply system)	individual sample	once every 92 days	once every 92 days	4
	2. Brežice (water supply system)				4
	3. Inside the NEK perimeter fence, borehole 0071				4
	4. Medsave borehole (Croatia)[47]	one-off water sampling	once every 31 days	once every 31 days	12
	5. Šibice borehole (Croatia)[47]		once every 31 days	once every 31 days	12
Tritium (H-3), specific analysis with scintillation spectrometer	1. Krško (water supply system)	individual sample	once every 92 days	once every 92 days	4
	2. Brežice (water supply system)		once every 92 days	once every 92 days	4
	3. Inside the NEK perimeter fence, borehole 0071		once every 92 days	once every 92 days	4
	4. Groundwater near NEK on the left bank of the Sava (VOP-4)		once every 31 days	once every 31 days	12
	5. VOP-1/06 borehole (ARAO)		once every 31 days	once every 31 days	12
	6. V-7/77 borehole (NEK)		once every 31 days	once every 31 days	12
	6. V-12/77 borehole (NEK)		once every 31 days	once every 31 days	12
	8. Medsave borehole (Croatia)[47]	one-off water sampling	once every 31 days	once every 31 days	12
	9. Šibice borehole (Croatia)[47]		once every 31 days	once every 31 days	12

4. Pumping stations, catchments

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements

Isotope analysis using gamma-ray spectrometry	1. Pumping station Krško - Rore 2. Pumping station Krško–Brege 3. Dolenja vas catchment 4. Pumping station Brežice VT1 (new) 5. Pumping station Brežice 481 6. Petruševac pumping station (Croatia)	composite samples	once per day	once every 31 days	6 x 12
Tritium (H-3), specific analysis with scintillation spectrometer			once per day	once every 31 days	6 x 12
Strontium Sr-90/Sr-89, specific analysis			once per day	once every 31 days	6 x 12
			once per day	once every 31 days	6 x 12

Note: In Brežice, sampling is only performed at active pumping stations that supply the water supply network.

5. Precipitation and depositions

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using gamma-ray spectrometry	1. Stara vas (Krško) 2. Brege 3. Dobova	composite sample collected over 31 consecutive days	once every 31 days	once every 31 days	3 x 12
Tritium (H-3), specific analysis with scintillation spectrometer					3 x 12
Strontium Sr-90/Sr-89, specific analysis					3 x 12

SLD = Straight-line distance

6. Depositions – vaseline slides

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using gamma-	7 sampling points at	monthly composite	continuous sampling for 31	once every 31 days	3 x 12

ray spectrometry	iodine pumps and the orchard next to NEK. 3 groups of locations	sample from 3 groups of locations, i.e. a month-long sample from an individual location at elevated values	days		

7. Air

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Measurement of I-131 (gamma-ray spectrometry)	1. Sp. Stari Grad SLD = 1.8 km, 4C1 2. Stara vas (Krško) SLD = 1.8 km, 16C 3. Leskovec SLD = 3 km, 13D 4. Brege SLD = 2.3 km, 10C 5. Vihre SLD = 2 km, 8D 6. Gornji Lenart SLD = 5.9 km, 6E 7. Spodnja Libna SLD = 1.3 km, 2B	continuous pumping through a glass fibre filter and a charcoal filter (15 days)	once every 15 days	once every 15 days	7 x 24
Strontium Sr-90/Sr-89, specific analysis	1. Libna or Stara vas SLD = 1.4 km or 1.8 km	filter residue continuous pumping through an aerosol filter	once every 92 days	once every 92 days	4
Isotope analysis of particulates and aerosols using gamma-ray spectrometry	1. Sp. Stari Grad SLD = 1.8 km, 4C1 2. Stara vas (Krško) SLD = 1.8 km, 16C 3. Leskovec SLD = 3 km, 13D 4. Brege SLD = 2.3 km, 10C 5. Vihre SLD = 2 km, 8D 6. Gornji Lenart SLD = 5.9 km,	continuous pumping through the aerosol filter (filter is changed every 31 days or when clogged)	once every 31 days	once every 31 days	8 x 12

	6E 7. Spodnja Libna SLD = 1.3 km, 2B 8. Dobova SLD = 12.0 km, 6F				
C-14 in CO_2 in air	2 locations inside the NEK perimeter fence	CO_2 absorbed on NaOH as Na_2CO_3	once every 2 months	once every 2 months	2 x 6

8. External radiation dose and dose rate

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Dose measured using environmental passive dosimeters in a ring around NEK	67 measuring points in Slovenia, of which 57 are arranged in circles at distances of 1.5 to 10 km from NEK, and 9 measuring points on the NEK fence – a total of 66 measuring points in the vicinity of NEK and 1 measuring point in Ljubljana; 10 in Croatia	TL dosimeter, at least 2 per measuring point	once every 182 days	once every 182 days	134 in Slovenia 20 in Croatia
Measurement of speed gamma radiation doses	at least 10 measuring points surrounding NEK	network with automatic operation		continuous measurement	constant monitoring

Note: NEK performs dose measurements with OSL dosimeters at six points on the site fence. At the same locations neutron dosimeters are used to also measure the neutron dose.

9. Land

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using	1. Amerika, SLD = 3.2 km, flood	one-off	once every	once every 6	2 x (3 x 4)

gamma-ray spectrometry	plain, brown alluvial deposits 2. Trnje (Kusova Vrbina), SLD = 8.5 km, flood plain, grey alluvial soil 3. Gmajnice (Vihre) SLD = 2.6 km, flood plain, brown alluvial deposits	sampling of soil from 4 depths 0–5 cm, 5–10 cm, 10–15 cm, 15–30 cm one-off sampling: alluvial deposits, pasture or arable land	6 months	months	
Strontium Sr-90/Sr-89, specific analysis (radiochemical isolation of Sr-90/Sr-89, detection with proportional counter)					2 x (3 x 4)

10. Food – milk

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using gamma-ray spectrometry	1. Pesje 2. Drnovo 3. Skopice	one-off sampling every 31 days	once every 31 days	once every 31 days	3 x 12
Strontium Sr-90/Sr-89, specific analysis		one-off sampling every 31 days			3 x 12
I-131, specific analysis		one-off sampling every 31 days during the grazing period – 8 months			3 x 8

11. Food – fruit

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using gamma-ray spectrometry	selected locations on the Krško Polje/Brežiško Polje, specifically an orchard near NEK, Sremič, Leskovec	one-off sampling of various seasonal fruits: apples, pears, currants, strawberries, grapes, wine	once every 365 days	once every 365 days	10
Strontium Sr-90/Sr-89, specific analysis					10

12. Food – garden and field crops

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements

Isotope analysis using gamma-ray spectrometry	selected locations on the Krško Polje/Brežiško Polje: Brege, Žadovinek, Vrbina, Sp. Stari Grad, Trnje	one-off seasonal sampling of broad-leaved garden and field crops: lettuce, cabbage, carrots, potatoes, tomatoes, parsley, beans, onions, wheat, barley, corn, hops	once every 365 days	once every 365 days	20
Strontium Sr-90/Sr-89, specific analysis					20

* Dobova is a reference sampling point.

13. Food – meat, poultry and eggs

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Isotope analysis using gamma-ray spectrometry	selected locations on the Krško Polje/Brežiško Polje: Žadovinek, Vrbina, Sp. Stari Grad, Pesje	one-off sampling of various meat and eggs	once every 365 days	once every 365 days	6
Strontium Sr-90/Sr-89, specific analysis					6

14. Food – C-14 measurements

Type and description of measurement	Sampling point	Type of sample	Sampling frequency	Frequency of measurement	Annual no. of measurements
Carbon C-14	selected locations on the Krško Polje/Brežiško Polje: the orchard next to NEK, Vrbina, Žadovinek, Brege, Spodnji Stari Grad, Dobova* (up to 17 locations)	Samples of seasonal garden crops, field crops and various fruit	twice every 365 days	twice every 365 days	35

Immission measurements are performed by authorised environmental monitoring contractors in accordance with the Rules on the monitoring of radioactivity (Official Gazette of RS, No. 27/18). A report on radioactivity monitoring in the vicinity of NEK, which includes dose estimations for reference population groups, is compiled every year. In 2020, the conservatively estimated annual effective dose for the most exposed individuals was less than 0.071 µSv.

Although C-14 has been the largest contributor to the dose for several years, the monitoring programme in the Rules on the monitoring of radioactivity (Official Gazette of RS, No. 27/18) only requires five measurements of C-14 in cereal samples. In previous years, and most recently in 2019 (I. Krajcar Bronić: Report on measurements of C-14 activity around NEK in 2019, LNA-5/2020, Institut Ruđer Bošković, Institute for Experimental Physics, Laboratory for Measuring Low-Level Activity, 9 January 2020), NEK has ordered measurements of 34 plant samples (vegetables, fruit) from which an estimate of dose can be made. A programme of such measurements should be incorporated into the regular monitoring programme (added to RETS). Since H-3 is also an isotope whose emissions into the environment are measurable and contribute to the dose, it makes sense to determine H-3 (organically bound tritium) in the same samples used to determine C-14.

The one-off evaluation of the possible impact on the environment or persons based on OBT (organically bound H-3) measurements is an integral part of reporting to administrative bodies and is also envisaged by NEK in 2021. Various expert works have already been published in connection with this, for example: Report on OBT intercomparison from IRB, Ruđer Bošković Institute, I. Krajcar Bronić workshops on the subject of OBT in Romania 2019; and Interlaboratory comparison and OBT measurements in biota in the environment of NPP Krško, a conference about radiation measurements in 2019 in the Czech Republic, R. Krištof, J. Kožar Logar, A. Sironić, I. Krajcar Bronić.

In the Republic of Croatia, measurements of the Sava are performed at a location in Podsused, while measurements of external radiation are performed at 10 locations. In 2018 and 2019, NEK also financed measurements of H-3 in continuous samples from the Petruševec pumping station, which is the largest potable water pumping station for the city of Zagreb. An article (J. Barešić, J. Parlov, Z. Kovač, A. Sironić: Use of nuclear power plant released tritium as a groundwater tracer, The Mining-Geology-Petroleum Engineering Bulletin, 2020) notes that H-3 values at Petruševec have increased, which is to be expected. Since this is the largest pumping station for the city of Zagreb, the location should be incorporated into the radioactivity monitoring programme (RETS). In addition to H-3, measurements of Sr-89/90 and gamma emitters should also be performed at the site using high-resolution gamma-ray spectrometry.

As follows from the report titled “Monitoring of radioactivity in the vicinity of NEK, Report for 2019” (Inštitut Jožef Stefan, IJSDP-12784, March 2020), measurements of fish samples using high-resolution gamma-ray spectrometry are performed at Podsused and Otok sites (four samples at each site) in Croatia. Measurements of groundwater are also performed in the Republic of Croatia at the Medsave and Šibice sites (high-resolution gamma-ray spectrometry, Sr, H-3). In addition, sediment (gamma emitters and Sr-90) is measured at the Podsused site. These measurements are not listed in RETS, although they have been carried out for a number of years. Measurements of sediments and fish at the Podsused site therefore need to be stated in or incorporated into the regular monitoring programme.

Monitoring of radioactive emissions follows the water transport path of the Sava. All sampling points are located under the NEK dam, except for the point near the VIPAP VIDEM KRŠKO cellulose plant. Sporadic measurements of OBT (organically bound H-3) in vegetation on the right bank of the Sava near the NEK dam (above the spillways) indicate increased OBT activity concentrations. It is not clear whether this is caused by airborne or liquid discharges from NEK. It is possible that released radioactivity does not fully drain through the spillways, and that stagnation and even counterflow of surface water occur on the right bank of the river. The study “Tritium in organic matter around Krško Nuclear Power Plant” (R. Krištof et al., J. Radioanal. Nucl. Chem., 2017, 314:675-679) showed that OBT activity concentrations in vegetation along the southwestern perimeter of NEK are higher than at other points along the perimeter. This is the result of airborne transport from NEK, where H-3 predominates in the form of the HTO molecule, which is part of the water cycle. Increased values were observed after an outage. These observations could be grounds for a change in radioactivity monitoring. Since the model of radioactivity dispersion along the Sava will be defined in the terms of reference for the "Impact of Brežice HPP on NEK and the Environmental Impact Assessment Report for the extension of NEK's operational lifetime" (public invitation to tender published on the Slovenian public procurement portal on 16 February 2021, public contract no. JN000870//2021-E01), the findings of the study should be included in the radioactivity monitoring programme. Following construction of Mokrice HPP, it will be necessary to review the radioactivity monitoring programme for the Sava.

Spent fuel dry storage
The construction of the spent fuel dry storage building will require additional external radiation monitoring. Currently, NEK is measuring the dose rate of ionising radiation with six passive optically stimulated luminescence (OSL) dosimeters at measuring points on NEK fence. After the construction of the spent fuel dry storage building, passive dosimeters will also be installed in the northwestern and southwestern corners of the storage area of the building. The upper dosimeter will be placed just below the roof, the lower dosimeter above the height of the partition wall, and the middle dosimeter halfway in height between the upper and lower dosimeter. Three dosimeters will therefore be installed in each of the two corners, or a total of six dosimeters in the dry storage building. Additional passive dosimeters will be installed on the NEK perimeter: one at a site nearest to the dry storage building and three more on each side of the first dosimeter at a distance of 10 m from each other. The dosimeters will measure neutron and gamma radiation doses, and will be read or changed at least once every six months. Even before construction starts, baseline monitoring will be conducted using the existing OSL dosimeter closest to the dry storage. The proposed scope of monitoring may be changed after a certain period of measurements.
According to calculations, the total dose (due to the operation of the dry storage and other NEK activities) on the fence will not exceed the limit value of 200 μSv.
During the transfer of spent fuel from the fuel building to the dry storage building, a temporary controlled area will be established along the transfer route and measurements of radiation parameters carried out.

Radioactivity monitoring following the construction of Brežice HPP
Since July 2017, NEK has been conducting additional radioactivity monitoring of the Sava to account for the impacts of the construction and operation of Brežice HPP. In addition to the usual sampling locations, radioactivity is measured on both sides of the reservoir, at the Brežice HPP dam, in the replacement habitat, and in additional boreholes. With the damming of the Sava, the flow and dispersion of radioactivity in the river have changed, as additional monitoring has shown. There was no increase in liquid radioactive discharges from NEK. The model currently in use is based on the "Exposure of the reference population group to radiation from liquid discharges from NEK into the Sava" study (IJS working report no. IJS-DP-10114, January 2009 (authors B. Pucelj, M. Stepišnik)). As mentioned above, the study "Impact of Brežice HPP on NEK and the Environmental Impact Assessment Report for the extension of NEK's operational lifetime", is being carried out. The results of this project will show whether it is necessary to change the radioactivity monitoring programme for the Sava.

<u>III. Explanation relating to an assessment of the acceptability of an activity affecting the environment</u>
The first paragraph of Article 39 of the Rules provides that, in line with the size and characteristics of an activity affecting the environment, an assessment of the acceptability of such activities shall be carried out as part of the procedure for the granting of (1) an environmental protection consent for an activity affecting the environment that has an environmental impact, (2) a natural conservation consent for an activity affecting the environment that does not have an environmental impact, (3) a permit for an activity affecting the environment as defined in Article 43 of these Rules or (4) a permit

under other regulations for activities affecting the environment for which a consent or permit referred to in the preceding three indents is not required.

For the lifetime extension, for the requirements of stage II of the assessment of the acceptability of plans and activities affecting the environment in protected areas and in accordance with the Rules, the Supplement Assessing the Acceptability of the Impacts on Protected Areas for the Extension of NEK's Operational Lifetime from 40 to 60 Years – Nuklearna elektrarna Krško d.o.o., order no.: 1456-20 VO, October 2021, updated January 2022 (AQUARIUS d.o.o. Ljubljana, cesta Andreja Bitenca 68, 1000 Ljubljana) was drawn up.
According to the Decree on the classification of buildings, the NEK complex is a built industrial complex. According to the Rules, complex industrial buildings are defined in Chapter II of Annex 2 as: areas of production activities that are areas of direct impact (100 m) for all groups, and areas of remote impact (1,000 m) for birds, bats, aquatic and riparian habitat types, and beetles. The only Natura 2000 area within the area of remote impact is the Vrbina SAC (SI3000234). The distance of the area from the planned activity (lifetime extension) is approx. 350 m. The stretch of Sava 8 km downstream from NEK has been declared a Natura 2000 area (Lower Sava SAC, SI3000304).

After studying the documentation referred to, the ministry found that the impact of the lifetime extension during operation on the Vrbina SAC (SI3000234) would not be significant ("B"), neither would it be significant on the Lower Sava SAC (SI3000304) as long as the mitigation measures were carried out ("C"). The ministry included the measures as conditions in the operative part of this environmental protection consent (conditions set out in point II/1 Conditions for the protection of surface waters, groundwater and the natural environment, including from the standpoint of climate change).

The seventh paragraph of Article 105 of the Nature Conservation Act (Official Gazette of RS, Nos. 96/04 [UPB], 61/06 [ZDru-1], 8/10 [ZSKZ-B], 46/14, 21/18 [ZNOrg], 31/18 and 82/20) provides that if an environmental impact assessment is prescribed for the construction of a structure referred to in the first paragraph of this article in accordance with the regulations governing environmental protection, an environmental protection consent shall be issued in place of a nature conservation consent. The second paragraph of Article 39 of the Rules provides that when an assessment of the acceptability of an activity affecting the environment is carried out as part of a procedure for granting an environmental protection consent, a nature conservation consent shall be deemed to have been granted at the same time as the environmental protection consent. The decision was therefore reached as per point III of the operative part of this Decision.

Pursuant to the eighth paragraph of Article 61 of the ZVO-1, an environmental protection permit ceases to be valid if, within five years of its entry into force, the applicant fails to begin carrying out construction activities in the area, or fails to obtain a building permit (if a building permit is required pursuant to the regulations on construction). The ministry has therefore decided as per point IV of the operative part of this environmental protection consent.

Costs

Pursuant to the fifth paragraph of Article 213 in conjunction with Article 118 of the ZUP, it was also necessary to decide on the costs of the procedure in the operative part of this permit. In view of the fact that no costs arose in this procedure, the ministry decided as per point V of the operative part of this environmental protection consent.

According to the second paragraph of Article 230 of the ZUP, an appeal against a decision issued by the ministry in the first instance is only permitted when the law allows. That law must also determine which authority is competent to decide on the appeal. If no determination is made, the appeal is decided upon by the government. Although the ZVO-1 does not provide for an appeal against the decision, an administrative dispute may be initiated.

Notice of legal remedy:
While this decision admits no appeal, an administrative dispute may be filed at the Administrative Court of the Republic of Slovenia within 30 days of delivery of the decision. The action shall be submitted directly with the competent court or sent by post.

Prepared by:

Ana Kezele Abramović
secretary

Vesna Kolar Planinšič
Head of the environmental assessment section

To be delivered to:
- the developer: Nuklearna elektrarna Krško, d.o.o., Vrbina 12, 8370 Krško – in person.

Also sent as per the eleventh paragraph of Article 61 of the ZVO-1 to:
- Inspectorate of the Republic of Slovenia for the Environment and Spatial Planning, Environment and Nature Inspection Service, Dunajska 58, 1000 Ljubljana – by email (gp.irsop@gov.si).
- Municipality of Krško, Cesta krških žrtev 14, 8270 Krško – by email (obcina.krsko@krsko.si);
- …..