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PROJECT:

Long term operation of Krško NPP (2023-2043)

Krško, 22 February 2021, Rev. 1

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Abbreviations:

AAF	Alternative Auxiliary Feedwater
AMP	Aging Management Program
ARSO	Slovenian Environment Agency
ASI	Alternative Safety Injection
BB1,2	Bunkered Building 1 or 2
BS OHSAS 18001:2007	Occupational Health and Health Assessment Series
CDF	Core Damage Frequency
CT3	Cooling Towers
DBF	Design Basis Flood
DEC TS	Design Extension Conditions Technical
DEH	Digital Electro Hydraulic
DG3	Diesel Generator 3
ENSREG	The European Nuclear Safety Regulators Group
EU	European Union
FHB	Fuel Handling Building
HTS	High-Temperature Seals
IAEA	International Atomic Energy Agency; see MAAE
IG	Spent Fuel
ISO 14001:2015	Environmental Management System
ISO 45001:2018	Occupational Health and Safety System Management System
JV5	Rules on Radiation and Nuclear Safety Factors
JV9	Rules on Operational Safety of Radiation and Nuclear Facilities
LTO	Long-term Operation
MAAE	International Atomic Energy Agency; see IAEA
MD1	Safety bus bars 1
MD2	Safety bus bars 2
MOP	Ministry of the Environment and Spatial Planning
NEK	Krško Nuclear Power Plant
NEK MD-2	Management System – Process Organization
NEPN	Integrated National Energy and Climate Plans of the Republic of Slovenia
OSART	Operational Safety Review Team
OVS	Environmental Consent
PCFVS	Passive Containment Filtering Vent System
PDEH	Programmable Digital Electro Hydraulic
PGA	Peak Ground Acceleration
PMF	Probable Maximum Flood
PNV	Safety Upgrade Program
PP	Screening
PSA	Probabilistic Safety Assessment; see VVA
PSR	Periodic Safety Review
PVO	Environmental Impact Assessment
RAO	Radioactive Waste
RETS	Radiological Effluent Technical Specifications
RH	Republic of Croatia
RS	Republic of Slovenia
RTP	Distribution Transformer Station
SFDS	Spent Fuel Dry Storage (IG)
SK	Supercompacting
TS	NEK Technical Specifications
Uredba PVO	Decree on Activities affecting the Environment that require an Environmental Impact Assessment
USAR	Updated Safety Analysis Report NEK
URSJV	Slovenian Nuclear Safety Administration
VVA	Probabilistic Safety Assessment; see PSA

VZD	Safety and Health at Work
ZVISJV-1	Ionizing Radiation Protection and Nuclear Safety Act
ZVO-1	Environmental Protection Act
WANO	World Association of Nuclear Operators
WENRA	Western European Nuclear Regulators

1. Summary

Nuklearna elektrarna Krško, d.o.o. (referred to as: NEK, Krško Nuclear Power Plant or Krško NPP) with an output power of 696 MWe produces approximately 38% of total Slovenian electricity, which represents about half of total low-carbon electricity in Slovenia.

In 1983, NEK obtained a license for regular operation and went into commercial business. At the time of construction, the minimum operational life span of the facility was projected at forty years, however, many safety and other upgrades have been carried out and numerous analyses conducted to date, from which it follows that in terms of climate protection, reduction of greenhouse gas emissions, phasing out the use of fossil fuels, safety and efficiency, the extension of NEK operational life span is a prudent solution that is well established across the globe too. Technical conditions were thus created for NEK to operate at least another twenty years, i.e. to the end of 2043.

NEK operates on the basis of operating license [3], which is directly related to the NEK safety report [2], containing all the conditions and limits for the safe operation of the nuclear power plant. NEK has a valid open-ended operating license, meaning it is technically capable of operating at least until 2043, provided that, in accordance with the applicable legislation, it performs a Periodic Safety Review (referred to as: PSR) every ten years and obtains approval by the administrative body, Slovenian Nuclear Safety Administration (referred to as: SNSA). NEK shall ensure all aspects for the safe operation of the nuclear power plant.

NEK operates in accordance with the legislation of the Republic of Slovenia and within operating limits set out in the Ionizing Radiation Protection and Nuclear Safety Act (referred to as: ZVISJV -1) and subordinate acts, the operating license [3], the NEK Technical Specifications (referred to as: TS) [7], the Radiological Effluent Technical Specification (referred to as: RETS) [9] and the Design Extension Conditions Technical Specifications (referred to as: DECTS) [8], water permit [5], environmental permit [4] and similar. The extension of the operational life span will enable NEK to be in operation for another twenty years, until 2043, within exactly the same limits and not exceeding any existing legal requirements or restrictions.

Owing to continual upgrades and modifications that have been and will be carried out, the ensured safety level is significantly higher than at the time when the power plant was built. Following the completion/implementation of the Safety Upgrade Program (referred to as: PNV) [21], NEK will be comparable to the new 3rd generation nuclear power plants. Safety standards and requirements in the nuclear industry are much stricter than in any other existing technology, which is why nuclear technology is now the safest way to produce electricity known to mankind [55].

In accordance with Decision No. 35405-286/2016-42 of 2 October 2020 [1], issued by the Slovenian Environment Agency (referred to as: ARSO), NEK must obtain environmental consent (referred to as: OVS) for extending the operation from 2023 to 2043. The procedure for acquiring the OVS is carried out in accordance with the Environmental Protection Act (referred as: ZVO-1) [36].

In the process of acquiring the OVS, the provisions of the Aarhus [39] and Espoo [38] conventions should be taken into account, meaning that a cross-border assessment procedure will be carried out as well.

2. Introduction

2.1. General about NEK

Nuklearna elektrarna Krško, d.o.o. (referred to as: NEK, Nuclear Power Plant or Krško NPP) with an output power of 696 MWe produces approximately 38% of total Slovenian electricity, which ranks it among the top Slovenian electricity producers.

As per the Interstate Treaty [26] NEK exports half of its electricity to the Republic of Croatia (referred to as: RH). The production of electricity is in the base-load mode (constant operation at 100%) and ensures the stability of the power system. As NEK does not release any greenhouse gases during electricity production, it is classified as a low-carbon production facility. The Slovenian share of the electricity produced by NEK represents about half of total low-carbon electricity in Slovenia.

NEK operates in accordance with the following decisions: Approval to Commence NEK Operation, Decision by the Energy Inspectorate of RS No. 31-04/83-5 of 6 February 1984, Amendment to NEK Operating License, Decision by the Slovenian Nuclear Safety Administration (referred to as: URSJV) No. 3570-8/2012/5 of 22 April 2013 [3], and NEK Updated Safety Analyses Report (referred to as: USAR) [2].

2.1.1. Safe, Reliable and Competitive Production of Electricity

In 1983, NEK obtained a license for regular operation and went into commercial business. At the time of construction, the minimum operational life span of the facility was projected at forty years, however, many safety and other upgrades have been carried out and numerous analyses conducted to date, from which it follows that in terms of safety and economy, the extension of NEK operational life span is a prudent solution that is well established across the globe too. Technical conditions were thus created for NEK to operate at least another twenty years, i.e. to the end of 2043.

NEK's major priority is to ensure reliable and safe operation. Since its construction, NEK has carried out a number of upgrades to enhance the safety and efficiency of the facility. The effects of many years of investments show in greater efficiency of production processes, resulting in an increase in electricity production – from 4.5 TWh/year to 5.45 TWh/year. This significant increase can be attributed to numerous investments in the secondary section of the nuclear power plant, such as extending the nuclear fuel cycle up to 18 months, shortening regular outage times, preventive replacement of equipment and updates in work processes. The said increase in production, which on average results in an additional 1,000 GWh/year in domestic electricity production without CO_2 emissions, is equivalent to the optimum annual production by all eight hydropower plants on the lower part of Sava River.

NEK operates safely and meets the strictest environmental and industrial standards.

2.1.2. Nuclear Safety is the First Priority

In nuclear power plants, safety always comes first. The existing international safety standards and requirements applicable to the nuclear industry are much stricter than with any other existing technology for the production of electricity. To meet all these requirements, the existing nuclear power plants have numerous and diverse nuclear safety systems in place, which during three generations of their development have achieved a very high reliability and efficiency level. Nuclear technology complies with the latest international safety standards, which is why it is now the safest way of electricity production known to mankind [55].

Compliance with and meeting safety requirements applicable to the nuclear industry undergo standardized international and national monitoring procedures in the form of different inspections and international assessment missions.

Many international missions, which focus on all aspects of operation with the greatest emphasis on nuclear safety, regularly assess NEK. The inspections are carried out by the following bodies: the International Atomic Energy Agency (referred to as: IAEA), the World Association of Nuclear Operators (referred to as: WANO or INPO) and others. After the WANO safety review, NEK was classified in the first performance class as one of the best nuclear power plants on a global scale.

In the last 10-year period, the following missions took place at NEK:

Special Safety Review (EU Stress Tests) in 2012, IAEA – Topical Peer Review Aging Management in 2018, OSART – Operational Safety Review Team conducted by the IAEA in 2017, and WANO Expert Review in 2014 and 2018.

Special Safety Review (EU stress tests)

In the framework of the EU stress tests, conducted by the European Commission following the Fukushima accident in March 2011, NEK was the only nuclear power plant in Europe without being issued any recommendations, which placed it at the very top of European power plants. The results of the report show that NEK is well designed and built and, taking into account its additional equipment installed, it demonstrates a high preparedness level in case of severe accidents. NEK carried out an in-depth analysis of beyond design basis accidents and produced the Safety Upgrade Program (referred to as: PNV) [21] that is approximately EUR 300 million worth. The PNV program that has been approved by the Slovenian Nuclear Safety Administration [21] comprises a number of improvements and additional systems for managing beyond design basis accidents. Following the implementation of the safety upgrade program, NEK will, in terms of safety, be comparable with the newer types of nuclear power plants that are presently built around the world.

One of the major safety upgrades in progress is the construction of a dry storage building for spent nuclear fuel. The dry storage system allows spent nuclear fuel to be transferred into special canisters and storage casks that provide passive cooling and shielding against ionizing radiation.

Operational Safety Review by the International Atomic Energy Agency (OSART)

In 2017, the International Atomic Energy Agency (referred to as IAEA) conducted its fourth Operational Safety Review Team (referred to as: OSART) mission. As Slovenia is a member of the IAEA, the Government of the Republic of Slovenia must approve formal procedures, such as an invitation sent to such a mission. The Slovenian Nuclear Safety Administration (referred to as: URSJV) reports to the Government on the findings and submits the OSART mission report. There were three such missions carried out at NEK in the past: in 1984, 1993 and 2003.

In the report, the OSART mission members emphasized that after the 2017 OSART mission NEK systematically analyzed all given recommendations and proposals, and prepared a plan of corrective actions. The OSART mission has concluded that the implemented measures, as well as those in progress, fully meet the recommendations and proposals given by the original OSART mission. The URSJV regularly checks the implementation status of the OSART measures in additional meetings and inspections. All measures were implemented by the middle of 2019.

WANO Peer Review in 2014 and 2018

In 2014, the World Association of Nuclear Operators (referred to as: WANO) conducted a comprehensive operational review. NEK received the highest overall rating for nuclear safety and operational preparedness. This was already the fourth verification of this type (the previous ones took place in 1995, 1999 and 2007).

In the last review in 2018, the mission members highlighted the above-average implementation of the recommendations, originating from international operational experience and achievements in the field of safety culture, which represents a set of principles that serve as guidance on the work procedures in nuclear facilities and are considered the foundation of safe and stable operation.

The performance and quality of the full scope simulator for operating personnel training was pointed out as one of the good practice cases that sets an example to other nuclear power plants.

The highest overall assessment for nuclear safety and operational efficiency represents an additional commitment for further improvements in the field of management, communication, internal policies, work-related goals and cooperation in order to meet all expectations.

2.2. Energy Future of Slovenia is based on Long Term Operation of NEK

To ensure a reliable energy supply, Slovenia will have to combine different sources of electricity, which, in terms of their efficiency and considering their environmental impact, will be sufficient to cover the estimated future electricity consumption. Due to the planned increase in electrification of traffic (use of electric vehicles), heating (use of heat pumps), and electrification and phasing out the use of fossil fuels in other sectors, Slovenia will require an ever increasing share of stable energy in the form of electricity. According to numerous estimates (Integrated National Energy and Climate Plans of the Republic of Slovenia; referred to as: NEPN) [12], deficit in electricity will continue to rise in Slovenia (for several years now, Slovenia has been importing electricity to cover for about 20% of its consumption). By 2030, Slovenia will have a deficit of at least 1 TWh of electricity, regardless of development of technology, significantly more efficient use of electricity and intensive introduction of new renewable energy sources (referred to as: OVE). The energy should either be imported or provided through implementation of new power plants, which in such a short time cannot even be spatially planned, let alone built and put into operation.

The key target of the NEPN [12] is to reduce greenhouse gas emissions by 2030, as determined for Slovenia in the Effort Sharing Regulation, i.e. at least by 20% compared to 2005, and even more restrictive figure for the energy sector, i.e. by 34%. Pursuing the set goals, the production of electricity by fossil fuel power plants should also be reduced. To be able to follow the guidelines on CO_2 and/or greenhouse gas reduction, fossil fuel power plants are expected to be gradually closed down.

As a signatory to the Paris Agreement, Slovenia has committed itself to reducing greenhouse gas emissions by 40% by 2030 as compared to the 1990 quantity. Reducing greenhouse gas emissions and phasing out the use of fossil fuels are being further tightened and accelerated due to the new EU commitments. In light of the aforementioned facts, NEK gains on importance, as it does not need fossil energy sources for operation and does not release any greenhouse gases during operation. On 28 February 2020, the Government of the Republic of Slovenia approved the NEPN which envisages the extension of the operational life span of NEK until 2043. Both scenarios (scenario with the existing measures and the NEPN scenario) plan that NEK continues to produce electricity at least until 2043.

3. Description of the Existing Situation in 2021

3.1. NEK Location, Siting, Overview of Plots

NEK 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 the area of long-term energy use on the left bank of the Sava River. 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 in Gauss-Kruger coordinates x = 88353.76 m and y = 540326.67 m.

When Krško polje was recognized as a potential location for the construction of a nuclear power plant, a work team of the Slovenian Energy Association carried out the initial research in the period from 1964 to 1969. The investors of the first nuclear power plant were *Savske elektrarne Ljubljana* and *Elektroprivreda Zagreb*, which together with the investment group carried out preparatory works, made a call and selected the most favorable bidder.

In August 1974, the investors entered into a contract with the American company Westinghouse Electric Corporation for the supply of equipment and construction of a 632 MW nuclear power plant. The nuclear power plant was designed by Gilbert Associates Inc., the contractors at the construction site were the domestic companies *Gradis* and *Hidroelektra* while the assembly was performed by the *Hidromontaža and Đuro Đaković* companies.

On 1 December 1974, the foundation stone was laid for the Krško Nuclear Power Plant (NEK). In February 1984, NEK obtained a permit for regular operation [3]. The area has good road and rail connections available, as it is located near the intersection of regional roads and in the immediate vicinity of the railway line.

The nearest residential areas are located northeast (buildings in Spodnji Stari Grad), at a distance of approximately 700 m, north (buildings in Spodnja Libna) at a distance of approximately 850 m and approximately 1.4 km southwest (Žadovinek) from the site of the planned project.

The nearest kindergartens (*Vrtec Krško, Vrtec Dolenja vas*) 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.

The following companies operate north of the location:

- SECOM d.o.o., main activity: 22.230 (Manufacture of builders' ware of plastic);
- GEN energija d.o.o., main activity: 64.200 (Activities of holding companies);
- GEN-I d.o.o., main activity: 35.140 (Electricity trading);
- Saramati Adem, d.o.o., main activity: 41.200 (Construction of residential and non-residential buildings).

The following company operates east of the location:

- KOSTAK d.d. *Center za ravnanje z odpadki* (*IED Naprava*), main activity: 36.000 (Water collection, treatment and supply).

At a distance of 800–2,000 m from the location, there are three IEDs: VIPAP VIDEM KRŠKO d.d., KRKA d.d. and KOSTAK d.d. (an IED device is a device that can cause large-scale pollution). Currently, there are no higher or lower risk plants (Seveso) in the area of the Krško town.

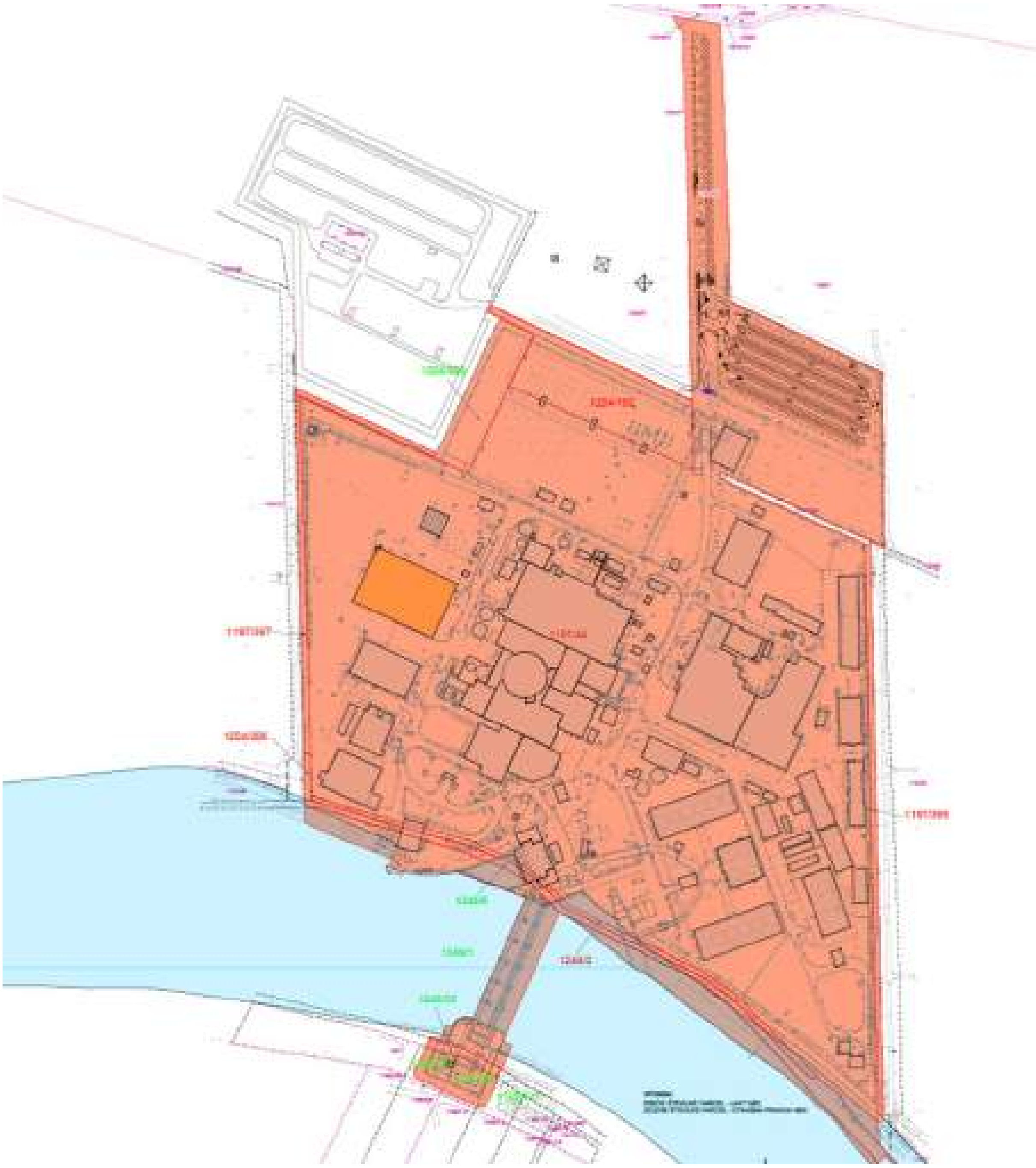


Figure 1: Area of assessed facilities

The area of environmental impact assessment comprises the following plot numbers in the cadastral municipality 1321 Leskovec:

- plots owned by NEK: 1197/44, 1204/192, 1197/397, 1246/2, 1197/398 (partially) and 1204/206 (partially)
- parts of plots, on which NEK holds building right: 1204/209, 1246/6, 1249/1, 1246/33, 1195/107, 1195/109, 1195/111

In terms of spatial planning, NEK is regulated by the Development Plan of the Krško Nuclear Power Plant (Official Gazette of the Republic of Slovenia, No. 48/87, Official Gazette of the Republic of Slovenia, No. 59/97 and Official Gazette of the Republic of Slovenia 21/2020).

3.1.1. Seismic Safety

The Reactor Site Criteria 10 CFR 100 App., applied in the design and construction of NEK, require buildings, components and systems of importance for nuclear safety be designed and constructed as earthquake-resistant structures, which is also in accordance with Slovenian legislation (JV5 Rules, [66]). The buildings and systems of the Krško Nuclear Power Plant are designed to resist earthquakes for design basis seismic loading with 0.3 g peak ground acceleration at foundation.

The stress tests at NEK [44] have verified that accelerations during an earthquake, at which the impacts on the structures and systems of the power plant could be expected, are significantly higher than the design basis accelerations, which demonstrates high nuclear and seismic safety of NEK nuclear facilities. Subsequently, seismic and nuclear safety was additionally enhanced through the construction of the third diesel generator system DG3, the implementation of the power plant safety upgrade program, where peak ground acceleration at surface being twice the design basis acceleration at foundation of the existing facilities and systems was taken into account.

In compliance with the US regulatory guidelines, NEK has a built-in seismic instrumentation (11 sensors) for earthquake shock detection to allow a comparison of response spectra (calculated from the measured accelerograms) with the design basis response spectra at the locations of individual sensors. In case the peak ground acceleration at open surface exceeds 0.01 g, the sensors record ground motion from the earthquake. If such an event occurs, all critical parts of the power plant are checked after the earthquake. If earthquake intensity, expressed with peak ground acceleration on the open surface, exceeds half the maximum design basis acceleration, the power plant shuts down as a precaution and is restarted only after no damage to buildings, systems or equipment of the nuclear power plant resulting from the earthquake is confirmed.

The stress test report provides an estimate of the seismic magnitude at which damage to the core, the containment and the cliff edge effect could occur. Ground accelerations at which damage to reactor core could occur have been estimated in the range of 0.8 g peak ground acceleration (PGA). Ground accelerations at which early major releases could occur should be in excess of 1.0 g PGA. Any subsequent filtered releases could occur in the range of ground accelerations between 0.8 and 0.9 g. The integrity of the spent fuel pool would not be compromised up to ground accelerations in excess of 0.9 g [44]. Seismic analyses have shown that earthquakes with a PGA greater than 0.8 g are very rare at the nuclear power plant location and have the expected return period estimated at more than 50,000 years.

3.1.2. Floods

Flood protection was carried out during designing the nuclear power plant and constructing the embankments of the Sava River upstream and downstream of the power plant. The entrances and openings of the buildings are built above the altitude of the estimated 10,000-year floods. The nuclear power plant is safe in case of a design basis flood, even if there were no protective embankments built.

In addition to the design basis flood (referred to as: DBF), the nuclear power plant is also protected against probable maximum floods (referred to as: PMF) with appropriately designed intermediate structures placed between the Sava River and the external devices, and the protective embankment against water intrusion into the area.

The area is also protected with the basic design and a built-in drain system to withstand extremely heavy local rain and storms. Further data is available in the stress test report [44].

Design Basis Floods (DBF)

NEK was designed against floods with a frequency of 0.01% per year (the return period of such an event is statistically determined at 10,000 years). The estimated maximum flow of Sava River in this period amounts to 4,790 m^3/s, which corresponds to an elevation of 155.35 meters above the Adriatic Sea (m.a.A.s.l.). The NEK plant yard is situated at elevation 155.20 m.a.A.s.l. The entrances and openings of the buildings in NEK complex, located in the center of the area and shown in Figure (Figure 1), are situated above the level of 155.50 m.a.A.s.l. This prevents water from intruding into the buildings in case the embankments along the Sava River would fail.

Probable Maximum Floods (PMF)

In addition to design basis floods (a 10,000-year return period), NEK is also protected against probable maximum floods (PMF). A PMF refers to a hypothetical flood considered to be the most severe, reasonably possible flood by using maximum probable precipitation and other hydrological factors, contributing to maximum water outflow, such as successive storms and simultaneous snowmelt.

The cliff edge effect for floods is estimated at the Sava River flows, which are 2.3 times higher than the design basis 10,000-year flood and 1.7 times higher than the PMFs. The annual probability for the flows of such size is estimated at less than 10^{-6} [44].

3.1.3. Other Extreme Weather Conditions

NEK prepared a technical report Screening of External Hazards [56], which provides a review of external hazards, i.e. all external hazards, other than earthquakes, and all other hazards not included in internal events, internal floods, internal fires and high-energy piping breakdowns.

External hazards, included in the screening, are summarized from the report EPRI– Identification of External Hazards for Analysis in WENRA Issue T: Natural Hazards, Guidance Document.

The review of external hazards has shown that all external hazards were duly taken into account in the NEK analyses and procedures, which is why no amendments to the existing model of probabilistic safety assessments (PSA) are necessary.

All external hazards (except air crashes, external floods, strong winds, ice and extreme drought) were reviewed taking into account the defined criteria, which is why no separate further assessment of their quantitative contribution to the core damage frequency (CDF) has been required.

3.2. NEK Technology

NEK produces heat by fission of uranium nuclei in the reactor. The reactor consists of a reactor vessel with nuclear fuel elements that form a core. In the primary circuit, purified water with the added boric acid circulates through the reactor. The pressurized water removes the released heat into the steam generators. In the steam generators, the steam is generated on the secondary side, which drives the turbine and this powers the electric generator. After the steam leaves the turbine, it condenses in a condenser cooled by the Sava River water. The condensate is then pumped back into the steam generators where it vaporizes again. The water from the Sava River flows through the condenser (the so-called tertiary circuit), where it condenses the steam and carries the excess energy away into the Sava River. The complete equipment of the reactor and the associated primary cooling circuit is located in the reactor building, which on account of its function is also called the containment.

During operation, the reactor pressure vessel, containing the nuclear fuel elements, is tightly closed and pressurized. The nuclear power plant must be shut down prior to carrying out the planned change of nuclear fuel. The period between two nuclear fuel changes is called a nuclear fuel cycle, which at NEK takes 18 months. At the end of each nuclear fuel cycle, spent nuclear fuel elements are replaced with the fresh ones.

3.2.1. Primary Circuit

The primary circuit consists of a reactor, two steam generators, two reactor pumps, a pressurizer and pipelines.

The heat released in the reactor core heats the water circulating in the primary circuit. The heat of the water is transferred through the pipe walls in the steam generators to the water in the secondary circuit. Two reactor pumps stimulate water circulation in the primary circuit. The pressurizer maintains the pressure in the primary circuit and prevents water from boiling in 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.

3.2.2. Secondary Circuit

The secondary circuit consists of two steam generators, a turbine, a generator, a condenser, feed pumps and pipelines. The two steam generators basically act as heat exchangers, converting the water of the secondary circuit into steam, which drives the turbine, where the steam energy is converted into mechanical energy. The generator converts this energy into electricity and transfers it to the electricity grid via transformers.

The spent steam from the turbine flows into the condenser where in contact with cold pipes it condenses and is converted into water. The feed pumps push the water from the condenser back into the steam generator, which generates the steam again.

3.2.3. Tertiary Circuit

The tertiary circuit consists of a condenser, cooling pumps, cooling towers and pipelines. The tertiary circuit removes the heat, which cannot be usefully utilized for electricity production, and is required for condenser cooling. The cooling pumps push the water from the Sava River into the condenser and return it back to the Sava River. When the water flows through the condenser, it warms up, as it absorbs the heat from the spent steam. The major impact NEK has on the environment is warming up the Sava River water, which can affect the biological properties of the Sava River. This impact is limited by administrative decisions specifying the permitted temperature increase [4] and the amount of water diverted [5]. In case of adverse weather conditions, the cooling towers are used. In extremely unfavorable weather conditions, the power of the nuclear power plant has to be reduced to keep the set values within the specified limits.

3.2.4. Basic Technical Data about the Facility

The following tables provide the basic technical data about the facility.

Table 1, *Table 2*, Table 3, Table 4, Table 5, Table 6, Table 7.

Table 1: Basic technical data about power plant

Reactor type:	Light-water pressurized reactor
Reactor thermal power:	1994 MW
Gross electrical output:	727 MW
Net electrical output:	696 MW
Thermal efficiency factor:	36.6 %

Table 2: Basic data about nuclear fuel

Number of fuel assemblies:	121
Number of fuel rods per assembly:	235
Fuel rod array in fuel assembly:	16 x 16
Length of fuel rods:	3,658 m
Cladding material:	Zircaloy-4, ZIRLO
Chemical composition of fuel:	UO_2
Total weight of nuclear fuel:	48.7 t

Table 3: Basic data about reactor coolant

Chemical compositions:	H_2O
Additives:	H_3BO_3
Number of cooling loops:	2
Pressure:	15.41 MPa (157 ata)
Temperature at reactor vessel inlet:	287 °C
Temperature at reactor vessel outlet:	324 °C

Table 4: Basic data about control rods

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

Table 5: Basic data about steam generators

Material:	INCONEL 690 TT
Number of steam generators:	2
Steam pressure at outlet:	6.5 MPa (63.5 ata)
Total steam mass flow:	1088 kg/s

Table 6: Basic data about turbine and generator

Maximum power:	730 MW
Steam flow rate:	1090 kg/s
Inlet pressure of fresh steam:	6.4 MPa (63 ata)
Temperature of fresh steam:	280.7 °C
Turbine speed:	157 rad/s (1500 rev./min)
Steam moisture at inlet:	0.10 %
Condenser pressure (vacuum):	5.1 kPa (0.052 ata)
Average condensate temperature:	33 °C
Rated power of generator:	850 MVA
Rated voltage:	21 kV
Rated frequency of generator:	50 Hz
Rated cos ø:	0.876

Table 7: Basic data about transformers

Main 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

3.2.5. Safety Systems

Safety systems prevent the uncontrolled release of radioactive substances into the environment. Already in the reactor and nuclear power plant design phase safety was paid full attention. 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:

- efficient reactivity control (reactor power control),
- nuclear fuel cooling in the reactor,
- retention of radioactive substances (prevented release of radioactive substances into the environment).

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

- **The first barrier** is nuclear fuel (or fuel pellets) retaining radioactive substances within itself.
- **The second barrier** is a waterproof cladding that encloses fuel pellets and prevents leakage of radioactive substances from fuel.
- **The third barrier** is the primary system boundary (pipe walls, reactor vessels and other primary components) that retains 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 substances from passing to the next barrier, whereas the fourth barrier prevents radioactive substances from being released directly into the surroundings of the nuclear power plant.

Since the operation of safety systems in case of a defect and failure or even an unlikely incident at a nuclear power plant is paramount, all safety systems are of double type (NEK has two lines of safety systems in place). To comply with safety conditions and maintain safety barriers, the operation of only one line of safety systems is always sufficient. Furthermore, all safety systems and/or their individual devices are systematically tested during the operation of the power plant and regular overhauls.

3.2.6. Ensuring Safety Functions

During operational states, design basis accident and extended design condition, NEK must ensure the so-called critical safety functions:

- monitoring nuclear fuel reactivity (and spent fuel pool and/or spent fuel storage),
- heat removal from the core and spent fuel pool and/or storage, and
- retention of radioactive substances and prevention of their uncontrolled spreading into the environment.

In ensuring safety functions, the following principles should be taken into consideration:

- the principle of in-depth defense;
- single failure criterion;
- the principle of independence;
- the principle of diversity;
- the principle of redundancy;
- the fail-safe principle;
- the principle of verified components;
- the principle of a graded approach.

NEK must regularly check the design bases that ensure the safety of the facility. A review of design bases should also be performed during each periodic safety review and after operational events affecting radiation or nuclear safety, as well as upon releasing new relevant information about radiation or nuclear safety (e.g. site characteristics assessment, safety analysis and development of safety standards or practice).

In reviewing design bases, deterministic and probabilistic safety analyses or engineering audit are applied to identify needs and potential for improvement, whereby the design solutions are compared with the prescribed requirements and good practice. NEK uses the findings from these analyses in updating its systems and structures accordingly or implements other measures necessary for ensuring radiation and/or nuclear safety.

Moreover, by analyzing extended design conditions, NEK ensures there are sufficient reserves available to prevent cases where a minor variation in a particular parameter could cause severe and unacceptable consequences, the cliff edge effect.

External and Internal Initiating Events

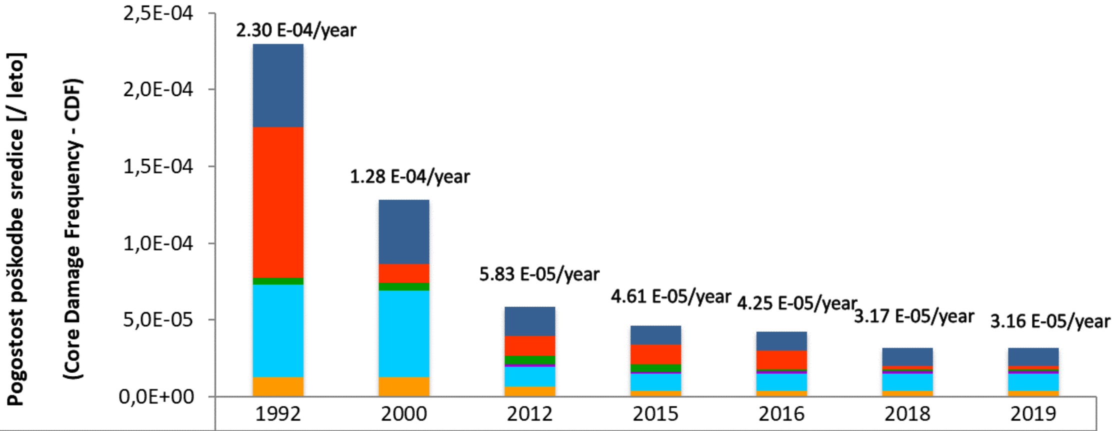
In the operation of a power plant, an initiating event is any event that can trigger a sequence of events (scenario) and can lead to undesirable consequences. Further data is available in the annual report of Probabilistic Safety Analyses [57].

General breakdown of initiating events:

a. Internal initiating events (IIE)
   Internal initiating events are divided into the following categories:

   - LOCA category or primary coolant piping system break (“Loss of Coolant Accident”);
   - Non-LOCA category includes: break of secondary side piping, transients, loss of support systems, events with loss of off-site power supply and transients without automatic reactor shutdown.

b. External initiating events in the power plant and/or internal risks, such as internal floods, internal fires and high energy line breaks (HELB).
c. External hazards /external initiating events outside of plant, such as seismic events, strong winds, external floods, aircraft crashes and other external events.



	1992	2000	2012	2015	2016	2018	2019
Internal initiating events	5,44E-05	4,20E-05	1,87E-05	1,24E-05	1,24E-05	1,20E-05	1,18E-05
Internal fires	9,78E-05	1,25E-05	1,28E-05	1,26E-05	1,26E-05	2,14E-06	2,14E-06
Internal floods	4,62E-06	4,53E-06	5,61E-06	4,87E-06	1,14E-06	1,13E-06	1,14E-06
High-energy line breaks			1,79E-06	1,39E-06	1,36E-06	1,24E-06	1,28E-06
Seismic events	6,03E-05	5,67E-05	1,29E-05	1,11E-05	1,12E-05	1,14E-05	1,14E-05
Other external initiating events	1,26E-05	1,26E-05	6,50E-06	3,73E-06	3,83E-06	3,83E-06	3,83E-06

Figure 2: History of core damage frequency due to internal initiating events, external initiating events from power plant and external initiating events outside of plant

3.2.7. Incident and Emergency Preparedness at the Nuclear Power Plant

Protection and Rescue Plan (NZIR)

NEK has prepared a special emergency plan. The Protection and Rescue Plant in NEK (referred to as: NZIR) addresses a nuclear and radiological accident at NEK.

The major purpose of planning and maintaining preparedness in an emergency is to ensure the protection, health and safety of the population in the environment and personnel at the nuclear power plant by preventing the emergency to deteriorate and/or by eliminating or mitigating the consequences of the emergency and providing the conditions for the restoration of the normal state.

NEK is competent and responsible for maintaining preparedness and taking action in an emergency in the power plant area, but also for providing information to the competent institutions on emergency status in the nuclear power plant to allow for taking protective actions in the environment.

The purpose of NEK's NZIR is to define:

1. scope of planning, prerequisite of planning and response concept;
2. NEK task forces and organization in case of an emergency, along with responsibilities and tasks for managing, coordinating and implementing the measures in emergency management as determined in advance;
3. additional support to NEK for emergency management;
4. emergency management measures, which comprise:
    - identification of emergency occurrence, hazard level classification and activation of first responders;
    - operative and corrective measures, and strategy for beyond design basis accident management;
    - assessment of nuclear safety and emergency consequences; proposals for immediate protection measures for the population;

- informing the commanders and personnel of Civil Protection (CZ) and other competent authorities in the environment about the occurrence and status of the emergency, as well as about the proposed protective actions for the population in endangered areas;
- informing the public about the emergency;
- operative and corrective measures in the nuclear power plant to eliminate or mitigate the consequence of the emergency, strategies for beyond design basis accident management;
- protective measures for protection, rescue and assistance task force in the power plant;

5. NEK assets, centers, equipment and communication facilities for emergency management;
6. professional training of NEK personnel for emergency cases and external supporting personnel for carrying out tasks in emergency management as defined in NZIR;
7. informing NEK personnel about protection and other measures in case of an emergency;
8. maintaining preparedness, coordination of NEK activities with competent local, regional and national authorities in ensuring preparedness and taking action in case of an emergency;
9. establishing the conditions for restoration of normal situation in the power plant.

Considering the results of NEK safety analyses, radioactive substances that are accumulated in the reactor core and in spent nuclear fuel are the main hazard source in the environment.

Design Basis Accidents and Design Extension Conditions (DEC)

NEK plans and maintains preparedness for the entire range of emergencies that could or would result in compromising nuclear safety of the power plant and the release of radioactive substances into the environment. This involves radiological accidents, power plant events or states that may have indirect impacts on nuclear safety in the power plant, nuclear accidents involving minimum radiological consequences in the environment and very unlikely design basis and beyond design basis nuclear accidents involving radiological consequences in the power plant and in the environment.

NEK was designed to withstand the design basis accidents and to manage them using their safety systems. Section 15 – ACCIDENT ANALYSIS of the updated USAR safety report [2] describes design basis accidents. The purpose of the analysis of postulated design basis accidents is to set the requirements and acceptable criteria for systems, structures and components (referred to as: SSK). With these requirements, SSKs are able to ensure their safety function while also the criteria for the operation during and after the occurrence are defined. The purpose of all safety systems is to protect people from releases and radiation. NEK was designed in accordance with the 10 CFR 50, Appendix A, General Design Criterion 19 exposure limits. Furthermore, NEK is continually pursuing global practice regarding model upgrade and development to improve analysis process in many technical reports. The FER-MEIS report "Calculation of Doses at Certain Distances for the Case of LOCA DBA and PCFVS Release in Case of an Emergency at NEK" [54] reflects the estimated dose for design basis accidents at certain distances from NEK.

Following the Fukushima accident, NEK carried out a series of accident analyses involving design extension conditions. These accidents are not addressed in the design bases of the nuclear power plant and/or as part of design basis accident. The analyses addressed the combinations of accidents, based on which an additional upgrade of the nuclear power plant was required (Design Extension Conditions – DEC). The upgrade took place as part of the PNV program, described in Section 3.4. on the new additional systems installed within the PNV, ensure that NEK will manage beyond design basis accidents using the extended range of equipment and upgrades. The equipment was divided into DEC-A and DEC-B equipment.

NEK can use the DEC-A equipment to prevent the reactor core from melting. The DEC-B equipment, however, is intended for managing the occurrence of a very unlikely core melting and focuses on protecting the final barrier before release, i.e. the integrity of the containment. From a statistical point of view, releases in case of core melting would not occur in about half of the cases because the radionuclides would remain in the containment. In about the second half of the cases, releases from the containment would occur through a special passive filter system (referred to as: PCFVS) that retains almost all of the radionuclides in the filters. The passive filter system serves to relieve the pressure in the containment, while harmful substances are intercepted in the filters. A direct release into the environment upon core melting is thus very unlikely.

The estimated doses at different distances from NEK in case of an emergency, where the use of the PCFV system would be expected, are given in the FER-MEIS report "Calculation of Doses at Certain Distances for LOCA DBA and PCFVS Release in case of an Emergency at NEK" [54].

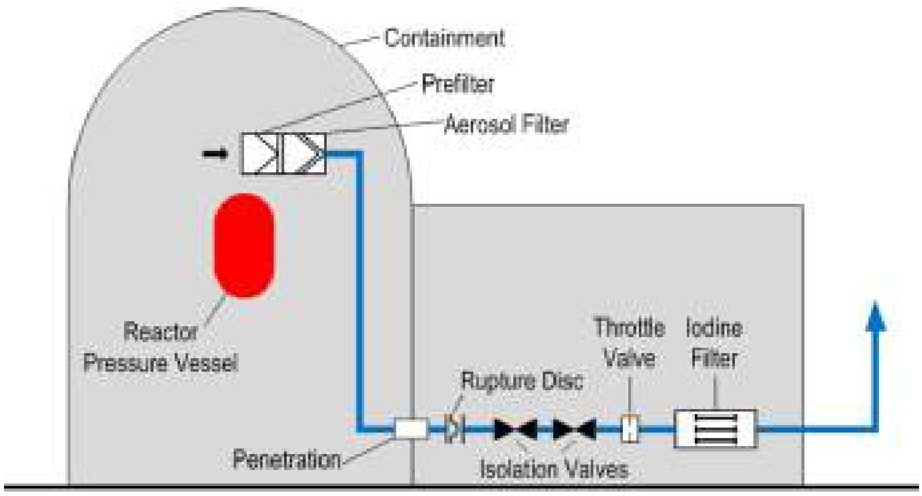


Figure 3: Schematic outline of passive filter system for containment relief

Both approaches to design basis and beyond design basis accidents are an upgrade of US regulations and in compliance with the Slovenian Ionizing Radiation Protection and Nuclear Safety Act (referred to as: ZVISJV-1) [41].

3.2.8. Aging Management Program

NEK has introduced the equipment aging program (referred to as: AMP) to monitor systems, structures and components (referred to as: SSK) during the operation of the power plant through the basic (40 years) and extended operational life span. The AMP program defines in detail the responsibilities, activities and methodology for monitoring equipment aging.

The AMP consists of various NEK programs, procedures and activities, which ensure that all planned functions of systems, structures and components managed by the AMP are identified and properly reviewed in terms of aging effects. Aging effects are closely monitored, based on which certain actions are determined that enable the SSK to fulfill their intended function by the end of NEK operational life span. The NEK AMP is designed and compliant with the NUREG-1801 – Generic Aging Lessons Learned (GALL) Report. The AMP program thus comprehensively covers the plant aging control of mechanical, electrical and construction SSK, and systematically recognizes the aging mechanisms and their effects on the SSK of significance for safety, identification of possible consequences arising from aging and for determination of emergency measures towards maintaining SSK operability and reliability.

The actual control of SSK due to aging and other activities related to the control of equipment, which are indicated in the procedures, are carried out by way of the work order system and preventive maintenance program.

The NEK aging program is thus based on 10CFR54 - "Requirements for Renewal of Operating Licenses for Nuclear Power Plants". Other activities are controlled through the so-called Maintenance Rule (10CFR50.49) and Environmental Qualification Programs (10CFR50.49). The activities of equipment replacement are contained in the long-term investment plan and maintenance activities.

3.2.9. Fire Safety

NEK has elaborated the Fire Safety Program at NEK - Fire Safety Rules [59], which defines the organization of fire safety, fire safety measures and supervision over their implementation, provides instructions for handling in case of fire and specifies a training program to support a successful fire protection.

The principle of in-depth defense is observed in the implementation of fire safety at NEK; in doing so, it is necessary to carry out the following actions:

- measures that prevent fires from occurring,
- rapid detection, control and extinguishing of any fire, and
- reducing the fire impact on critical safety functions of the nuclear power plant in a way which does not compromise the ability for a safe shutdown.

Fire safety measures are the activities that ensure the minimum probability for a fire outbreak. These include: maintenance of order and cleanliness, control of works involving thermal effects, control of combustible substances, fire permit, fire guard and fire barriers. Other precautionary and active fire safety measures involve fire-fighting procedures and the actions for the operation, maintenance, testing and technical instructions of fire-fighting systems.

Furthermore, NEK has determined measures for prevention of explosion hazards and safety of combustible waste, electrical, gas appliances and other ignition sources, as defined in the Explosion Hazard Study.

Measures for safe evacuation and rapid intervention are also defined in case undesired events occur. These include the activities: suitable evacuation routes passable at all times, knowledge of the audible alarm for evacuation, training, knowledge of the facility and understanding one’s task during evacuation, adequate lighting of evacuation routes, etc.

Other preventive and active fire safety measures include fire-fighting procedures and activities for the operation, maintenance, testing and technical instructions of fire-fighting systems.

3.2.10. Radioactive Waste

Ever since the beginning of nuclear energy use in Slovenia, the profession has been aware of both its benefits and risks. Therefore, international and Slovenian nuclear energy is subject to very strict environmental, safety and ethical standards applicable to radioactive waste management. All radioactive substances and/or all objects containing radioactive substances are under on-going control from their generation to disposal.

NEK keeps accurate records on the use of radioactive substances and always appoints persons responsible for radioactive waste as of the moment its generation begins until its final disposal. All these measures ensure a safe present and future use of nuclear energy. Experts in Slovenia have already mastered safe management technologies for all types of radioactive waste, which is why nuclear energy represents an example of a sustainable energy source.

Gaseous Radioactive Waste

A gas mixture originating from the primary cooling system and containing radionuclides of noble gases or other elements in the form of vapors and aerosols is considered as gaseous radioactive waste (referred to as: RAO). It is stored in hold-up tanks for gas decay, in which their activity reduces over time due to natural radioactive decay.

Carbon and high-efficiency particulate filters installed in the ventilation system filter the gases prior to their controlled release.

Liquid Radioactive Waste

Liquids contaminated with radionuclides, the concentration of which exceeds the value for omission of radiological control, are considered as liquid RAO.

This type of waste has a considerable share in the total amount of RAO generated in the nuclear power plant, which is why it undergoes special treatment and preparation to reduce its volume. There are several procedures and methods of liquid RAO treatment available with their choice depending on the quantity and physicochemical properties. After treatment, two separate products are obtained, namely a concentrate with the increased concentration of radionuclides and a decontaminated liquid. The concentrate is further processed to assume a solid stable form suitable for transport and storage. Decontaminated liquid and/or water is reused or released subject to radiochemical analyses, a special control and approval. The processes used for treatment of liquid RAO at NEK are listed in the table below (Table 8).

Table 8: Processes used for treatment of liquid RAO at NEK

PROCESS	Media	FORM OF WASTE
Evaporating in evaporator	Liquids	Sludge after evaporation (concentrate)
Ion exchange	Water with ionic contaminants	Spent ion exchangers (dried)
Filtering	All liquids with particles	Filter inserts

Solid Radioactive Waste

Solid RAO is waste material whose specific activity exceeds the values for omission of radiological control in accordance with the regulation governing radiation activities.

With regard to the level and type of radioactivity, solid RAO is classified into the following categories: transient radioactive, very low-level radioactive, low- and intermediate-level radioactive waste (these are further classified in the subcategories of short-lived and long-lived), high-level radioactive and radioactive waste with natural radionuclides. The most represented category in terms of quantity and consequently taking up the most space in NEK storage is the short-lived low- and intermediate-level radioactive waste.

Solid RAO includes solidified (e.g. hardened concentrate) and encapsulated RAO, filters and contaminated solid waste, such as plastics, paper, cloths, personal protective equipment, tools and machine parts.

In accordance with the Decree on Radiation Activities [69], criteria are set on the basis of which a larger amount of waste whose activities are below administrative limits can be excluded from further administrative control.

Substances and objects that do not get contaminated during their use in the radiologically controlled area, and/or may be removed from the area in small quantities after being radiologically controlled, are treated in accordance with the procedure: Removal of Equipment, Tools, Clean Substances and Samples from NEK's radiologically controlled area. In this case, the surface contamination and concentration of activity per volume unit, which corresponds to the derived concentration for drinking water according to the applicable regulations, are controlled.

The volume of non-solidified solid RAO is reduced in mechanical and chemical processes, the choice of which depends on the properties of the waste. The table (Table 9) shows the processes that are used to reduce the volume of non-solidified solid RAO.

Table 9: Processes for reducing non-solidified solid RAO

PROCESS	SUBSTANCES FOR WHICH THE PROCESS IS USED	REDUCTION FACTOR
Compressing using a low-pressure press into a barrel	Fabrics, plastics, metal, cables, small tools etc.	≤ 4
Supercompacting of barrels	Fabrics, plastics, paper, metal, smaller metal parts etc.	≤ 10
Incineration	All combustible substances	≤ 30
Pyrolysis	Combustible substances, ion exchangers	≤ 60
Melting	Metals	≤ 10
Cutting, crushing	All substances	≤ 2

Waste is stored inside the NEK fence in the radioactive waste storage building (referred to as: RSWB) and described in Section 11 of the USAR [2], titled Radioactive Waste Management. The stored waste meets special storage criteria that comply with the Rules on the Management of Radioactive Waste and Spent Fuel [68]. These Rules regulate the classification of radioactive waste according to the radioactivity level and type, radioactive waste and spent fuel management, the scope of reporting on radioactive waste and spent fuel generation, and the manner and scope of keeping central records on radioactive waste and spent fuel generation, as well as on stored and disposed radioactive waste and spent fuel.

3.2.11. Spent Nuclear Fuel

From the beginning of operation, NEK stores all spent nuclear fuel (referred to as: IG) inside the fence of power plant's technological section. In the design bases of the power plant the storage of IG was planned in the spent fuel pool (referred to as: SFP) in the fuel handling building (referred to as: FHB).

The removal of residual heat from the IG takes place in the active cooling system of the spent fuel pool and the excess heat is discharged into the Sava River. After the Fukushima accident, NEK analyzed possible improvements.

The analysis of possible improvements in nuclear fuel storage was part of the response from the nuclear industry and regulatory authorities. It follows from the conclusions of analyses and decisions from the Slovenian Nuclear Safety Administration that due to new safety requirements and extension of NEK operational life span until 2043, the introduction of dry storage for spent nuclear fuel constitutes an important safety upgrade. Due to its passive operation mode, this type of storage does not require any device, system or energy source for cooling and operation.

The main purpose of dry storage building for spent nuclear fuel is a technology upgrade in temporary IG storage. The IG dry storage technology is a safer way of IG storing, as the cooling system is of passive type. Additionally, both radiation safety and the robustness of the system are improved.

The introduction of dry spent fuel storage technology provides a safer way of IG storing in identical environmental and radiological conditions, as specified in the existing operating license. Dry storage is recognized worldwide as the safest and most widespread technological solution for IG storage. Dry storage works in a completely passive mode. In addition to the passive cooling method, better radiation safety and robustness, dry IG storage also has other benefits, arising from a better protection against intentional and unintentional negative influences and/or human acts. The proposed solution of IG dry storage technology is included in the Resolution on the National Program for Managing Radioactive Waste and Spent Fuel for the Period of 2016–2025 (ReNPRRO16–25) [28].

After a few years of cooling in the spent fuel pool, the IG is transferred into special canisters (*Figure 4: Spent fuel multi-purpose canister (MPC)*

) that are sealed and placed in a suitable overpack (for transfer, storage or transport) [31].

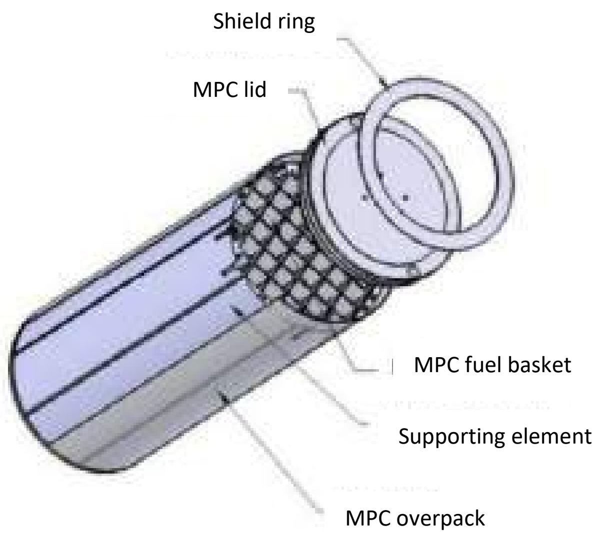


Figure 4: Spent fuel multi-purpose canister (MPC)

These canisters in special storage overpacks are then placed in the IG dry storage building (Figure 5), which is divided into several areas: manipulation, technical and storage area. Spent fuel will be kept stored in the building until a decision is made on the national strategy for the IG disposal or re-processing.

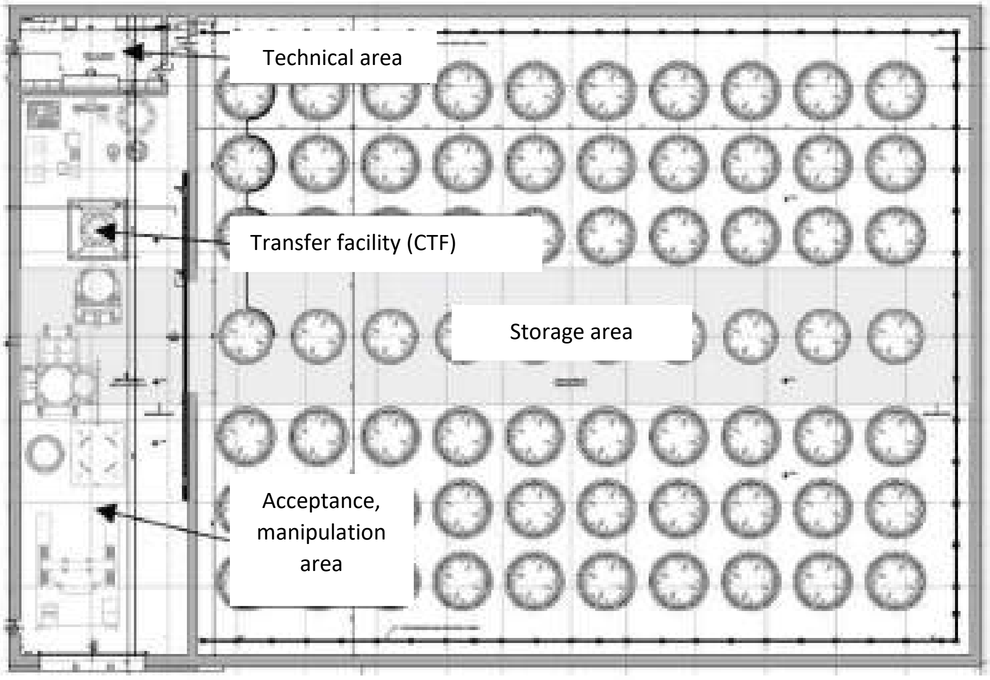


Figure 5: Floor plan of IG dry storage building

After a shutdown in the 2021 overhaul (outage), the spent fuel pool will contain 1,376 spent fuel elements. The first phase of dry storage loading follows in 2023, when the initial 592 spent fuel elements will be transferred. In the second phase the next 592 spent fuel elements (more in Section 5.2.8) will be transferred.

3.3. External Preparedness Reviews of Severe Accident Management

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 states 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 (the so-called SAMG). Furthermore, equipment was inspected and some modifications were made to allow a more appropriate response either from the equipment or personnel in case of such accidents. Some of the examples: the strategy of flooding the space under the reactor vessel (wet cavity) in case of reactor vessel melting, replacement of the lattice of the containment collector and thermal insulation of the containment piping. After purchasing a simulator for operator training and the preparation of the SAMG, NEK is able to perform emergency preparedness drills for accidents that go beyond design basis accidents too. During the drills, the functionality of the SAMG procedures was tested as well.

At the invitation from the URSJV, the RAMP mission organized by the IAEA was held at NEK in 2001. The mission reviewed the scope and adequacy of the aforementioned analyses and guidelines for severe accident management. The RAMP recommendations were partially implemented in the post-review period, while the rest of 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 case of a severe accident). As part of the action plan for periodic safety review, NEK also prepared specific documents with the instructions for emergency operating procedure (EOP), and revised the set-points on the basis of analyses for the said instructions.

The event at the Fukushima nuclear power plant is an example of a low-probability event, yet bearing extremely far-reaching consequences. The Fukushima nuclear power plant was not prepared to properly respond to such an event. One of the major lessons the nuclear industry and administrative bodies have learned on this occasion is a necessity to focus on the defense against such low-probability events.

On the basis of the second indent of the fourth paragraph of Article 112 of the Ionizing Radiation Protection and Nuclear Safety Act [41], the URSJV, in its decision, instructed NEK to propose and carry out all possible improvement measures aimed at nuclear safety, which had already been identified in Slovenian legislation, but their implementation had been postponed to the future (Article 62 of the JV5 Rules [66]). The nuclear power plant must assess the response to severe accidents in accordance with Section 1.12 of Attachment 1 to the JV5 Rules [66] and, on the basis of the results obtained, propose measures and implement them in the shortest time possible.

Already prior to the events in Japan, certain upgrades were in progress at NEK, such as the installation of a third diesel generator for safety systems powering, thereby contributing to safety enhancement while also supporting the initiatives for the upgrades following the Fukushima accident. Based on NEK's own analyses as well as the recommendations from international organizations and administrative bodies, certain short-term and long-term actions were adopted at NEK.

As part of the short-term actions, certain mobile equipment was purchased (examples: diesel generators of various power values, air compressors, water pumps, towing vehicle). Appropriate connection points for mobile equipment connection were installed on individual systems in the nuclear power plant.

As part of the long-term actions and based on the URSJV Decision [62], a thorough analysis was carried out [61] and a comprehensive upgrade program for the prevention of severe accidents and mitigation of their consequences was elaborated – NEK Safety Upgrade Program [21]. The program also comprises the proposals not included in the action plan by the power plant, originating from the Slovenian National Post Fukushima Action Plan [45] and, of course, the proposals from the Report on NEK's Emergency Preparedness [47]. Arising from the additional WENRA requirements, ([48] and [49]), and certain technical solutions developed in comparable European and global industries, NEK performed additional analyses, [50], [51], [52], [63] and [64], to prove that technical solutions are suitable and comprehensive enough for an acceptable level of severe accident prevention and mitigation.

The URSJV issued Decision No. 3570-9/2011/2 on carrying out an extraordinary periodic safety review [25]. The URSJV demanded NEK to perform an extraordinary periodic safety review, during which it must analyze the response of the nuclear power plant to exceptional external events. On 15 August 2011, NEK carried out stress tests [45] in accordance with the EU program, called the EU Stress Tests Specifications, and submitted its findings to the URSJV. The URSJV prepared a final report summarizing the most important actions [16]. Some of the key actions dealt with the possibility of a mobile 2 MW diesel generator connection, raising the Sava riverbanks as an anti-flood measure etc.

In October 2012, the European Commission published a final report containing the results of the extraordinary safety reviews of all power plants [17]. The report confirms that NEK achieves extremely good results and is adequately prepared for respond to extreme events. The report further includes an overview of recommendations for safety improvements to be carried out in individual nuclear power plants. According to this review, NEK is the only nuclear power plant that did not receive a single recommendation – also because it already carried out actions B.5.b (compiled due to the WTC attack on 11 September 2001), drew up a draft PNV and was able to prove large integrated safety reserves in terms of both seismic and flood safety.

3.4. Safety Upgrade Program (PNV)

In 2012, NEK fully completed the actions from the periodic safety review, referring to the extension of NEK operational life span. By issuing Decision No. 3570-6/2009/32 of 20 June 2012, the URSJV verified and confirmed the amendments to those parts of the NEK safety report and related documentation that until then had limited its operational life span to 40 years. The approved amendments provided the basis for the extension of NEK operational life span by additional 20 years, i.e. 60 years of commercial business in total.

In accordance with Slovenian nuclear safety legislation (JV5 Rules, [66]), analyzing the systems, structures and components in view of severe accidents is one of the key elements for extending the operation. 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 catastrophic accident at Japan's Fukushima Daiichi power plant in March 2011, this process was given high priority. Based on the URSJV Decision No. 3570-11/2011/7 of 1 September 2011, the severe accident analysis and the action program run parallel to a decision-making process on the extension of NEK operational life span. In its reasoning, the aforementioned decision specifically highlights good practice in Europe that NEK should take into account in its analysis.

The Fukushima nuclear power plant accident has made the entire nuclear industry realize severe accidents can happen, therefore technological preparedness is required to be able to prevent and manage them. The accident triggered rapid responses in all countries with nuclear technology in place. Based on the methodology prepared jointly by all countries of the European Community, the URSJV instructed NEK in Decision no. 3570-9/2011/2 of 30 May 2011 to carry out an extraordinary safety review. The report was prepared by 31 October 2011 and mainly reflects the assessment of the then nuclear safety measures in case of external emergencies and the preparation of short-term improvements proposal. In this framework additional modifications were made to allow mobile equipment connection. On 23 December 2011, the URSJV submitted the National Report on Stress Tests [16] to ENSREG and published it on its website.

Bearing adequate nuclear safety in mind, NEK has also always acted in a preventive manner and responded to important events in the nuclear industry. NEK also responded quickly and effectively in case of the Fukushima accident. The program proposed by NEK in response to the decision by the URSJV is of a long-term character and proves reasonable in the context of extending the operational life span of the nuclear power plant. The program further complies with the WENRA requirements and is comparable to the industrial practice in other European countries.

The update in safety solutions includes state-of the art technological solutions available and follows international practice (e.g. Switzerland, Belgium, Sweden, and France). This applies in particular to the reliable cooling of the core in order to ensure the integrity of the containment, management of severe accidents and cooling of spent nuclear fuel.

At NEK, the spent fuel pool, in addition to the reactor core, is the major potential source of radiological hazards to the environment in case of a nuclear accident. The spent fuel storage strategy was adapted to follow the latest events and findings from the Fukushima accident, the planned extension of the plant's operational life span and the revised Resolution on the National Program for Radioactive Waste and Spent Fuel Management for the Period of 2016 –2025 [28]. By the end of 2023, the construction project of dry spent fuel storage will be completed [31]. It will further enhance nuclear safety and minimize the risk of potential accidents in the spent fuel pool.

NEK adopted certain short-term and long-term actions derived from its own analyses and the recommendations from international organizations and administrative bodies. The short-term actions include purchase of specific mobile equipment (e.g. diesel generators of various power values, air compressors, water pumps, towing vehicle). Appropriate connecting points for mobile equipment connection were installed on individual systems in the nuclear power plant. As part of the long-term actions and based on the URSJV Decision, a thorough analysis was carried out and a comprehensive upgrade program for the prevention of severe accidents and mitigation of their consequences was drawn up that will be carried out by the end of 2021, with the exception of a dry storage construction and IG relocation (first campaign), which will be carried out in 2023.

3.5. Periodic Safety Review (PSR)

The Ionizing Radiation Protection and Nuclear Safety Act (ZVISJV-1, Official Gazette RS, No. 76/17 and 26/19) [41] requires, in Article 112, from the operator of a radiation or nuclear facility to »ensure regular, comprehensive and systematic assessment and review of the radiation or nuclear safety of a facility in periodic safety reviews«.

More details on the frequency, content and scope, duration and method of carrying out periodic safety reviews, and the manner of reporting on the reviews are set out in the JV9 Rules [67].

The purpose of the periodic safety review is for the operator of a radiation or nuclear facility to:

- review the overall effects of facility aging, the effects 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 license was issued, with international safety standards and international practice, thereby confirming the facility is at least as safe as projected during its design and it continues to be fit to operate safely;
- use the latest, appropriate, systematic and documented methodology, which is based on a deterministic as well as probabilistic approach to analyses and assessments of radiation and nuclear safety;
- eliminate in the shortest time possible any deviations from the facility project identified during the periodic safety review, taking into account their significance for nuclear safety;
- examine and organize knowledge of the facility and processes, as well as the complete set of technical documentation;
- identify and evaluate the importance of safety deviations from applicable standards and best international practice;
- carry out all appropriate and reasonable modifications resulting from the periodic safety review;
- carry out modifications by preparing a written status assessment for each individual content to be documented and supported by corresponding analyses.

Following the requirements, NEK successfully carried out two periodic safety reviews, the first one in 2003 [19] and the second one in 2013 [20]. The third periodic safety review [70] is currently in progress and will be completed in 2023.

3.6. Independent International Expert Reviews of Nuclear Power Plant Operation

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 organizations: IAEA – International Atomic Energy Agency, WANO – World Association of Nuclear Operators and others.

The purpose of the missions is to encourage 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 the 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 behavior, organization and administration, improvement in efficiency and operational experience, operation, maintenance, chemistry, work process management, engineering, configuration control, nuclear fuel efficiency, equipment reliability, radiological protection, training and qualification, fire protection, occupational health and safety, organization and measures in case 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.

3.7. Aging Management Program (AMP)

In the administrative procedure, the entire NEK Aging Management Program (AMP) was approved based on the amendments to the NEK safety report (USAR) [2] and NEK technical specifications (TS) [7] and the completion of the actions from the periodic safety review referring to the extension of the operational life span of NEK (Decision from the URSJV No. 3570-6/2009/28 of 20 April 2012 and Decision from the URSJV No. 3570-6/2009/32 of 20 June 2012). 2012). In the course of the administrative procedure, no changes in technical specifications regarding radiological effluents (RETS – Radiological Effluent Technical Specifications) [9] were identified. All radiological limits from the NEK safety report [2] remained unchanged too. As part of the administrative procedure, all amendments to the NEK TS [7] and the USAR [2] were taken into account, however, the operational conditions and limits did not change.

The NEK Aging Program is based on US legislation NUREG-1801, Generic Aging Lessons Learned, Revision 2. The AMP program thus covers all passive and long-lived systems, structures and components. The European AMP program, designed by the IAEA (International Generic Aging Lessons Learned (IGALL) for Nuclear Power Plants) expects for the aging program to also address the active components. NEK has reviewed the active components in accordance with the so-called Maintenance Rule (10CFR50.65) and Environmental Qualification Program (10CFR50.49).

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

- 10CFR50.65 – 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 in NUMARC 93-01,
- Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants, Rev. 4A.

An important part of the AMP program refer to time-limited safety analyses (TLAA analyses), among which the AMP-TA-10 analysis "Update of USAR Chapters 11 and 15" should be emphasized, as it has shown that the extension of NEK operational life span does not induce any change to the existing status that would lead to new environmental hazards and burdens.

The compliance and integrity of the aging program 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 report ENSREG Topical Peer Review (TPR) on Aging Management,
- 2019, WANO Peer Review NEK AMP.

All missions and the URSJV review along with the subsequent decision demonstrated the compliance of the aging program with international recommendations and the JV9 Rules [67].

3.8. Management System

The framework for NEK's operation and business is determined by legislation, the Interstate Treaty, the standards of the nuclear industry and the standards for the effective management of companies.

The internal organization of the company is designed to include all functions, which, in accordance with the standards of the nuclear industry and regulations, are necessary for the quality implementation of work processes. At the same time, the specific role of the company is taken into account, which, in addition to the operational function, also comprises engineering and corporate functions, including the independent nuclear safety monitoring. The NEK MD-2 management system, as one of the key documents, systematically outlines the basic organizational features and defines the responsibilities of the management, key and supporting processes.

The total management system, described in the NEK MD-2 – Management System – Process Organization is in accordance with the requirements set out in the Ionizing Radiation Protection and Nuclear Safety Act, ZVISJV-1, Official Gazette RS 76/17, 26/19 [41] and in more detail the Rules on Radiation and Nuclear Safety Factors (JV5 Rules, [66], Official Gazette RS 74/16, in Section 5 (Management System). The program also complies with the General Safety Requirements No. GSR Part 2, Leadership and Management for Safety, 2016.

An integral part of the total management system is the environmental management system, which at NEK was introduced in accordance with the ISO 14001: 2004 standard in 2008. In November 2017, a recertification audit of the environmental management system and a successful transition to the new issue of the ISO 14001: 2015 standard were performed. A certificate No. SL22114E according to the ISO 14001: 2015 standard was issued on 14 December 2017 with validity until 18 December 2020. The certificates were issued for a three-year period and after two follow-up audits in October 2020 a recertification audit was efficiently completed. NEK was granted a new ISO 14001: 2015 certificate [13] for the next three-year period (until the end of 2023).

The occupational safety and health system according to the BS OHSAS 18001: 2007 standard was introduced in 2011. In November 2017, a recertification audit was performed and a new certificate No. SL22118S, with the date of issue 18 December 2017 and validity until 29 December 2020, was granted. The certificate was issued in Ljubljana and marked as temporary; subsequently NEK obtained a certificate issued by the then competent Bureau Veritas Italia Office for the field OHSAS 18001: 2007, with the number IT281123/UK and the date of issue 16 March 2018 [15]. In 2018, a new occupational safety and health standard ISO 45001 was published. In the last two years, all changes and amendments to the occupational health and safety management system necessary for transition from the BS OHSAS 18001: 2007 to the ISO 45001: 2018 standard were gradually introduced. In October 2020, the transition to the new standard was thoroughly audited and verified in the recertification audit by the external certification organization Bureau Veritas. NEK obtained the ISO 45001: 2018 certificate for a three-year period [14]. In the interim period, two follow-ups will be performed by the certification organization.

3.9. Updates and Upgrades of NEK aimed at Long Term Operation

Given all prudent and focused safety upgrades NEK has carried out in the last ten years, especially the implementation of the safety upgrade program, the safety level is improving on an on-going basis, as shown in Figure (Figure 6), illustrating the core damage frequency due to all potential internal and external events (equipment failure, piping breaks, fires, earthquakes, floods etc.).

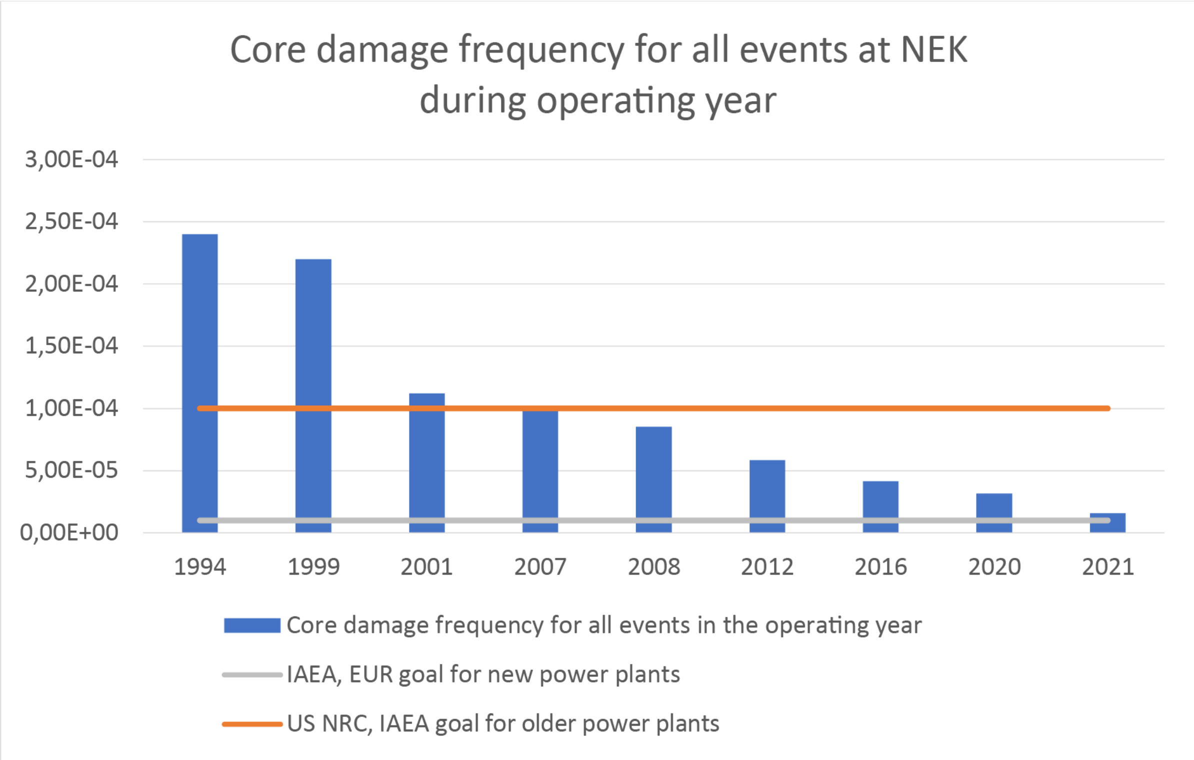


Figure 6: Safety level measured with core damage frequency per operating year (CDF/yr)

Figure 6 shows core damage frequency for all events at NEK in the operating year on the basis of historical operation data compared with the target values of US NRC and the IAEA for 2nd generation nuclear power plants, indicated with the orange line, and target values of the IAEA and EU for new 3rd generation power plants, indicated with the gray line, as defined in the NEA/CSNI/R (2009) 16. Core damage at NEK complies with the definition of the US NRC 10 CFR 50.46, Section 1b. The above figure shows core damage frequency has significantly reduced during the past 20 years, which is due to heavily investing in safety-related upgrades in the nuclear power plant. Certain essential upgrades were made referring to the earthquake risk, flood protection, mitigation measures for consequence due to a fire, provision of additional electricity sources in case of an emergency or loss of mains supply, and others. Owing to the NEK Safety Upgrade Program [21] the level or risk decreased in the past few years and is planned to further decrease in 2021.

3.9.1. Major Modifications in the Primary Circuit Design

Replacement of the steam generator

The replacement of steam generators was carried out as part of the power plant modernization, which also allowed a 40 MW-increase in the power plant output capacity. The modernization comprised a number of subprojects. The first one involved the design, manufacture, finishing, assembling, testing and transporting new steam generators. The second one dealt with safety analyses and obtaining permits for replacement. The third one, which was completed at the overhaul start, involved the building of a comprehensive personnel training simulator and analyzing the power plant behavior in various events. The replacement of steam generators and building of the simulator took place in 2000.

Introduction of the new system for temperature measurements in the primary circuit

The temperature measurement system for the primary coolant had a bypass installed on the A and B cooling loops that was connected to the hot, cold and intermediate system branch and equipped with a total of 30 valves. Due to difficult maintenance and possible leaks, all valves and bypass lines were removed during the 2013 outage, whereas temperature measuring sensors were installed directly in the primary coolant pipe. Due to this solution, the number of operational and maintenance interventions and the risk of primary coolant leaks are reduced.

Upgrade of reactor pump motors

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

Replacement of the reactor head

Taking into account the operational experience in the industry, the reactor head was replaced. The operation of the nuclear power plant is now safer and more reliable, as the material exhibits better corrosion-resistant properties while the manufacturing processes are improved. The replacement of the reactor head took place in 2012.

3.9.2. Major Modifications in the Secondary Circuit Design

Replacement of the low-pressure turbine

NEK replaced both low-pressure turbines, as they were worn-out and the production of electricity needed optimization. The new low-pressure turbines have a higher internal efficiency factor compared to the old turbines, namely output power is higher by 3% and/or additional electricity of more than 20 MW. The replacement took place in 2006.

Replacement of the stator and the 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 modernization of control instrumentation with data transfer to the main command 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 exhibits improved features in terms of efficiency and reliability.

The replacement of the stator and the rotor of the main generator took place in 2010 and 2012.

Replacement of turbine control and protection system (turbine control 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 control and monitoring system also involved the replacement of the turbine emergency trip system (ETS), steam overheating and moisture separator regulation system and the relocation of controlling and checking device 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

In the project of third generator system upgrade, the exciter and the voltage regulator of the main generator were replaced.

The replacement of the main generator switch is one of the performed upgrades of the generator system to enhance the reliability of the nuclear power plant operation. The project involves the replacement of the main generator switch with the associated equipment and the replacement of overvoltage protection. Since the new generator switch requires neither water cooling nor compressed air for its drive, both the existing compressor station and the cooling system of the old generator switch were dismantled and removed. The system was replaced in 2016.

Renewal of the switchyard and replacement of the 400-kilovolt system bus bars

In accordance with the Agreement on Technical Aspects of Investments, the switchyard was thoroughly refurbished in cooperation with the ELES system operator. The renewal started already in the 2010 outage, continued in the 2012 and 2013 outages when the complete primary equipment, such as circuit breakers, isolators and bus bars, and measuring and control systems were replaced.

In the area from the double fence between NEK and RTP Krško to the NEK transformer field, the 400-kilovolt bus bars with insulating supports and portals were partially replaced. The replacement of bus bars is the first phase of the joint project that NEK and ELES carry out in the reconstruction of the 400-kilovolt switchyard.

Installation and connection of the energy transformer

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

3.9.3. Major Modifications in the Tertiary Circuit and Subsystem Design

Expansion of the cooling tower system

The design modification is due to the modification performed in the power plant and the environment. Owing to introducing the selected technical solutions, the cooling system of the tertiary circuit at NEK was improved. Four new cooling cells (a new cooling tower – CT3) were installed while the electrical equipment of the cooling tower system was entirely replaced. The expansion took place in 2008.

Reconstruction of the equipment at NEK dam

The modification comprises the reconstruction of hydro-mechanical equipment and the floodgate control due to the rising level of the Sava River, resulting from building a dam at the Brežice hydropower plant.

The reconstruction involved extensive construction work on the dam and in the stilling basin of the dam, works on the storage area of the new service floodgates, laying a new track, mounting a crane for the operation of the new floodgates, replacement of segmental gate control machinery, and to a great extent also replacement of electrical and control equipment of the management system. The reconstruction took place in 2018.

3.9.4. Other Important Design-Related Modifications

Replacement of spent fuel storage racks

In accordance with international practice, NEK prepared all the necessary analyses to increase the number of stored spent fuel elements in the spent fuel pool. In 2003, spent fuel storage racks in the spent fuel pool were replaced, thereby increasing the number of free spaces for spent fuel storage. The storage capacity of spent fuel elements in the pool increased from 828 cells to 1,694 cells. The racks were replaced in 2003.

Improvement of AC safety power supply (DG3)

The power plant's AC safety power supply was improved by providing an alternative source in case of a failure of the entire AC power supply (Station Blackout - SBO). The upgrade of the safety power supply involved 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 bus bars via a new 6.3-kilovolt bus bar (MD3). The improvement took place in 2006 and 2013.

3.9.5. Safety Upgrade Projects in accordance with the ZVISJV-1 Act

In accordance with the ZVISJV-1 Act, Official Gazette RS 76/17, 26/19 [41] and in more detail with Article 5 of the JV5 Rules [66], NEK prepared the Safety Upgrade Program document (PNV) [21]. The PNV was reviewed and approved by the URSJV in February 2012 with Decision No. 3570-11/2011/09. Already in 2012, NEK began to prepare project documentation for the PNV and in 2013 it also filed the applications for the implementation of the first two safety upgrade modifications (installation of a passive autocatalytic system for hydrogen bonding and installation of a passive filter ventilation system of the containment). These two modifications are the key solutions to severe accidents and were approved by the URSJV in October 2013.

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

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

Phase 1 – Construction of the 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 into the environment in case of severe accident. A dry filter system was installed, consisting of five aerosol filters in the containment, an iodine filter in the auxiliary building, a piping with a relief plate, valves, a throttle element, a nitrogen station, a radiological 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 case of severe accident that could result in the uncontrolled pressure increase. The system was installed in 2013.

Phase 2 – Flood safety of NEK facilities

In 2012, design solutions were produced to ensure flood safety of NEK facilities up to an elevation of 157.530 m above sea level, also in case that downstream and upstream embankments of the Sava River collapse. Design solutions include passive and active flood protection elements. Passive elements comprise waterproof external walls of facilities, replacement of external doors with the waterproof ones and replacement of seals on penetrations through the external walls with the waterproof ones. The active flood protection is ensured through the installation of water barriers and non-return 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 auxiliary control room

The major purpose of the auxiliary control room is to provide for an alternative monitoring location, which allows safe shutdown and cooling of the power plant in case of evacuation from the main control room and control of the status in the containment in case of severe accident involving core damage. The construction of the control room was completed in 2019.

The new auxiliary control room provides an alternative location for shutdown and power plant cooling operation (if the main control room is lost); in doing so, NEK can compete with the comparable nuclear power plants in northern Europe, which built similar bunkered auxiliary control rooms in the 90s. The newer nuclear power plants have this solution integrated already in the basic design.

The auxiliary control room has additional instrumentation installed that operates independently of the main control room and is used for controlling the power plant in case of severe accident.

Phase 2 – Upgrade of technical and operational support center

Along with the construction of the auxiliary control room, an upgrade in the new technical support center (referred to as: TPC) was carried out. The capacity of the existing underground bunker will be increased while the new TPC building will provide conditions for long-term work and stay of a team of up to 200 people, even in case of extreme earthquakes, floods and other unlikely emergencies. In addition to extra air filters, the building will have a new diesel generator available to provide autonomous power supply to the center. The upgrade will be completed in 2021.

Phase 2 – Alternative cooling of the spent fuel pool

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

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

This modification allows a flow path for the controlled relief of the primary system in design extension conditions if the existing relief valves are not available. Such a coordinated relief and replenishment 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 modification involves the installation of an alternative system for long-term residual heat removal. The primary function of the new system will be to remove the residual heat from the reactor cooling system in design extension conditions by removing the coolant from the hot branch of the reactor cooling system, cooling via the heat exchanger and returning the coolant to the cold branch of the reactor cooling system, and removing the residual heat from the reactor cooling system by recirculating water from the storage tank of the containment back to the reactor cooling system. It is also possible to cool the containment by spraying. The modification will be completed in 2021.

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

The upgrade involves the construction of a bunkered building 2 (BB2) with auxiliary systems and the connection of different new systems within the new building to the existing NEK systems, buildings and components. The BB2 building is designed to accommodate alternative safety injection systems (ASI), alternative auxiliary feedwater system (AAF) and safety power supply to the BB2 building. 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. The construction will be completed in 2021.

Phase 3 – Alternative auxiliary feedwater system (AAF)

This upgrade is part of the third phase of the safety upgrade program and involves the installation of an additional pump for feedwater system of steam generator along with all pipelines and valves for connection of the new system to the existing auxiliary feedwater system of steam generators. The new alternative feedwater system of steam generator will provide an alternative source of cooling water to one or both steam generators in design extension conditions, in case the existing auxiliary feedwater system fails, to allow heat removal from the primary circuit and reactor cooling. The upgrade will be completed in 2021.

Phase 3 – Alternative safety injection (ASI)

This upgrade, also part of Phase 3 of the PNV, involves the installation of an alternative safety injection system for injection of borated water into the primary circuit of the reactor coolant. The system consists of a tank with a capacity of 1,600 m^3 borated water, a high-pressure pump and the main motor-operated valve (all of which will be installed in the new bunkered building BB2), the accompanying pipeline connected to the existing NEK system and the equipment to support the system operation and control. The upgrade will be completed in 2021.

Phase 3 – Spent fuel dry storage (SFDS)

The dry spent fuel storage (IG) brings a technological and safety upgrade within the existing NEK energy complex. In addition to the passive cooling, improved radiation safety and robustness, spent fuel dry storage has other benefits too, i.e. better protection against intentional and unintentional human influences or acts with negative impact. Spent fuel dry storage is a temporary and IG safer storage during NEK operation but also after its shutdown, however, it is not intended as permanent final spent fuel storage.

The dry spent fuel storage will be built in the technological part of NEK, west of the present spent fuel pool location. The external appearance of the dry spent fuel storage will be adapted to the existing facilities in the NEK complex, already well integrated in the landscape and a recognizable feature of the wider area of Krško Town.

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

The installation of a new sealing insert in the reactor coolant pumps with high-temperature seals (HTS). The HTS are intended for a better response from the power plant to a potential loss of total 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. The installed HTS thus prevent the loss of primary coolant. The upgrade will be completed in 2021.

3.9.6. Following the Experience, Research and Development of Science and Technology

Operational experience (OE) from other nuclear power plants is a valuable source of information for learning about and improving the safety and reliability of any nuclear facility. At NEK, the experiences gained by other nuclear power plants are systematically reviewed and studied in terms of their applicability to NEK, potential use of the recommendations and probability for similar events to occur at NEK. Corrective actions for the identification of weaknesses are determined and implemented in the NEK corrective measures program. The processes in this regard are well defined and documented.

There are various programs for sharing of operational experience conducted by the IAEA, WANO, the Institute of Nuclear Power Operations (INPO), various nuclear owner groups (PWROG, WOG), as well as numerous publications by regulatory authorities, correspondence with suppliers and architects/engineers, EPRI and the Nuclear Energy Agency at OECD available. The OE program at NEK defines sharing NEK analyses and events with the industry. NEK personnel participate in various activities, such as the OSART delegation (INPO), the WANO delegation and in a number of EPRI activities. The information acquired is a valuable source of operational experience. Many activities are addressed by the WANO/INPO information programs, the Nuclear Operation and Maintenance Information System (NOMIS) and the Nuclear Maintenance Experience Information System (NUMEX).

The Independent Safety Engineers Group (ISEG) conducts independent assessments of regulatory issues, industrial warnings, license event reports, and other sources of power plant design- and operation-based pieces of information, including similarly designed power plants where areas for safety improvement could be identified.

The entire array of WANO SOER recommendations had been reviewed and approved by the nuclear power plant, after which appropriate corrective measures were introduced for timely implementation and follow-up activities until their completion.

NEK participates in numerous research projects and participates in many international conferences in various domains, such as:

- prototype of stainless steel pump rotor manufactured using a 3D laser printer for NEK,
- participation in PWROG (research in PAR autocatalytic plate testing),

- development of dispersion model – Lagrangian model of nuclides dispersion in the environment,
- annual co-funding of applied research projects from the tender by the Research Agency RS (ARRS),
- cooperation in international projects under the auspices of the International Atomic Energy Agency (IAEA),
- etc.

4. Description of the Planned Situation 2043

4.1. Starting Points

4.1.1. Basic and Technical Characteristics of the Assessment

Attachment 1 of the PVO Decree [37] determines, under the code D.II (Nuclear Energy), the types of activities affecting the environment in case of which an environmental impact assessment (PVO) and screening (PP) are mandatory. The potential activities are listed under codes D.II.1 to D.II.7 inclusive, as follows:

- nuclear power plants and other nuclear reactors, including their dismantling or removal;
- nuclear devices for researching the manufacture and conversion of fissile and enriched materials whose maximum power exceeds 1 kW constant heat load;
- other nuclear devices for researching the manufacture and conversion of fissile and enriched materials;
- devices for the manufacture or enrichment of nuclear fuel;
- devices for processing radioactive nuclear fuel or highly radioactive waste or reprocessing radioactive nuclear fuel;
- deep drilling for nuclear waste storage;
- permanent dumping ground for spent fuel or solely radioactive waste;
- long-term storage facilities (planned for more than 10 years) solely for spent fuel or radioactive waste at a location other than the production site.

The extension of NEK operational life span:

- does not change the position or location in the nuclear power plant area;
- does not change the dimensions and design of the nuclear power plant including technology;
- does not change the production capacity of the nuclear power plant and its operation mode;
- changes the operational life span of the facility by extending it by 20 years, i.e. from 40 to 60 years;
- does not plan the construction of any new buildings or facilities that would change the physical characteristics of NEK.

Until the end of the planned extended operational life span (in 2043), NEK will continue to operate as hitherto i.e. in a reliable and safe manner, not exceeding the limits of emissions into the environment. The safety culture, employee competences and responsibility will remain the guiding principle and the major platform of NEK's organizational and business structure, and will ensure its safe and environmentally friendly operation. NEK will regularly and timely introduce the necessary safety and other improvements as this has been the case so far.

NEK will maintain and regularly update all management systems listed in Section 3.8. NEK will make all natural and legal persons working for NEK acquainted with the environmental policy and provide the interested public with an insight into the environmental management policy. Following a comprehensive upgrade of safety systems [21], all operation-related risks at NEK will be significantly decreased as governed by the nuclear energy legislation of the Republic of Slovenia.

The extension of NEK operational life span from 40 to 60 years until 2043 affects neither the existing environmental license [4] nor the existing water permit [5] NEK presently holds.

An environmental impact report (PVO) should be prepared for the activity affecting the environment: extension of NEK operational life span from 40 to 60 years until 2043. The environmental impact assessment covers the environmental impacts of facilities as per Decree on the effects on the environment report on plot numbers shown in Figure 1.

4.1.2. Preliminary Information – ZVO-1 Act

In accordance with Article 52 of the ZVO-1 Act [36], NEK submitted, in November 2020, an application for the issuance of preliminary information on the scope and content of the report on the effects of the planned activity on the environment. In accordance with the provisions of the third paragraph of Article 52 of ZVO-1, the Ministry of the Environment and Spatial Planning requested ministries and other organizations responsible for individual matters of environmental protection or preservation or the use of natural resources or protection of cultural heritage or protection of human health, to rule on what data the environmental impact statement should contain to give an opinion on the effects of the intended activity on the environment from the point of view of their respective field of competence.

In the communication [65] from the end of 2020, the ARSO submitted opinions on the data to be contained in the environmental impact statement under the third paragraph of Article 52 of ZVO-1 for the intended activity on the basis of the draft project. The data is partly included in this document while it will be included in the environmental impact statement in full.

4.1.3. Existing Valid Permits; Operation and Environment

NEK operates in accordance with the open-ended operating license (URSJV Decision No. 3570-8/ 2012/5, amended on 22 March 2013) [3], which is directly related to the NEK Updated Safety Analysis Report, Rev. 26 (USAR) [2], and defines the conditions and limits to be met for ensuring the safe operation of the power plant. NEK is technically capable of operating for at least another 20 years, provided that, in accordance with the applicable legislation, it performs a periodic safety review (PRS) every 10 years (according to the ZVISJV-1, a periodic safety review).

The construction of NEK began in 1974, the supplier of the nuclear power plant being Westinghouse from the United States. NEK was spatially located in accordance with the location permit [6] and the legislation in force at the time.

4.1.4. Operating License

In May 1981, after obtaining a special license, the nuclear fuel was inserted into the reactor for the first time. The nuclear power plant was synchronized with the electricity grid in October of the same year. During trial operation, it reached full power in August 1982. With Decision No. 31-04/83-5 of 6 February 1984, issued by the Republic Energy Inspectorate in Ljubljana [3], NEK obtained a special consent for commissioning (operating license). The administrative procedure was carried out on the basis of the NEK preliminary and final safety report taking into account the regulations of the supplier country and with the assistance from the missions of the International Atomic Energy Agency. On 17 July 1989, NEK obtained the use permit No. 351-02/89-15. The design of all safety equipment at NEK complies with the requirements of the US Nuclear Regulatory Commission from 1973. Westinghouse, as the main contractual partner, was responsible for the implementation of incorporating these requirements in design, construction and testing phases. To enhance safety, many modifications to the equipment were made during operation. In accordance with the URSJV Decision No. 390-2/2004/1/13 of 8 July 2004, NEK was classified as a nuclear facility. NEK is entered in the register of radiation and nuclear facilities under consecutive No. 1.

4.1.5. Environmental Permit

In 2006, NEK filed an application at the Ministry of the Environment and Spatial Planning (MOP) and the Environmental Agency of the Republic of Slovenia (ARSO) for the issuance of an environmental permit for the operation of the Krško Nuclear Power Plant. On 30 June 2010, the MOP issued Decision No. 35441-103/2006-24, Environmental Permit for the Operation of the Krško Nuclear Power Plant regarding Emissions into Waters [4], which defined special conditions for the operation of the facility. On 4 June 2012 and 10 October 2013, Decisions No. 3544-103/2006-33 and 35444-11/2013-3, which introduced modifications in paragraphs determining the operating conditions of the facility [4], were issued. NEK operation is compliant to the valid environmental permit [4].

4.1.6. Water Permit

NEK operation is compliant with the valid water permit for water use for technological purposes. The initial partial water permit was issued on 15 October 2009, No. 35536-31/2006-16 [5] and amended by Decision No. 35536-54/2011-4 of 8 November 2011 and Decision No. 35530-7/2018-2 of 22 June 2018 [5].

4.1.7. Amendment to the Operating License – Unlimited Operation

In 2012, the Slovenian Nuclear Safety Administration (URSJV) confirmed and approved with Decisions No. 3570-6/ 2009/28 and No. 3570-6/2009/32 the amendments to the NEK safety report (USAR) [2] and the accompanying documentation, which until then limited NEK's operational life span to 40 years. The aforementioned URSJV decisions now provide the possibility for NEK to extend its operation by another 20 years, i.e. to 60 years in total. The operation of NEK was thus extended from the projected 2023 to 2043, provided that periodic safety reviews in 2023 and 2033 are passed. Based on the URSJV decisions, the Republic of Slovenia and the Republic of Croatia as the owners of NEK gave their support under Interstate Treaty [26] to the decision for NEK operational life span extension until 2043 [27]. Following the requirements of the legislation, NEK carried out a procedure for modifying and amending the Development Plan through the Decree on the Modifications and Amendments of the Decree on the NEK Development Plan of the Krško Nuclear Power Plant, Official Gazette RS, No. 59/97) and the Decree on the Amendments to the Decree on the Development Plan of the Krško Nuclear Power Plant, Official Gazette RS, No. 21/20).

4.1.8. Integrated National Energy and Climate Plan of the Republic of Slovenia – NEPN

The NEPN is a strategic document that must set goals, policies and actions up to 2030 (with an outlook to the year 2040) for the five dimensions of the Energy Union:

1. decarbonization (greenhouse gas emissions (TGP) and renewable energy sources (OVE)),
2. energy efficiency,
3. energy security,
4. the internal energy market, and
5. research, innovation and competitiveness.

The projects and measures set out in the NEPN will, in accordance with the Energy Act, be in the public interest in terms of energy and climate policy.

The following scenarios of future energy use and supply were discussed and analyzed as part of the NEPN preparation:

- a scenario with the existing measures (OU) – further development is based on carrying on the implementation of all measures adopted already by 1 October 2018,
- the NEPN scenario.

The scenario with the existing measures serves for comparison purposes and plans minimum additional investments in large plants. It envisages the completion of the chain of hydroelectric power plants on the lower Sava River, but no other investments in renewable energy sources (OVE). It is further assumed that, upon obtaining the appropriate environmental consent, the existing NEK will operate until the end of the extended operational life span (in 2043).

The development-oriented NEPN scenario projects an increase in the production of electricity from hydropower, as well as wind and solar power, which are both considered dispersed power sources, in combination with electricity storage facilities. The existing NEK will operate until 2043, subject to obtaining the appropriate environmental consent.

A strategic environmental impact assessment of the NEPN implementation was carried out along with the preparation of NEPN [12]. As part of the NEPN preparation and its strategic assessment, the complexity of goals and contributions for the period until 2030 was discussed. The extensive and well-founded expertise-based discussion provided the platform for reaching agreement of the widest possible stakeholder circle on demanding yet feasible goals Slovenia has set to achieve by 2030, which will take into account specific national circumstances and will represent a necessary step ahead towards the climate-neutral Slovenia by 2050.

From the point of view of the NEPN, Slovenia's goals are:

- decarbonization of energy,
- to ensure a reliable and competitive energy supply,
- to maintain a high level of electricity interconnection with neighboring
- countries,
- at least 75% of electricity supply from sources in Slovenia by 2030 and by 2040, and ensuring an adequate level of security of electricity supply,
- to continue to exploit nuclear energy and maintain excellence in the operation
- of nuclear facilities in Slovenia,
- to reduce fossil fuel import dependency,
- to increase electricity distribution network resilience to disruption – increase the share of underground medium-voltage network from the current 35% to at least 50%.

It is clear from the above-listed that the operation of NEK has a significant role in the implementation of the NEPN goals.

The updates in work processes, upgrades in technology, and the 18-month fuel cycle and employee commitment ensure stable and increased production of electricity. At present, when the world as a whole and Europe in particular are developing energy strategies to tackle climate change, such results substantially contribute to the understanding that nuclear energy is of strategic importance in transition to a low-carbon society; nuclear energy will maintain energy independence of countries, enable the economy a competitive edge and citizens access to affordable electricity.

The figure below (Figure 7) shows the increase in electricity production as of the beginning of NEK operation.

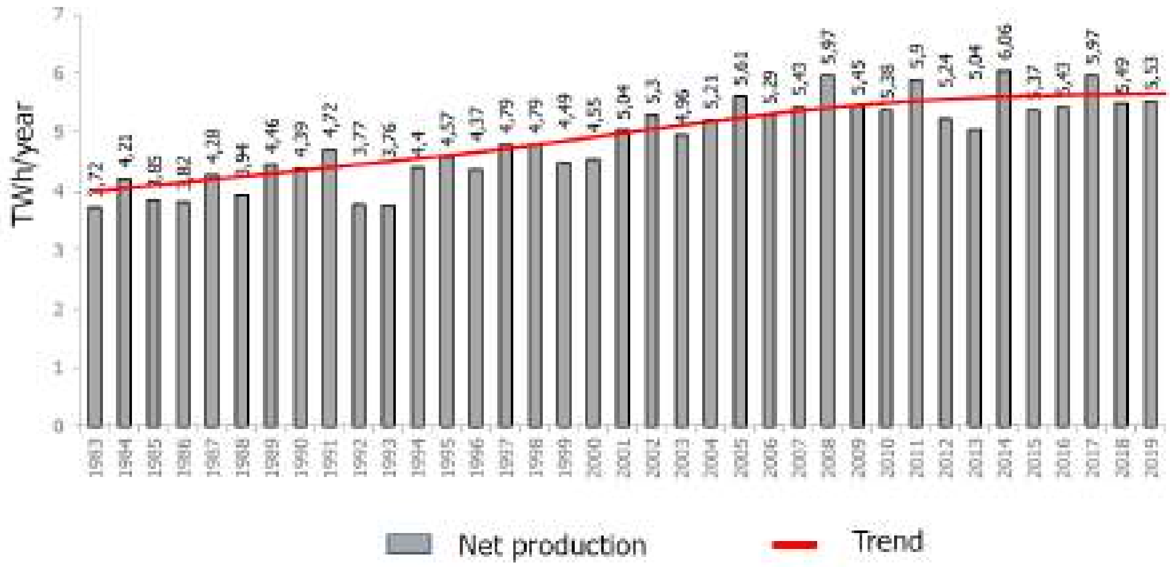


Figure 7: Net production of electricity by year

4.2. Design Bases for Long Term Operation of NEK

Although NEK was designed for a minimum of 40 years, the nuclear power plant carried out all the necessary analyses and upgrades, from which it follows it can operate for another 20 years. Based on a number of studies and analyses, the SNSA, by Decision No. 3570-6 / 2009/32 of 20 June 2012, confirmed the appropriate condition of the selected equipment at NEK in spite of its aging, whereby all safety reserves and operational functions are ensured.

The capacity for extending the operational life is based primarily on the following facts:

1. The nuclear power plant has built-in materials and equipment that provide sufficient safety reserves;
2. The complete equipment that affects operation reliability has been replaced;
3. The operation of the nuclear power plant is stable;
4. A safety upgrade has been carried out to comply with the ZVISJV-1 requirement and the lessons learned from all major nuclear accidents to date, which is reflected the ENSREG, Slovenian national post-Fukushima plan [45], [24];
5. NEK has a comprehensive Aging Management Program (AMP) in place to monitor aging of all passive structures and components (reactor vessel, concrete, underground pipelines, steel structures, electrical cables etc.).

4.2.1. Description of the Activity for Long Term Operation of NEK

In the past, NEK already carried out all the necessary analyses and safety upgrades required for extending its operational life span and obtained the necessary permits and consents from the URSJV. As a result, NEK replaced the essential equipment to allow further safe and reliable production of electricity without disruptions. The enumerated actions prove that all the necessary technical prerequisites for extending the operational life span have already been put in place.

On 2 October 2020, the ARSO issued Decision No. 35405-286/2016-42 [1], which requires from the responsible of the intended activity - the Krško Nuclear Power Plant to carry out an environmental impact assessment for the intended activity "Extending the Operational Life Span of NEK from 40 to 60 Years until 2043" and acquire environmental consent.

The Ministry ex officio carried out screening in accordance with the first paragraph of Article 8 of the Decree on the activities affecting the environment for which an environmental impact assessment is to be carried out [37]. In the process of screening referred to in the first paragraph of Article 51.a of the ZVO-1 [36], the criteria regarding the characteristics of the intended activity in the environment, its location and the characteristics of possible impacts of the activity on the environment were taken into account.

It has been established that the intended activity foresees a modification affecting the essential feature of the existing activity, since the operational life span of NEK is extended until 2043. The impacts arising therefrom would significantly increase and/or a significant increase in environmental impacts due to the intended modification can be expected. Furthermore, the planned activity has been established functionally and economically related to at least another planned activity, namely the construction of a dry storage building. The Ministry notes that the obligation of carrying out an environmental impact assessment for extending the operation of the nuclear power plant also arises from court practice of the European Union.

Based on the facts established, the Ministry has concluded the intended activity requires carrying out an environmental impact assessment and acquiring environmental consent, as already imposed by the mentioned decision.

5. Starting Points for the Environmental Impact Assessment of Long Term Operation of NEK

5.1. Initial Explanations about the Activity

The extending of NEK operational life span from 40 to 60 years will have certain impacts on the environment.

- Increased amount of spent nuclear fuel;
- Increased amount of generated low- and intermediate-level radioactive waste (NSRAO);
- Up to 6 TWh produced electricity per year (a total of up to 120 TWh electricity – Slovenian share 60 TWh);
- Up to 4.8 million tons less CO_2 emissions per year due to the operation of NEK (total: 97 million tons less CO_2);
- Regular service works and replacement of systems with the safer ones;
- Regular replacements of systems with more efficient and reliable ones;
- Cleaning of the Sava River using all types of grates.

Both owners of NEK (*GEN energija* and *Hrvatska elektroprivreda*) have decided to make major investments on the basis of the studies analyzing energy, system, economic and ecological aspects of the operational life span extension [42][43].

The **construction** of any new facilities or installations that would change the physical properties of NEK **is not planned** in the context of extending the operational life span of NEK.

5.2. Potential Impacts of the Intended Activity on the Environment

The impacts arising from the extension of NEK operational life span must be assessed in accordance with the Espoo Convention, Annexes 1 and 2.

According to the Decree determining the contents of the environmental impact statement (Official Gazette of the Republic of Slovenia, No. 36/09 and 40/17), the contents to be addressed and of importance for the assessment must be determined. Further below, the starting points for expert assessment are presented. The majority of activities will remain within the same scope, however, the number of spent nuclear fuel elements and the amount of low- and intermediate-level radioactive waste will increase. All effects are defined in view of the 2020 situation. No additional emissions into the air are expected due to extending the operational life span of NEK from 40 to 60 years. The types and concentrations/activities of the estimated emissions remain unchanged. The estimated amount of annual emissions remains unchanged and within the limits defined at NEK TS [7] and RETS [9].

5.2.1. Greenhouse Gas Emissions

There will be no additional greenhouse gas emissions into the air as a result of the extension of the operational life span.

5.2.2. Substance and Heat Emissions into Waters

No new emissions into waters as a result of the extension of NEK operational life span from 40 to 60 years are expected. The types and concentrations/activities of the projected substance emissions into waters will not change. The amount of annual substance and heat emissions into waters will remain UNCHANGED and within the permitted limits as specified in the OVD [4] and RETS [9].

5.2.3. Substance Disposals/Releases into the Soil

No new substance disposals and/or releases into the soil as a result of the extension of NEK operational life span from 40 to 60 years are projected. Rainwater, process and municipal wastewater will be released in accordance with the valid environmental permit.

5.2.4. Noise

No new noise sources as a result of the extension of NEK operational life span are projected, meaning there will be no increase in noise levels either in the natural or living environment. Noise emissions will be identical to the present ones.

5.2.5. Ionizing Radiation – Normal Operation

The types and annual estimated doses of radioactive radiation remain unchanged in spite of the extension of NEK operational life span from 40 to 60 years. The estimated doses of radioactive radiation remain UNCHANGED and within the USAR [2] and RETS [9].

The annual dose at NEK fence will not exceed the limit of 200 µSv [9] as a result of the extension of operational life span. The dose rate will not exceed the limit of 3 µSv/h, as defined in the fourth point of the first paragraph of Article 4 of the Rules on the Radiation Protection Measures in Controlled and Monitored Areas [71] and determining the limit average dose rate within eight hours for controlled areas. Moreover, the dose rate will not exceed the limit from the first paragraph of Article 7 of the mentioned Rules [71] for monitored areas, which amounts to 0.5 µSv/h.

In addition to NEK measurements of all emissions into waters and the atmosphere, an independent radiological monitoring is also carried out. The monitoring is conducted by authorized institutions from the Republic of Slovenia (Jožef Stefan Institute, ZVD Institute for Occupational Safety, MEIS Environmental Services) and the Republic of Croatia (Ruđer Bošković Institute). The purpose of radiological monitoring is to monitor the operation of the nuclear power plant and assess the impacts on the environment and/or the population, as well as the compliance with the specified limits. The external authorized institutions measure samples taken from the environment, mainly in a 12-kilometer radius around NEK.

In the vicinity of the power plant, there are also 13 automatic radiation measuring stations in place that can detect any changes in the natural level of radiation due to precipitation as well as any changes due to the nuclear facility.

The independent authorized institutions also conduct monitoring of the Sava River downstream in a length of up to 30 kilometers from the nuclear power plant.

The impact of NEK's radioactive radiation on the environment is so low that in fact, it is immeasurable. However, using the models, it can be calculated for the most exposed population group and the annual dose can be compared with the dose arising from natural and other radiation sources.

The measurement results in the environment are dealt with in detail in special reports available on NEK website at (https://www.nek.si/sl/novinarsko-sredisce/porocila/letno-porocilo-o-meritvah-radioaktivnosti-v-okolju). The measurement results confirm that all environmental impacts are far below the administrative limits.

No increase in environmental impacts is expected as a result of the extension of NEK operational life span. All environmental and radiological conditions and limits, indicated in the existing and valid NEK operating license [3], remain unchanged after the extensions of NEK operational life span from 40 to 60 years.

5.2.6. Ionizing Radiation – Emergency Condition

As indicated in Section 3.2.7, NEK addresses design basis accidents and design extension conditions. Design basis accidents are described in the NEK Safety Report [2]. The effects in the environment and/or on the border of the controlled area (500 m) lie within the administrative limits, which are specified in the American regulation 10 CFR 100. The NEK Safety Report [2] provides the calculated doses for a number of projected design basis accidents at distances of 0.5 km and 1.5 km. The estimated dose loads due to accidental releases of radioactive substances into the atmosphere for greater distances are given in the FER-MEIS report: "Calculation of Doses at Specific Distances for LOCA DBA and PCFVS Releases in case of an Emergency at NEK" [54].

The analyzed beyond design basis accidents also include major but significantly less likely core damage. In most cases the integrity of the containment is expected to remain uncompromised. However, with a certain minor share of events, a release through the passive containment filtering vent system (PCFVS), as shown in the figure (Figure 3), is projected. The estimated doses at different distances from NEK in case of a beyond design basis accident are described in the FER-MEIS report "Calculation of Doses at Specific Distances for LOCA DBA and PCFVS Release in case of an Emergency at NEK" [54].

5.2.7. Waste Generation

With the extension of the operational life span of NEK from 40 to 60 year, the types and dynamics of the projected waste generation remain unchanged. The total amount of waste (for another 20 years of operation), the final disposal of which is planned at the low- and intermediate-level waste repository after closure (referred to as: NSRAO) in Vrbina, will increase.

The dynamics of waste generation remains UNCHANGED and compliant with the provisions of the USAR [2] and RETS [9]. The amount of waste as at 31 December 2019 is given in the following table (Table 10).

Table 10: Inventory of NSRAO waste located in Storage Building as at 31/12/2020

Waste origin	Waste type	Number of packages	Total volume of packages [m^3]	Gross mass of packages [t]
Evaporator	Evaporation residues	14	10.8	15.8
	Evaporation residues in silicate concrete	1465	1261.9	3172
	Dried concentrate	125	102.6	124.1
	Dried sludge/concentrate	11	8.9	10
Spent ion-exchange resins	Primary resins captured in silicate concrete	795	234.9	439.7
	Resins from primary systems	71	61	127.9
	Resins from BD system	15[1]	12.4	11.2
Used filters	Filters in concrete	140	44.2	147.4
Supercompactor (SK)	Compacted waste	7 [2]	1.5	0.7
	Combustible compacted waste	759	375.7	431.4
	Ashes, dust	83 [3]	25.9	32.7
Non-compressible waste	Other non-compressible waste	7[4]	1.5	1
	SK non-compressible waste	234	151.2	222.4
Specific waste	SK active charcoal	12	10.4	9.9
Total	**-**	**3738**	**2302**	**4746[1]**

In the 13th meeting of the Interstate Commission for Monitoring the Execution of the Treaty between the Government of the Republic of Croatia and the Government of the Republic of Slovenia on the Regulation of Status and Other Legal Relations Related to Investments, Exploitation and Decommissioning of the Krško Nuclear Power Plant (MDP) held on 30 September 2019, a decision was made, based on the report from the Coordination Committee, that a joint solution for the NSRAO waste repository proved to be impractical.

The total quantities of NSRAO to be shared between the Slovenian and Croatian parties, determined on the basis of the waste inventory in the NEK storage building and the estimates of future NSRAO generation during NEK operation and decommissioning, are shown in the following table (Table 11).

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[1] Additional 53 packages located in Decontamination Building are prepared for incineration (10.6 m^3; 11.7 t)

[2] Additional 393 packages located in the WMB and DB, prepared for incineration (82.0 m^3; 40 t)

[3] Additional 19 packages located in Decontamination Building (4.0 m^3; 6.2 t)

[4] Additional 28 packages of other waste (4.0 m^3; 6.2 t)

Additional 80 ingots located in Decontamination Building (8.8 m^3; 49.5 t)

Table 11: Total amount (1) NSRAO to be shared between the Slovenian and Croatian parties.

Period of NSRAO generation	Data source	Mass (t)	Volume (m^3)	Activity (Bq)
1983 – 2018	inventory	4877.4	2294.9	5,98 E13
2018 – 2023	estimate	264	163.4	1,44 E13
Up to 2023	**estimate**	**5141.4**	**2458.3**	**7,42 E13**
2024 – 2043	estimate	883.7	546.6	4,33 E13

Each party will manage its half of NSRAO in accordance with national strategies and programs addressing radioactive waste management [53].

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 NSRAO from the operation and other sources; in the second phase, from 2050 to 2061, disposal of the remaining NSRAO from the operation of NEK together with the NSRAO from decommissioning, at which time the procedures for the final closure of the repository will also be initiated. The NSRAO from other sources refer to the NSRAO that meets the acceptance criteria for waste disposal and originates from the central nuclear waste storage facility.

As the NEK site will not have sufficient waste management capacities available, the Croatian scenario assumes that the Croatian part of NSRAO from the operation will be treated and prepared in an appropriate facility in a third country, after which it will be transported to Croatia. The strategy further plans the construction of a special center for radioactive waste management (CRAO). The priority location of the CRAO center 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.

5.2.8. Spent Nuclear Fuel

The total amount of spent nuclear fuel at NEK is currently stored in the spent nuclear fuel pool, where 1,694 cells are available in storage racks. After the 2021 outage, a total of 1,376 fuel elements will be stored in the spent fuel pool.

The spent nuclear fuel elements will be relocated from the spent fuel pool to the storage in four campaigns, as listed in the table below (Table 12) [31].

Table 12: Relocation campaigns for IG from the pool to dry storage

Relocation campaigns:	Execution	Indicative number of fuel elements
Campaign I	2023	592 fuel elements
Campaign II	2028	592 fuel elements
Campaign III	2038	444 fuel elements
Campaign IV	2048	Other fuel elements

5.2.9. Electromagnetic Radiation

Electromagnetic radiation is limited solely to the NEK site. The intensity of electromagnetic radiation remains unchanged and limited to the NEK site in spite of extending NEK operational life span from 40 to 60 years.

5.2.10. Light Radiation in the Surroundings

Light radiation is limited to the NEK site. The intensity of light radiation in the surroundings remains unchanged and is limited to the NEK location in spite of extending NEK operational life span from 40 to 60 years.

5.2.11. Atmospheric/Water Warming

Atmospheric warming or additional water warming as a result of the extension of NEK operational life span from 40 to 60 years is not foreseen. The parameter size of temperature increase of the Sava River (delta T) remains unchanged. The extent of water warming will remain UNCHANGED and within the limits defined in the environmental permit [4].

The effects of warming on the atmosphere increased only slightly due to dry storage of spent nuclear fuel. The impact was analyzed in the Environmental Impact Assessment (referred to as: PVO) to obtain the environmental consent (referred to as: OVS) for the spent fuel dry storage project [31].

5.2.12. Odor

The operation of NEK is not a source of stench and/or odor.

5.2.13. Visual Exposure

The extension of NEK operational life span from 40 to 60 years will not physically change the visual exposure compared to the existing appearance.

5.2.14. Vibrations

NEK is an insignificant source of vibration transmission into the environment. The arrangement of the machinery, which could be a source of vibrations, in facilities prevents the transmission of vibrations inside and outside facilities. There will be no effects of vibrations during operation.

5.2.15. Change of Land Use

The extension of the operational life span will not change either the planned or the actual land use.

5.2.16. Change of Vegetation

The extension of NEK operational life span will not change the vegetation in the surroundings.

5.2.17. Explosions

NEK does not use any explosive materials in its operation and will use none in the future.

5.2.18. Physical Change/ Topography Reshaping

NEK will not make any physical changes or reshape topography due to the extension of the operation life span.

5.2.19. Water Use

Water Quality

The quality of water is not projected to change as a result of extending NEK operation life span from 40 to 60 years. The water use will remain UNCHANGED and compliant with the water permit [5].

Water Use

The use of water is not projected to change as a result of extending NEK operation life span from 40 to 60 years. The water use will remain UNCHANGED and compliant with the water permit [5].

5.2.20. Other

The extension of NEK operational life span from 40 to 60 years neither changes nor is in conflict with any of the present legally defined protected areas, such as Natura 2000, water protection or other legally defined conservation areas and cultural heritage.

5.3. Baseline and Outline of Further Development without Carrying out the Activity (Zero Variant)

Energy, system, environmental, social and economic research has shown that the extension of NEK operational life span constitutes the most favorable alternative to all other technologies that are suitable for the production of electricity in the base-load mode and have matured for commercial use in 2020.

Its benefits are particularly great in terms of:

- assuming the role of a 400 kV network support point in normal operation and in case of disruptions,
- a positive impact on managing international obligations the Republic of Slovenia has regarding the CO_2 emissions, as it does not generate any, whereas using the replacement fossil fuel-based technologies would make Slovenia depart from compliance with the requirements of the Kyoto Protocol,
- land use, as it does not require any new development of land, and
- business economics, as operating costs are much lower than in case of any alternative technologies or purchase of energy on the market.

The non-extension of the operational life span of NEK will compromise the energy independence of the Republic of Slovenia. The deficit in energy would have to be compensated for by using other sources or leasing it out from other countries; this would lead to consequences in the economy, politics and ecology.

The consequences of the zero variant are described in detail in the study Energy, Systemic, Economic and Ecological Aspects of Operational Life Extension of the Krško NPP, Rev.1, EIMV, Ljubljana, 2007 [42].

5.3.1. Economic Consequences of the Zero Variant

The zero variant not only has a direct negative impact on the owners, but brings about even greater negative macroeconomic effects on Slovenia [60]. Due to its involvement in Slovenian society, the operation of NEK, as well as the operation of all other energy industries has direct and indirect effects. The negative macroeconomic effects presented in the following table (Table 13) are calculated for 2019 and are based on the findings from the analysis results prepared by the Institute of Economics at the Faculty of Law from 2008 [60].

A shutdown of NEK would cause a loss in electricity production in the amount of 5.526 TWh (data for 2019), of which 2.763 TWh cover the needs in Slovenia. The loss of electricity for domestic market supply would be largely compensated for by increasing imports in the medium term. The direct effect of NEK's shutdown would generate a loss in revenues of EUR 267 million per year. NEK's operation, the purchase of materials and services namely drive supplier demand, leading to an increase in their revenues and added value. In case of NEK's shutdown, Slovenia's GDP would immediately decrease by EUR 125 million per year (0.3% GDP). The closure of NEK would directly affect fiscal revenues of the budget and public treasury, given the fact that NEK's contribution totals EUR 91 million per year.

With the zero variant, almost 2,200 high-quality and reliable jobs would disappear in Slovenia. Each job created directly at NEK maintains another 1.5 jobs in the rest of the economy, i.e. a total of 2.5 jobs.

Table 13: Negative macroeconomic effects of the zero variant calculated in 2019. The estimated value in case that NEK discontinues its operation and electricity production (macroeconomic effects of decommissioning are not taken into account).

Economic and social effects of the zero variant	Direct effect	Indirect effect	Total
Reduction of production	EUR 161 million/year	EUR 107 million/year	EUR 267 million/year
Lower GDP	EUR 600 million/year	EUR 1,600 million/year	EUR 2.2 billion/year
Negative impact on revenues for public finance	EUR 200 million/year	EUR 400 million/year	EUR 600 million/year
Number of jobs lost	2,000	3,500	5,500

Besides discouraging investments, both owners (the Republic of Slovenia and the Republic of Croatia) would have to provide the missing funds for NEK decommissioning and radioactive waste disposal. According to Revision 3 of NEK's Decommissioning Program [29] and the RAO Disposal Program [30], this would require from the owners to provide an additional sum of EUR 1 billion within a 10 year-year period after 2023. If NEK operates for another 20 years, these financial assets will inflow as levies in both funds earmarked for NEK decommissioning.

The additional economic sensitivity analysis, which compared two scenarios – the shutdown of NEK in 2023 and the extension of the NEK operational life – has verified that the eligibility criterion for continued operation is met [43].

5.3.2. Environmental Consequences of the Zero Variant

The major negative impact of the zero variant on the environment is a deviation from decarbonization plan – the primary goal set out in the NEPN document [12], as adopted in 2020.

The NEPN defines, in several sections, the development of nuclear energy as being the core technology for achieving a low-carbon society and/or for achieving the goals of reducing greenhouse gas emissions, thereby also following the 2030 guideline direction of SRS and the vision of Slovenia.

Strategic documents, both at international and national level, suggest that considerable efforts will be needed to significantly reduce CO_2 emissions, phase out the use of fossil fuels and protect our climate to the greatest extent possible.

The project of extending the NEK operating license can be a great contribution to ensuring a safe and reliable source of electricity supply. The following applies to energy supplied by NEK:

- as interpreted by internationally applied methodology, it is a domestic energy source that reduces energy import dependence,
- a competitive source of energy at an acceptable, predictable and stable price,
- an optimal solution that meets environmental requirements and standards, ensures reduction of CO_2 emissions at national level – considering the entire operational life, nuclear energy not only generates very low CO_2 emissions, but also does not generate CO_2 emissions during operation,
- meets the strictest international safety requirements and standards,
- supports the positive effects on economic development and living standard, and thus on highly skilled jobs.

Climate

When taking into account the impact of a particular technology on the climate, it is important to get familiar with the data about greenhouse gas emissions throughout a life cycle (i.e. from the construction of a nuclear power plant, fuel production, operation, decommissioning and waste disposal). According to the United Nations International Panel on Climate Change, IPCC [IPCC reference 2014], thermal power plants have the greatest impact on the environment in their entire life cycle, releasing the most emissions into the atmosphere during electricity production. The internationally recognized value of emissions generated from burning of black coal is 0.82 kg CO_2 eq/kWh, and according to the Statistical Office of the Republic of Slovenia these values amount to as much as 1.2 kg CO_2 eq/kWh for Slovenian lignite (because of its poorer calorific value and a power plant utilization factor).

NEK produces a net 696 MW of electricity. In the event of NEK's shutdown, energy would have to be replaced with other sources.

The data on emissions of particular technologies are summarized according to the IPCC, which acts as a United Nations body [IPCC reference 2014]. The IPCC values are used in all analyses performed by all other relevant international agencies (such as the IEA at the OECD) as well as EU bodies and institutions. Throughout its life cycle (construction, operation, decommissioning, uranium ore mining and processing), a nuclear power plant releases 0.012 kg of CO_2 into the atmosphere per each kWh of electricity generated. On average, the estimate shows that 8.3 kg of CO_2 is generated every hour in the operation of a power plant of the same power output as NEK has.

According to the internationally verified data, a thermal power plant produces 0.82 kg of CO_2 per each kWh of electricity produced (this applies to black coal thermal power plants; brown coal or lignite thermal power plants generate even higher CO_2 emissions per each kWh generated). This means that a 696 MW thermal power plant generates at least 571 kg of CO_2 every hour, releasing it into the atmosphere. Gas power plants of the same output power produce about half as much CO_2 emissions or 341 kg of CO_2 per hour.

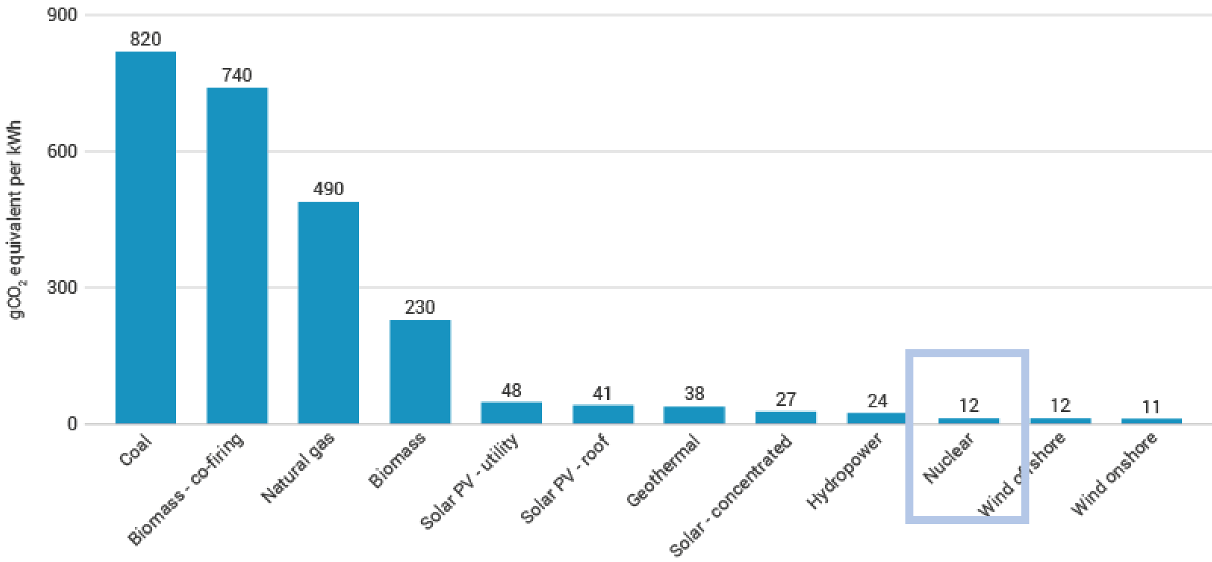


Figure 8: Average emissions of carbon dioxide equivalents in a life cycle of different electricity producers (Source: IPCC)

NEK's shutdown will have the greatest environmental impact in terms of greenhouse gases, as there are no other sources whose capacity, reliability and economy could cover for electricity deficit.

Land Use

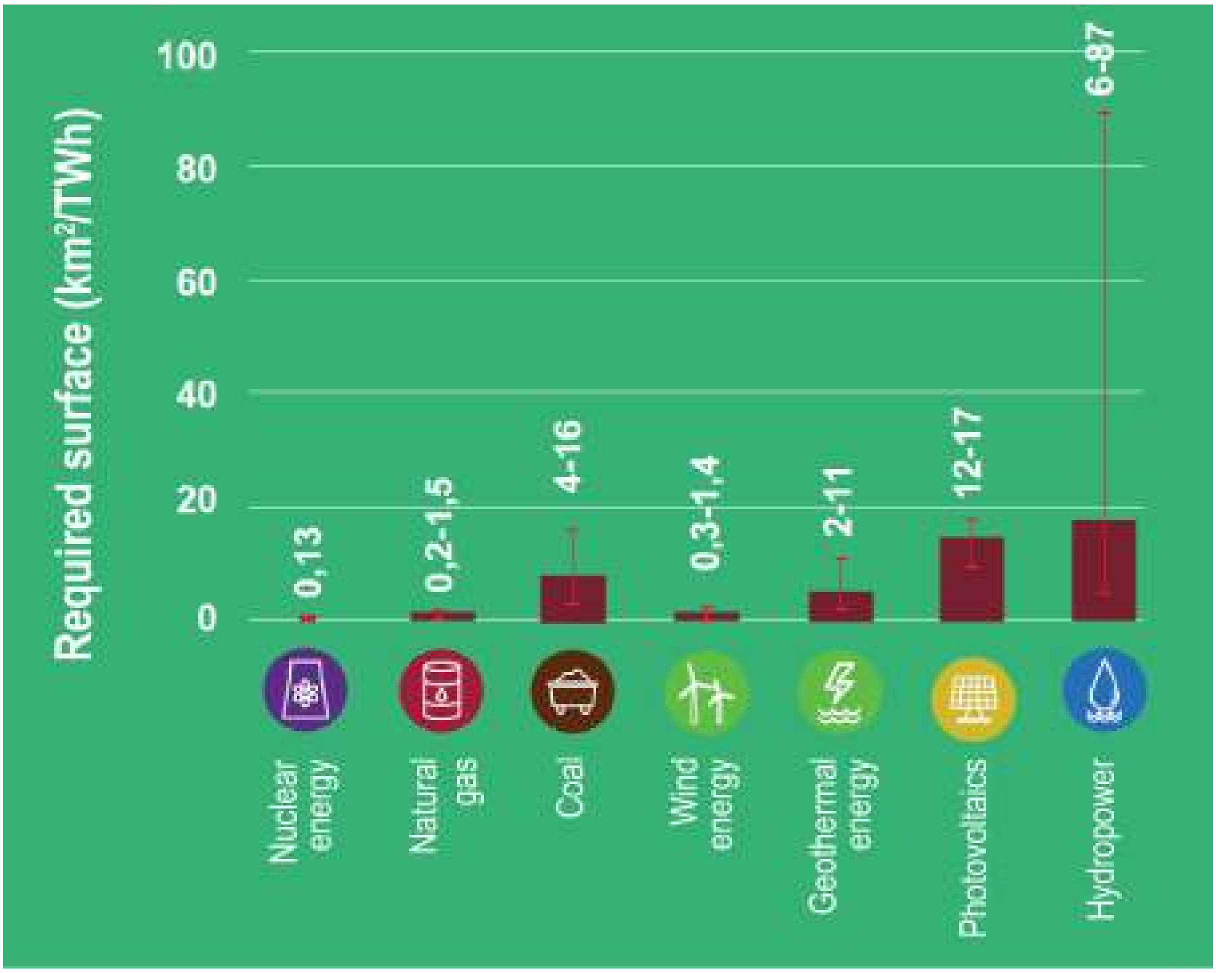


Figure 9: Land use with regard to production source of electricity; Source: »Energy Sprawl Is the Largest Driver of Land Use Change in United States«, A.M.Trainor PLOS ONE | DOI:10.1371/journal.pone.0162269 September 8, 2016

On the assumption that Slovenia wants to replace the existing production capacities, the graph (Figure 9) shows that nuclear energy has the smallest possible footprint on land use compared to other production sources. With new energy facilities, not only land for the facilities themselves, but also the required construction of new transmission line infrastructure for connection of the facilities to the grid must be taken into account.

It should be further pointed out that power plants of the same power installed do not necessarily produce the same annual output, e.g. solar power plants do not operate at night, hydroelectric power plants rarely produce electricity at rated power etc. The utilization of a power plant is the factor that really matters. Power plant utilization is calculated as the ratio between the energy a power plant would produce if it were operating uninterrupted at full power and the energy actually produced. One should bear in mind that the renewable energy sources (OVE) have priority in the network and supply their total produced energy to the network, whereas other power plants must adapt to consumption, meaning electricity supply does not take place all the time, but only when the network needs it. The following figure shows the utilization of all Slovenian power plants in 2019. (Data source: Report on the energy sector in Slovenia for 2019, Energy Agency of the Republic of Slovenia, Maribor, 2020).

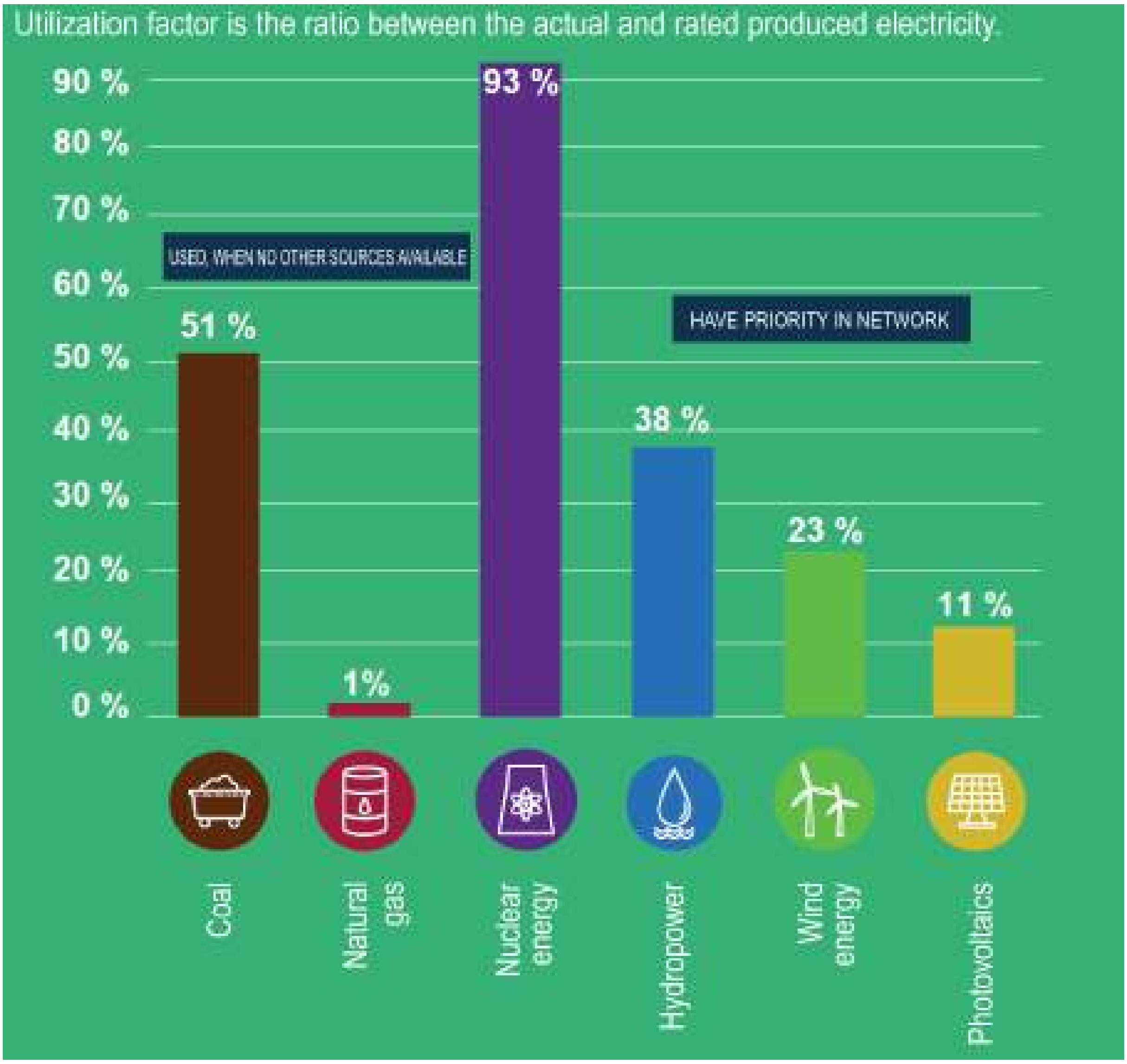


Figure 10: Annual electricity production with regard to the installed power. Source: »Report on the energy sector in Slovenia for 2019, Energy Agency of RS, Maribor, 2020«

6. Decommissioning Program

International standards and the relevant Slovenian laws (ZVISJV-1 [41]) lay down strict requirements regarding the approach to decommissioning and waste management for all nuclear facilities, NEK being the most important one. Pursuant to item 15, paragraph 2, Article 101 of ZVIJSV-1 [41], the Decommissioning Program is an integral part of the Safety Report.

As the experience with decommissioning of older pressurized-water nuclear power plants gathered over the years is already sufficient, cumulative generic data is available on decommissioning waste volumes and decommissioning costs. For all OECD member states, this type of data has been accumulated by OECD NEA for over 20 years, and periodically published in the reports on decommissioning approaches, strategies and costs [23]. Reports on decommissioning costs and methods are subject to periodic updating. On a global scale, decommissioning of nuclear facilities has become a mature and well-developed industry branch with various providers also featuring on the international markets. Given the above, decommissioning itself does not constitute a high and unpredictable cost as the uncertainties related to decommissioning costs are relatively few.

The decommissioning of NEK, disposal of radwaste and disposal of spent fuel are all joint responsibility of the contracting parties, the Republic of Slovenia and the Republic of Croatia, as determined in the Joint Convention from the preamble of the Treaty [26].

The two countries agree to provide an efficient joint solution for decommissioning and for disposal of radwaste and spent fuel in terms of economy and environmental protection.

The disposal of operational and decommissioning radioactive waste and spent fuel will be carried out in accordance with the Radwaste (RAO) and Spent Fuel (IG) Disposal Program. In cooperation with NEK d.o.o., the RAO and IG Disposal Program will be prepared according to international standards by a professional organization selected by the contracting parties.

In accordance with the Treaty [26], the first removal of Radwaste from NEK's NSRAO storage facility will take place in the 2023–2025 period. As the contracting parties failed to reach a common solution, and in accordance with the revision of the 3rd RAO Disposal Program [29], 50% of NSRAO will be disposed of at the Vrbina Repository, and another 50% in a long-term storage facility and later at a repository in the Republic of Croatia.

The Decommissioning Program also covers the management of all the decommissioning radioactive waste and other decommissioning waste, until its transport from the NEK premises, estimation of the financial assets needed, and its implementation deadlines.

The first description of the Decommissioning Program was provided in the document under the title »Development of the Site-Specific Decommissioning Plan for NEK, NIS Ingenierungeselschaft mbH«, April 1996 [18].

In accordance with Article 10 of the Treaty [26], a review has to be made every 5 years that includes the development of new findings in the field of decommissioning nuclear facilities.

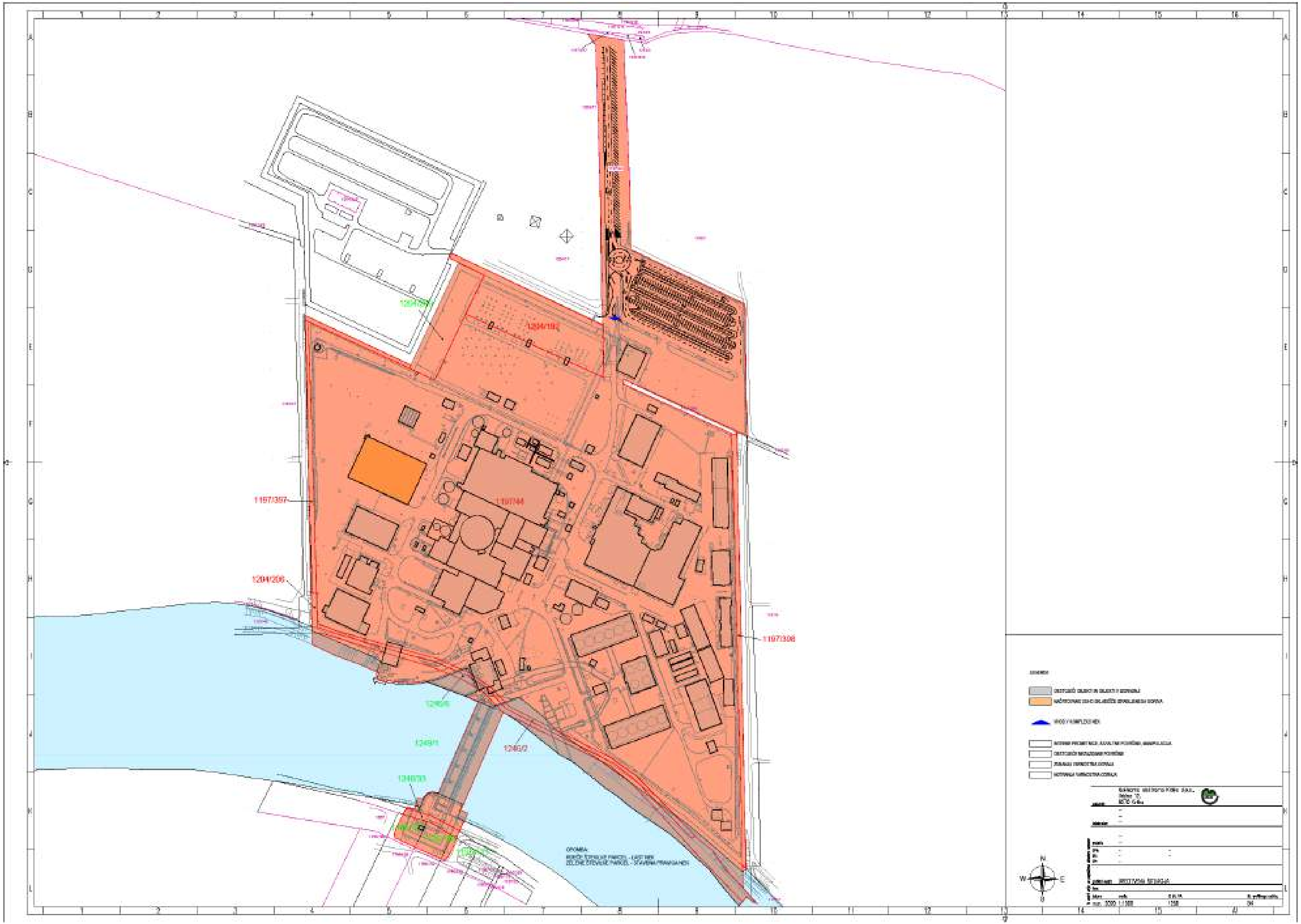
In 2019, the NEK Decommissioning Program, Rev. 3 [29] and the RAO Disposal Program, Rev. 3 [30] were prepared and signed by both contracting parties. In accordance with the Treaty [26] endorsed by the governments of RS and RH, financial assets for the NEK Decommissioning Program and the RAO Disposal Program are being raised within special funds. Both reports are publicly available at: https://www.sklad-nek.si/porocila-o-poslovanju [34] and http://www.fond-nek.hr/en/financial-assets/annual-reports/17 [35].

The objective of periodic reviews of the Decommissioning Program is to regularly review and reasonably implement new international standards while applying the best practices throughout the power plant's operation. These reviews are needed for the estimation of costs of the future decommissioning and radiological waste and spent fuel management, and they form a basis for decommissioning funds in Slovenia and Croatia. All the studies carried out in the past used the limiting conditions for NEK operation in the period up to the year 2023. In 2013, NEK adopted the URSJV Decision on the Modification of the Operating License [3], which means that all the studies were made in consideration of the operational life span extended to 2043.

The impacts of decommissioning will be further specified and assessed / evaluated for the operational life span in a special administrative procedure in accordance with the Decommissioning Program [29] and pursuant to ZVO-1, Decree on Activities affecting the Environment that require an Environmental Impact Assessment [37]; Attachment 1, Chapter D.II and ZVISJV-1 [41], Article 109.

7. Graphic Displays

1. Site Layout



8. Conclusions

The project of extending NEK operational life span from 40 to 60 years describes the power plant's status after the 2021 outage upon the issuance of the application for the Environmental Consent (OVS).

In its 40 years of operation, NEK has implemented all the upgrades needed for safe operation for a minimum additional period of 20 years. By the end of 2023, the project of building a dry storage facility for spent fuel will also be completed, which will further improve the nuclear and radiation safety of the plant.

The extension of NEK operational life span will leave the types of radioactive waste and the anticipated dynamics of its generation unchanged, the only difference being an increase in the total volume of spent fuel already taken into consideration in the project of building a dry storage facility for spent fuel, and the volume of low- and intermediate-level radioactive waste.

NEK has a valid open-ended operating license [3], as well as all the other permits needed ([2], [7], [8], [9], [4], [5]), such as the environmental emissions permit and the water resources abstraction permit. The extension of NEK operational life span will leave unchanged all the environmental and radiological conditions, and limitations stated in the valid permits.

In the process of electricity production, NEK generates virtually no greenhouse gas emissions, which ranks it among low-carbon energy producers. This fact is particularly important as NEK represents a key element in the creation of Slovenia's energy future.

In the NEK construction process, a minimum operational life span of 40 years was anticipated. During this period of time, however, a number of safety and other upgrades have been carried out, and numerous analyses have been performed. Due to all the safety upgrades, key equipment replacements, as well as other updates and safety and probability analyses, it can be concluded that in terms of safety and economy, the extension of NEK operational life span is the only reasonable and globally recognized solution. After the Safety Upgrade Program which will be completed in 2023 [21], NEK will be comparable to 3rd generation nuclear power plants.

9. References

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[2] Updated Safety Analysis Report (USAR), Rev. 27

[3] Operating License: Decision – Approval to Commence NEK Operation; Decision by the National Energy Inspectorate, No. 31-04/83-5, dated 6 February 1984, and the URSJV Decision, No. 3570-8/2012/5, Amendment to the Operating License for NEK, dated 22 April 2013

[4] ARSO Environmental Protection Permit: Environmental Protection Permit for the operation of NEK regarding emissions to water, No. 35441-103/2006-24, dated 30 June 2010, which was modified, a new Decision No. 35441-103/2006-33, dated 4 June 2012, was adopted for three of its items, and it was modified with Decision No. 35441-11/2013-3, dated 10 October 2013 (referred to as: OVD)

[5] ARSO Water Permit: Partial Water Permit, No. 35536-31/2006-16, dated 15 October 2009, and the Decision on the Modification of the Water Permit, No. 35536-54/2011-4, dated 8 November 2011, and the Decision on the Modification of the Water Permit, No. 35530-7/2018-2, dated 22 June 2018 (referred to as: VD)

[6] Location Permit: Decision by the National Secretariat for Urban Planning, No. 350/F-15/69, dated 8 August 1974, and the Decree on the NEK Development Plan UN 55/87; Official Gazette of SRS, No. 48/87; the Decree on the Modifications and Amendments of the Decree on the NEK Development Plan; Official Gazette of SRS No. 59/97, and the Decree on the Modifications and Amendments of the Decree on the NEK Development Plan; Official Gazette of SRS, No. 21/20

[7] NEK Technical Specifications, Rev. 181

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[12] Integrated National Energy and Climate Plan (NEPN) – adopted by the Government of the RS (Version 5.0), No. 35400-18/2019/22, 28 February 2020

[13] Bureau Veritas: ISO 14001:2015 Certificate, dated 20 November 2020

[14] Bureau Veritas: ISO 45001:2018 Certificate, dated 20 November 2020

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[22] URSJV Decision in the Administrative Case "Approval of the NEK Safety Upgrade Program, Rev. 3, and the Extension of the Implementation Deadline", No. 3570-11/2015/25, dated 20 January 2017

[23] Decommissioning Nuclear Power Plants, Policies, Strategies and Costs, OECD NEA 2003, Report No. 3590

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[25] URSJV Decision on the Implementation of an Extraordinary Safety Review of NEK, No. 3570-9/2011/2, dated 30 May 2011

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[27] Minutes and decisions by the Interstate Committee regarding the extension of NEK life span (PŽD NEK), dated 20 July 2015

[28] Resolution on the National Program for Managing Radioactive Waste and Spent Fuel for the Period of 2016–2025 (ReNPRRO16–25); Official Gazette of RS, No. 31/2016, dated 29 April 2016

[29] 3rd Revision of the NEK Decommissioning Program, Siempelkamp NIS for NPP Krško, Document No. 4520 / CA / F 010640 5 / 01, June 2019

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[33] PVO NEK (decontamination building), No. IJS DP-8190, Institute Jožef Stefan, February 2000

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48/12, 57/12, 92/13, 56/15, 102/15, 30/16, 61/17 – GZ, 21/18 – ZNOrg and 84/18 – ZIURKOE and 158/20 (referred to as: ZVO-1)

[37] Decree on Activities affecting the Environment that require an Environmental Impact Assessment; Official Gazette of RS, Nos. 51/14, 57/15, 26/17 and 105/20

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[39] Act Ratifying the Convention on Access to Information, Public Participation in Decision-Making, and Access to Justice in Environmental Matters (Official Gazette of RS –Interstate Treaties, No. 17/04); Aarhus Convention

[40] Nature Conservation Act (ZON); Official Gazette of RS, No. 96/04 – official consolidated text, 61/06 – ZDru-1, 8/10 – ZSKZ-B, 46/14, 21/18 – ZNOrg, 31/18 and 82/20

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[51] Analysis of Containment Cooling During and After DEC-B Accidents, NEK ESD-TR-18/15, Rev. 2

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[53] Analysis of Potential Division and Takeover of Operational and Decommissioning RW from Krško NPP, Extended Contents, Enconet and Ekonerg, 2018

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[57] Annual Report on Probabilistic Safety Assessments 2019

[58] MD-5 – NEK Aging Management Program, Rev.5

[59] TD-6 - Fire Safety Program - Fire Safety Rules, Rev. 3

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[70] URSJV Decision on the Approval of the Program of the 3rd Periodic Safety Review of NEK (PSR3 Program), No. 3570-7/2020/22, dated 23 December 2020

[71] Rules on Radiation Protection Measures in Controlled and Monitored Areas (Official Gazette of RS, No. 47/18); SV8A Rules

10. Attachments

10.1. Attachment 1: List of Building Permits

1. Permit issued by the National Secretariat for Economic Affairs, Ljubljana, No. 352-265/73-VI/ST, 12 May 1973, for laying below-ground telephone lines to NEK (*Dovoljenje Republiškega sekretariata za gospodarstvo Ljubljana št. 352-265/73-VI/ST, 12.05.1973, za položitev zemeljskih kablov za telefonsko povezavo NE Krško*)
2. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16/75, 17 February 1975, for the execution of preliminary activities for the construction of NEK at Vrbina near Krško (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16/75, 17.02.1975, za izvršitev pripravljalnih del za gradnjo NE Krško v Vrbini pri Krškem*)
3. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16/75-ind/SE, 26 March 1975, for the construction works for deep excavations of a building pit *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16/75-ind/SE, 26.03.1975, za gradbena dela za globoke izkope gradbene jame*)
4. Building permit issued by the Krško Municipality, No. 3-351-765/74, 12 April 1975, for 12 additional barracks as part of temporary housing for workers (*Gradbeno dovoljenje Skupščine občine Krško št. 3-351-765/74, 12.04.1975, za nadaljnjih 12 stanovanjskih barak v sklopu začasnega delavskega naselja)*
5. Building permit issued by the Krško Municipality, No. 3-351-765/74, 12 April 1975, for the execution of preliminary works for the construction of a new residential complex located at a pond in Krško. (*Gradbeno dovoljenje Skupščine občine Krško št. 3-351-353/75, 27 May 1975, za izvedbo pripravljalnih del za gradnjo novega stanovanjskega naselja pri ribniku v Krškem*)
6. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16/75-ind/SE, 16 June 1975, for the Phase II construction of an auxiliary building and RHR-M-elevation 82.25 (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16/75-ind/SE, 16.06.1975, za gradnjo faze II-Pomožne zgradbe & RHR-M-kota 82.25*)
7. Building permit issued by the Krško Municipality, No. 3-351-353/75, 20 June 1975, for the construction of the following facilities: a prefabricated residential barrack for workers, a provisional restaurant, a water distribution system, a sewage system, a power distribution system, and outdoor lighting, a wastewater treatment plant, a hot water distribution system (*Gradbeno dovoljenje Skupščine občine Krško št. 3-351-353/75, 20.06.1975, za gradnjo objektov: montažno stanovanjska baraka, provizorij restavracije, vodovod, kanalizacija, energetski razvod in zunanja razsvetljava, čistilna naprava, toplovodni razvod*)
8. Building permit issued by the Krško Municipality, No. 3-351-353/75, 7 October 1975, for the construction of prefabricated residential homes within the “Building along Zdolska cesta” housing complex (*Gradbeno dovoljenje Skupščine občine Krško št. 3-351-353/75, 7.10.1975, za gradnjo montažnih stanovanjskih hiš na kompleksu* "Zazidava ob Zdolski cesti”
9. Permit issued by the National Secretariat for Industry, No. 351/B-16-6/75-KO, 27 October 1975, for the Phase 4A construction of foundations of an auxiliary building at elevations 94.21 and 97.26, Phase 4B construction of foundations of an intermediate building, Phase 11-auxiliary building between elevations 82.85 and 89.64 (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-6/75-KO, 27.10.1975, za gradnjo faze 4A-temelji pomožne zgradbe na kotah 94.21 in 97.26, faze 4B temelji vmesne zgradbe, faze 11-pomožna zgradba od kote 82.85 do kote 89.64)*
10. Permit issued by the National Secretariat for Industry, No. 351/B-16/75-ind/SE, 7 November 1975, for the Phase III construction of foundations of the reactor building (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16/75-ind/SE, 7.11.1975, za gradnjo faze III-temeljev reaktorske zgradbe*)

11. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-7/75-KO, 13 November 1975, for the construction of Phase 29 B, Phase 44, Phase 5 A, Phase 5 C and Phase 12 A (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-7/75-KO, 13.11.1975, za gradnjo faze 29 B, faze 44, faze 5 A, faze 5 C in faze 12 A)*
12. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-8/75-KO, 25 November 1975, for the construction of a shield building from elevation 100.3 m to elevation 106.3 m, and the containment vessel – steel shell on the basis of technical documents (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-8/75-KO, 25.11.1975, za gradnjo zaščitne zgradbe od kote 100.3 do 106.3m in zadrževalnega hrama-jeklene lupine po tehnični dokumentaciji*)
13. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-9/75-KO, 27 November 1975, for the construction of a 70 m high meteorological tower *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-9/75-KO, 27.11.1975, za gradnjo meteorološkega stolpa H 70 m)*
14. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-10/75-KO, 16 December 1975, for the construction of an auxiliary building from elevation 94.32 m to elevation 100.3 m, and a foundation plate for fuel-handling buildings (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-10/75-KO, 16.12.1975, za gradnjo pomožne zgradbe od kote 94.21 do 100.3m in temeljne plošče za zgradbe za ravnanje z gorivom*)
15. Building permit issued by the Krško Municipality, No. 351-694/75, 25 December 1975, for the construction of a central disposal facility in the bonded warehouse (*Gradbeno dovoljenje Skupščine občine Krško št. 351-694/75, 25.12.1975, za gradnjo centralne deponije v carinskem skladišču*
16. Permit by the National Secretariat for Industry, No. 351/B-16-11/75, 16 January 1976, for the construction of a weather station (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-11/75, 16.01.1976, za gradnjo meteorološke postaje*)
17. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-12/76-KO, 21 January 1976, for the construction of Phase 8, 31, a supplement to NP 13, 17A, 34, 35, 36, and a supplement to NP 34, 35, 36 (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-12/76-KO, 21.01.1976, za gradnjo faze 8, 13 in dodatek k NP 13, 17A, 34, 35, 36 in dodatek k NP 34, 35, 36*)
18. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-14/76-KO, 20 February 1976, for the construction of a fuel-handling building and a turbine building – foundation plate (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-14/76-KO, 20.02.1976, za gradnjo zgradbe za ravnanje z gorivom in turbinsko zgradbo-temeljna plošča*)
19. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16/13/76-KO, 2 March 1976, for the construction of an access road C III Phase I, and the Potočnica culvert *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16/13/76-KO, 2.03.1976, za gradnjo dovozne ceste C III I.faza in propusta Potočnica*)
20. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-20/76-KO, 7 March 1976, for the construction of a control building (Phase 20), and a component-cooling system building (Phase 23) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-20/76-KO, 7.03.1976, za gradnjo komandne zgradbe (faza 20) in zgradbe sistemov za hlajenje komponent (faza 23*)

21. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-30/75-KO, 11 April 1976, for the construction of an intermediate building (Phase 19), fuel-handling building (Phase 28), turbine building, service elevation (Phase 32), reactor building (Phases 37 and 38) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-30/75-KO, 11.04.1976, za gradnjo vmesne zgradbe (faza 19), zgradbe za ravnanje z gorivom (faza 28), turbinska zgradba, posluževalna kota (faza 32), reaktorske zgradbe (faza 37 in 38)*
22. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-15/75-KO, 14 April 1976, for the construction of a fuel-handling building (Phase 25) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-15/75-KO, 14.04.1976, za gradnjo zgradbe za ravnanje z gorivom (faza 25)*
23. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-17/76-KO, 27 May 1976, for the construction of a neutralization pool for waste regeneration water (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-17/76-KO, 27.05.1976, za gradnjo nevtralizacijskega bazena za odpadno regeneracijsko vodo)*
24. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16/19/76-KO, 18 June 1976, for the construction of an industrial siding (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16/19/76-KO, 18.06.1976, za gradnjo industrijskega tira*)
25. Permit issued by the National Secretariat for Industry Ljubljana, No. 351/B-16-21/76-KO, 7 July 1976, for the construction of a turbine building (Phase 31) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-21/76-KO, 7.07.1976, za gradnjo turbinske zgradbe (faza 31*)
26. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-22/76-KO, 28 July 1976, for the construction of an auxiliary building (Phase 14) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-22/76-KO, 28.07.1976, za gradnjo pomožne zgradbe (faza 14)*
27. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-18/76-KO, 6 August 1976, for the construction of Phases 27 and 17 B (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-18/76-KO, 6.08.1976, za gradnjo faze 27 in 17B*)
28. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16/23-76-MA, 16 August 1976, for an alteration of the fuel pipeline passage under the C III access road in Krško (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16/23-76-MA, 16.08.1976, za rekonstrukcijo prehoda cevovoda za gorivo pod dovozno cesto C III v Krškem*)
29. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-26/76-KO, 23 August 1976, for the construction of a component-cooling system building (Phase 24) *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-26/76-KO, 23.08.1976, za gradnjo zgradbe sistemov za hlajenje komponent (faza 24)*
30. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-25/76-KO, 23 August 1976, for the construction of an intermediate building (Phase 18) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-25/76-KO, 23.08.1976, za gradnjo vmesne zgradbe (faza 18)*
31. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-24/76-KO, 23 August 1976, for the construction of an access road III (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-24/76-KO, 23.08.1976, za gradnjo dovozne ceste III*)
32. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-27/75-KO, 27 August 1976, for the construction of an auxiliary building (Phase 15) and a control building

(Phase 21) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-27/75-KO, 27.08.1976, za gradnjo pomožne zgradbe (faza 15) in komandne zgradbe (faza 21)*

33. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-28/76-KO, 9 September 1976, for the construction of a shield building (Phase 9) and a turbine building (Phase 32) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-28/76-KO, 9.09.1976, za gradnjo zaščitne zgradbe (faza 9) in turbinske zgradbe (faza 32)*
34. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-16/75, 5 November 1976, for the fencing off of a building pit for the dam on the Sava river *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-16/75, 5.11.1976, za gradnjo-ograditev gradbene jame za jez na Savi)*
35. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-31/76-KO, 22 November 1976, for the construction of a control building (Phase 22) *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-31/76-KO, 22.11.1976, za gradnjo kontrolne zgradbe (faza 22)*
36. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-29/76, 10 December 1976, for the construction – excavation of an Essential Water pumping station (Phase 48) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-29/76, 10.12.1976, za gradnjo - izkop za črpališče bistvene vode (faza 48)*
37. Building permit issued by the Krško Municipality, No. 5-351-583/76, 13 December 1976, for the storage area for gases, dyes and prefabricated components within the central disposal facility (*Gradbeno dovoljenje Skupščine občine Krško št. 5-351-583/76, 13.12.1976, za skladišče plinov, barv in montažnih delov v sklopu centralne deponije*)
38. Decision by the National Committee for Transport and Communications, No. 340/F-31/76-I/MA, 23 December 1976, the Slovenian Railways company (ŽG) shall renovate the road surface of the railway crossing within the 466+409 km section of the Zagreb – Sežana railway line (Stara vas – Krško secondary road), following all applicable technical regulations (*Odločba Republiškega komiteja za promet in zveze št. 340/F-31/76-I/MA, 23.12.1976, ŽG je dolžno obnoviti in po veljavnih tehničnih predpisih urediti vozišče cestnega prehoda v km 466+409 železniške proge Zagreb-Sežana(lokalna cesta Stara vas-Krško)*
39. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-62/77, 31 March 1977, for the construction-reinforcement of the bridge across the Sava river near Brežice. *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-62/77, 31.03.1977, za gradnjo-ojačitev mostu čez Savo pri Brežicah)*
40. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-32/75, 1 April 1977, for the construction of a turbine building and a roof over the heating room section (Phase 33) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-32/75, 1.04.1977, za gradnjo turbinske zgradbe in strehe predelka za grelnico (faza 33*)
41. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-2/77-KO, 13 April 1977, for the construction of a turbine building – stepped towers (Phase 33A) and a building for two emergency diesel power generators (Phase 6) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-2/77-KO, 13.04.1977, za gradnjo turbinske zgradbe -stopnični stolpi (faza 33A) in zgradbe za zasilna diesel agregata (faza 6)*
42. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-5/77-KO, 14 April 1977, for the construction of a dam across the Sava river, a cooling water pumping station, a cooling water discharge facility, an Essential Supply Water pumping station (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-5/77-KO, 14.04.1977,*

za gradnjo jezu preko Save, Črpalnice za hladilno vodo, iztočni objekt hladilne vode, črpalnice bistvene oskrbne vode)

43. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-4/77-KO, 14 April 1977, for the construction of cooling water tunnels outside the turbine building (Phase 44 ADO) and a shield building dome (Phase 10) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-4/77-KO, 14.04.1977, za gradnjo tunelov za hladilno vodo izven turbinske zgradbe (faza 44 ADD) in zaščitna zgradba kupola (faza 10)*

44. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/8-77-KO, 23 May 1977, for the construction of a facility for two emergency diesel generators at elevation 100.30-107.62 m (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/8-77-KO, 23.05.1977, za gradnjo zgradbe za zasilna diesel agregata od kote 100.30-107.62 m*)

45. Building permit issued by the Krško Municipality, No. 5-351-460/75, 23 May 1977, for the construction of a water supply system leading from the main line FI 250 at the Pirc family's residential home across the military bridge to NEK (*Gradbeno dovoljenje Skupščine občine Krško št. 5-351-460/75, 23.05.1977, za gradnjo vodovoda od glavnega voda FI 250 pri stanovanjski hiši Pirc preko vojaškega mostu do NEK*)

46. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-6/77-KO, 17 June 1977, for the construction of a 380 and 110 kV switchyard (Phase 55) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-6/77-KO, 17.06.1977, za gradnjo stikališča 380 in 110 kV (faza 55)*

47. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-9/77-KO, 28 June 1977, for the construction of high-water embankments on the left bank of the Sava river as part of hydrotechnical facilities (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-9/77-KO, 28.06.1977, za gradnjo visokovodnih nasipov na levem bregu Save v sklopu hidrotehničnih objektov)*

48. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-1/77, 4 July 1977, for the construction of a reactor building (Phase 39) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-1/77, 4.07.1977, za gradnjo reaktorske zgradbe (faza 39*)

49. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-11/77-KO, 19 July 1977, for the construction of various foundations and a turbine building (Phase 33/Rev) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-11/77-KO, 19.07.1977, za gradnjo raznih temeljev in turbinske zgradbe (faza 33/Rev*)

50. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/10-77-KO, 19 July 1977, for the construction of a reactor building - inner reinforced-concrete construction between elevation 96.04 m and elevation 115.5 m (Phase 40) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/10-77-KO, 19.07.1977, za gradnjo reaktorske zgradbe-notranja armiranobetonska konstrukcija od kote 96.04 do 115.55 m (faza 40)*

51. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-3/77-KO, 24 August 1977, for the installation of technology systems, supporting systems and electrical systems in the auxiliary building, the fuel-handling building, and the component-cooling building (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-3/77-KO, 24.08.1977, za vgradnjo tehnoloških, pomožnih in električnih sistemov v pomožni zgradbi, zgradbi za ravnanje z gorivom in zgradbi za hlajenje komponent)*

52. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-12/77-KO, 29 August 1977, for the construction of an inner reinforced-concrete reactor building above

elevation 115.55 m (Phase 44) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-12/77-KO, 29.08.1977, za gradnjo notranje armiranobetonske konstrukcije reaktorske zgradbe nad koto 115.55 m (faza 44*)

53. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-16-30/75-KO, 6 September 1977, for the construction of a reactor building + Phase 37 and Phase 38 (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-16-30/75-KO, 6.09.1977, za gradnjo reaktorske zgradbe + faza 37 in faza 38)*

54. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-15/77-KO, 10 October 1977, for the construction of wire conduits on the NEK plateau (Phase 55A) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-15/77-KO, 10.10.1977, za gradnjo kabelskih kanalov na platoju (faza 55A)*

55. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-14/77-KO, 21 October 1977, for the construction of the systems as indicated in the Permit (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-14/77-KO, 21.10.1977, za gradnjo sistemov, kot je navedeno v dovoljenju)*

56. Building permit issued by the Krško Municipality, No. 5-351-628/77, 25 October 1977, for the erection of a 2x20 kV power line on the Djuro Salaj factory section (Krško) (*Gradbeno dovoljenje Skupščine občine Krško št. 5-351-628/77, 25.10.1977, za postavitev DV 2x20 kV Brestanica -Roto Krško na odseku Tov. Djuro Salaj Krško)*

57. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-6/77-KO, 5 November 1977, for the construction of a 380 and 110 kV switchyard (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-6/77-KO, 5.11.1977, za gradnjo stikališča 380 in 110 kV)*

58. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-16/77-KO, 10 November 1977, for the construction of Phase 53 – architectural works, tradesmen's activities, and construction works on auxiliary buildings *(Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-16/77-KO, 10.11.1977, za izgradnjo faze 53- arhitektura in obrtniško gradbena dela pomožnih zgradb)*

59. Building permit issued by the Krško Municipality, No. 5-351-461/77, 9 December 1977, for the consolidation and fencing off of an expanded temporary warehouse for piping materials (*Gradbeno dovoljenje Skupščine občine Krško št. 5-351-461/77, 9.12.1977, za utrditev in ograditev razširjenega začasnega skladišča za cevni material*)

60. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-19/77-KO, 2 January 1978, for the construction of various foundations for transformers on the NEK plateau (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-19/77-KO, 2.01.1978, za gradnjo raznih temeljev transformatorjev na platoju NEK)*

61. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-17/77-KO, 18 January 1978, for the installation of technology systems in the turbine building within the Inlet and outlet structure (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-17/77-KO, 18.01.1978, za vgradnjo tehnoloških sistemov v turbinski zgradbi v vtočnem in iztočnem objektu)*

62. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-18/78, 27 January 1978, for the construction of a water decarbonization plant (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-18/78, 27.01.1978, za gradnjo objekta za dekarbonizacijo vode)*

63. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-20/78-KO, 28 February 1978, for the construction of an auxiliary boiler house (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-20/78-KO, 28.02.1978, za gradnjo pomožne kotlovnice*)
64. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/21-78-KV, 31 May 1978, for the construction of a head office building and a repair shop, and a safety barrier within the NEK construction process (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/21-78-KV, 31.05.1978, za gradnjo upravne zgradbe in servisne delavnice ter varnostne ograje v sklopu izgradnje NEK*)
65. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-22/77-IND/KV, 26 June 1978, for the construction of an industrial siding on the NEK plateau (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-22/77-IND/KV, 26.06.1978, za gradnjo industrijskega tira na platoju NEK)*
66. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-23/78-MA, 8 September 1978, for the Phase I construction of a parking area and a gatekeeper station with the entrance into NEK) (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-23/78-MA, 8.09.1978, za gradnjo Parkirišča I. faza in Vratarnice z vhodom v NEK)*
67. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/24/78-KO, 18 September 1978, for the construction of a 5-year radwaste storage area (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/24/78-KO, 18.09.1978, za gradnjo petletnega skladišča radioaktivnih odpadkov)*
68. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-18/78-KO, 25 September 1978, for the construction of a water decarbonization plant in accordance with the amended technical documents (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-18/78-KO, 25.09.1978, za gradnjo objekta za dekarbonizacijo voda po dopolnjeni tehnični dokumentaciji)*
69. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-25/78-KO, 10 November 1978, for the construction of power connections of the NEK facilities (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-25/78-KO, 10.11.1978, za gradnjo elektroenergetskih povezav objektov NEK)*
70. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/23-78-KO, 12 November 1978, for the construction of an outdoor lighting system for the plateau and the electrical part of the gatekeeper station (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/23-78-KO, 12.11.1978, za gradnjo zunanje razsvetljave platoja in elektro del vratarnice)*
71. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-26/78-KO, 22 November 1978, for the construction of a fuel storage facility for the auxiliary boiler room, and two emergency diesel generators (Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-26/78-KO, 22.11.1978, za gradnjo skladišča goriva za pomožno kotlarno in zasilna diesel agregata)
72. Permit issued by the National Secretariat for Industry, Ljubljana, No. 16/79-KO, 19 February 1979, for construction – security of NEK (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 16/79-KO, 19.02.1979, za gradnjo-zavarovanje NEK)*
73. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-27/79, 20 February 1979, for the construction of a potable water supply network and a decarbonated process water distribution system on the NEK plateau (*Dovoljenje Republiškega sekretariata za*

industrijo Ljubljana št. 351/B-56-27/79, 20.02.1979, za gradnjo omrežja pitne vode in razvoda dekarbonirane tehnološke vode na platoju v NEK)

74. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/28-77/KO, 27 February 1979, for the construction of cooling water distribution ducts between the cooling towers and the Sava river (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/28-77/KO, 27.02.1979, za gradnjo razvodov hladilne vode med hladilnimi stolpi in Savo*)
75. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/31-77-KO, 4 March 1979, for the construction of a sewerage system for the plateau (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/31-77-KO, 4.03.1979, za gradnjo kanalizacije platoja)*
76. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/30-77-KO, 27 March 1979, for the construction of installations into the head office building and the repair shops (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/30-77-KO, 27.03.1979, za gradnjo inštalacij v upravno zgradbo in servisne delavnice*)
77. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-33/79-KO, 20 April 1979, for the construction of the main earthing system of the power plant (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-33/79-KO, 20.04.1979, za gradnjo glavne ozemljitve elektrarne)*
78. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56-32/78-KO, 20 April 1979, for the construction of cooling towers (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56-32/78-KO, 20.04.1979, za gradnjo hladilnih stolpov*)
79. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/34-77/KO, 17 May 1979, for the construction of TP 1 and TP 3 transformer stations (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/34-77/KO, 17.05.1979, za gradnjo transformatorskih postaj TP 1 in TP 3)*
80. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/35/77-8, 26 June 1979, for the construction of the NEK outdoor hydrant system (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/35/77-8, 26.06.1979, za gradnjo zunanjega hidrantnega omrežja NEK)*
81. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/38-77-8, 9 July 1979, for the construction of a flood embankment along the Potočnica stream (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/38-77-8, 9.07.1979, za gradnjo visokovodnega nasipa ob Potočnici*)
82. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/31-77-82, 11 August 1979, for the construction of a rainwater drainage system with a pumping station (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/31-77-82, 11.08.1979, za gradnjo podavinske kanalizacije s črpalno postajo*)
83. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/29-78-KO, 3 December 1979, for construction – grading, paving and utility works and roads on the NEK plateau (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/29-78-KO, 3.12.1979, za gradnjo-zunanja ureditev s komunikacijami na platoju NEK)*
84. Permit issued by the National Secretariat for Industry, Ljubljana, No. 351/B-56/40-79-8, 28 January 1980, for the construction of foundations for a hydrogen, oxygen and nitrogen gas cylinder storage facility, a platform for drum and wagon washing, and a platform for mobile air compressors (*Dovoljenje Republiškega sekretariata za industrijo Ljubljana št. 351/B-56/40-79-*

8, 28.01.1980, za gradnjo temeljev za skladišče jeklenk za vodik, kisik in dušik, ploščad za pranje sodov in vagonov in ploščad za prenosne kompresorje za zrak)

85. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/4-80-8, 7 February 1980, for the construction of a personnel elevator for 13 individuals, 1000 kg load capacity (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/4-80-8, 7.02.1980, za gradnjo osebnega dvigala za 13 oseb nosilnosti 1000 kg)*

86. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/8-80-8, 12 February 1980, for the construction of an accurate time system *(Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/8-80-8, 12.02.1980, za gradnjo sistema točnega časa)*

87. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/5-80-8, 9 March 1980, for the construction of a 110/70 oC water distribution system from the TS 100 heating station up to 1 m outside the turbine section (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/5-80-8, 9.03.1980, za gradnjo razvoda vode 110/70 oC od toplotne postaje TS 100 do 1 m izven turbinskega dela)*

88. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/7-80-8, 11 May 1980, for the construction of a condensate purification plant (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/7-80-8, 11.05.1980, za gradnjo postroja za čiščenje kondenzata)*

89. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/2-80-8, 6 June 1980, for the construction of a well on the right bank of the Sava river *(Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/2-80-8, 6.06.1980, za gradnjo vodnjaka na desnem bregu Save)*

90. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/1-80-8, 6 June 1980, for the construction of a TP 2/1000 kVA 6.3/0.4 kV transformer station (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/1-80-8, 6.06.1980, za gradnjo transformatorske postaje TP 2/1000 kVA 6.3/0.4 kV*)

91. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/3-80-8, 18 June 1980, for the construction of a TS 100 heat station (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/3-80-8, 18.06.1980, za gradnjo toplotne postaje TS 100)*

92. Building permit issued by the Krško Municipality, No. 5-351-526/79, 4 August 1980, for laying a local telephone cable between the Agrokombinat Krško cold storage plant and the NEK facility (*Gradbeno dovoljenje Skupščine občine Krško št. 5-351-526/79, 4.08.1980, za postavitev krajevnega telefonskega kabla od hladilnice Agrokombinata Krško do objekta NEK)*

93. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/3-80-8, 28 August 1980, for the construction of a hot water distribution system on the NEK plateau (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/3-80-8, 28.08.1980, za gradnjo toplovodnega omrežja na platoju NEK*)

94. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/6-80-8, 19 September 1980, for the construction of a 380 and 110 kV switchyard in compliance with the amended technical documents *(Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/6-80-8, 19.09.1980, za gradnjo stikališča 380 in 110 kV po spremenjeni tehnični dokumentaciji)*

95. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/11-81, 17 March 1981, for the construction of a public address system on the NEK plateau (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/11-81, 17.03.1981, za gradnjo sistema razglasa na platoju NEK)*
96. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/13-80-8, 25 May 1981, for the construction of a storage facility for flammable liquids and gases, and a compressor station (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/13-80-8, 25.05.1981, za gradnjo skladišča vnetljivih tekočin in plinov ter kompresorske postaje)*
97. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/15-80-8, 10 July 1981, for the Phase II construction of a head office building complex, and a bunker on the basis of the projects listed in the relevant decision (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/15-80-8, 10.07.1981, za gradnjo upravnega kompleksa II. faza ter zaklonišča po navedenih projektih iz odločbe)*
98. Decision by the Krško Municipality, No. 5-351-460/75, 10 July 1981, for the construction of a water distribution system between the main FI 250 duct and NEK in accordance with the relevant amendments (*Odločba Skupščine občine Krško št. 5-351-460/75, 10.07.1981, za gradnjo vodovoda od glavnega voda FI 250 do NEK z upoštevanjem dopolnitev*)
99. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-7/81-8, 23 July 1981, for the construction of a FTR 200 G microwave barrier (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-7/81-8, 23.07.1981, za gradnjo mikrovalovne baraže FTR 200 G)*
100. Permit issued by the National Committee for Energy, Industry and Civil Engineering, No. 351/B-48/14-80-8, 23 July 1981, for the construction of a carbonate sludge pool (*Dovoljenje Republiškega komiteja za energetiko, industrijo in gradbeništvo št. 351/B-48/14-80-8, 23.07.1981, za gradnjo bazena karbonatnega mulja)*
101. Building permit issued by the Krško Municipality, No. 5-351-43/75, 10 August 1981, for the reconstruction of access road II (*Gradbeno dovoljenje Skupščine občine Krško št. 5-351-43/75, 10.08.1981, za rekonstrukcijo pristopne ceste II.)*
102. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/82-5-8, 17 May 1982, for the Phase II construction of a head office building complex on the basis of the projects listed in the relevant decision (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/82-5-8, 17.05.1982, za gradnjo upravnega kompleksa II.faza po navedenih projektih iz odločbe)*
103. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/82-57/8, 30 June 1982, for the Phase II construction of a head office building complex on the basis of the projects listed in the relevant decision *(Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/82-57/8, 30.06.1982, za gradnjo upravnega kompleksa II.faza po navedenih projektih iz odločbe)*
104. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/82-192, 1 December 1983, for the construction of a generator plant (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/82-192, 1.12.1983, za gradnjo agregatskega postrojenja)*
105. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/83-425, 16 December 1983, for the construction of a butane gas station (*Dovoljenje Republiškega*

komiteja za industrijo in gradbeništvo št. 351-05/83-425, 16.12.1983, za gradnjo postaje za butan)

106. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/84-654, 7 December 1984, for an alteration of the CW system (cooling water pumping station) *(Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/84-654, 7.12.1984, za adaptacijo CW sistema (črpališča hladilne vode)*

107. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/85-80, 30 July 1985, for the construction of a parking garage for emergency vehicles, repair shops, and a security service building (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/85-80, 30.07.1985, za gradnjo garaže intervencijskih vozil, mehanične delavnice in prostorov službe zavarovanja)*

108. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/84-654, 10 October 1985, for laying high- sand low-voltage current installations in the CW system facility (cooling water pumping station) (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/84-654, 10.10.1985, za vgradnjo instalacij za jaki in šibki tok v objektu CW sistema (črpališče hladilne vode)*

109. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/85-270, 26 November 1985, for the construction of a radiation protection building (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/85-270, 26.11.1985, za gradnjo objekta za radiološko zaščito)*

110. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-05/85-259, 2 June 1986, for the construction of two overhanging roofs on the flammable liquid storage facility (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-05/85-259, 2.06.1986, za gradnjo dveh nadstrešnic pri skladišču vnetljivih tekočin*)

111. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-01/89-83, 5 October 1989, for the construction of a storage facility for spare parts and equipment (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-01/89-83, 5.10.1989, za gradnjo skladišča rezervnih delov in opreme)*

112. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-01/90-390, 4 June 1990, for the construction of a waste oil storage facility (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-01/90-390, 4.06.1990, za gradnjo skladišča odpadnih olj)*

113. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-01/89-83, 5 July 1991, for installing elevators n the storage facility for spare parts and equipment (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-01/89-83, 5.07.1991, za montažo dvigal v objekt skladišče rezervnih delov in opreme*)

114. Permit issued by the National Committee for Industry and Civil Engineering, No. 351-01/92-1008, 19 May 1992, for extending the current gatekeeper station (*Dovoljenje Republiškega komiteja za industrijo in gradbeništvo št. 351-01/92-1008, 19.05.1992, za dozidavo obstoječe vratarnice)*

115. Notification of the Ministry of Economic Affairs, No. 351-01/159-93/DR, 10 April 1993, for the erection of a seismic monitoring station has been duly noted (*Priglasitev Ministrstva za gospodarske dejavnosti št. 351-01/159-93/DR, 10.04.1993, za postavitev seizmološke opazovalnice je vzeta na znanje).*

116. Building permit issued by MOP, No. 351-01-23/95, 28 March 1995, for the construction of a 2xKB 20 kV+PE02-2x50 RTP 110/20 kV power line Krško-TP Customs office - RTP 400/110 kV

Krško (*Gradbeno dovoljenje MOP št. 351-01-23/95, 28.03.1995, za gradnjo kablovoda 2xKB 20 kV+PE02-2x50 RTP 110/20 kV Krško-TP Carinarnica - RTP 400/110 kV Krško)*

117. Building permit issued by MOP, No. 351-01-36/97, 21 July 1997, for the reconstruction of workshops on the ground floor, kitchen, restaurant with the relevant program, and doctor's office within NEK (*Gradbeno dovoljenje MOP št. 351-01-36/97, 21.07.1997, za rekonstrukcijo delavnic v pritličju, kuhinje, restavracije s spremljajočim programom ter ambulante v okviru objekta NEK*)
118. Combined permit issued by MOP, No. 350-03-63/97-MD/TŠ, 14 October 1998E, for the construction of a simulator building (*Enotno dovoljenje MOP št. 350-03-63/97-MD/TŠ, 14.10.1998, za gradnjo zgradbe za simulator*)
119. Combined permit issued by MOP, No. 350-03-63/97-MD/TŠ, 4 January 1999, for the construction of a decontamination building (*Enotno dovoljenje MOP št. 350-03-63/97-MD/TŠ, 4.01.1999, za gradnjo objekta za dekontaminacijo*)
120. Combined permit issued by the Brežice Administrative Unit, No. 35102-254/99-152, 11 May 1999, for the construction of a continuous-sampling station (*Enotno dovoljenje Upravna enota Brežice št. 35102-254/99-152, 11.05.1999, za gradnjo postaje za neprekinjeno vzorčenje*)
121. Combined permit issued by MOP, No. *350-03-63/97-TŠ,JK*, 13 May 1999, for the construction of a parking area and an access road (*Enotno dovoljenje MOP št. 350-03-63/97-TŠ,JK, 13.05.1999, za gradnjo parkirišča in dovozne ceste*)
122. Combined permit issued by MOP, No. 350-03-64/99-TŠ, 18 February 2000, for the paving and grading of the area surrounding the decontamination building (*Enotno dovoljenje MOP št. 350-03-64/99-TŠ, 18.02.2000, za izvedbo Zunanje ureditve objekta za dekontaminacijo*)
123. Building permit issued by MOP, No. 351-01-97/99, 20 March 2000, for the reconstruction – replacement of evaporators at NEK (*Gradbeno dovoljenje MOP št. 351-01-97/99, 20.03.2000, za rekonstrukcijo - zamenjavo uparjalnikov v NE Krško)*
124. Building permit issued by MOP, No. 35105-41/2010-TŠ,HČ, 11 August 2010, for the construction of the DG3 facility (*Gradbeno dovoljenje MOP št. 35105-41/2010-TŠ,HČ, 11.08.2010, za gradnjo objekta DG3)*
125. Building permit issued by MOP, No. 35105-110/2011/4-TŠ,HČ, 1 December 2011, for the reconstruction of Hangar 07 into offices and workshops) (*Gradbeno dovoljenje MOP št. 35105-110/2011/4-TŠ,HČ, 1.12.2011, za rekonstrukcijo hangerja 07 za ureditev pisarn in delavnic)*
126. Building permit issued by MOP, No. 35105-3/2012/2-TŠ,HČ, 23 January 2012, for the reconstruction of a mobile equipment facility (*Gradbeno dovoljenje MOP št. 35105-3/2012/2-TŠ,HČ, 23.01.2012, za rekonstrukcijo objekta za mobilno opremo)*
127. Building permit issued by the Ministry of Transport, No. 35105-11/2012/TŠ,HČ, 28 March 2012, for the reconstruction of the RTP Krško 400/110 kV switchyard (*Gradbeno dovoljenje MZP št. 35105-11/2012/TŠ,HČ, 28.03.2012, za rekonstrukcijo stikališča RTP Krško 400/110 kV*)
128. Building permit issued by the Ministry of Transport, No. 35105-25/2014/5-01031383 TŠ, GB, 16 June 2014, for the construction of the WMB facility (Phases 1 and 2) (*Gradbeno dovoljenje MZP št. 35105-25/2014/5-01031383 TŠ, GB, 16.06.2014, za gradnjo objekta WMB (1. in 2. faza*)
129. Building permit issued by MOP, No. 35105-10/2015/6 1093-08 VC,HČ, 18 June 2015, for the construction of an operational & supporting center) (*Gradbeno dovoljenje MOP št. 35105-10/2015/6 1093-08 VC,HČ, 18.06.2015, za gradnjo operativno podpornega centra OPC*)
130. Building permit issued by the Krško Administrative Unit, No. 351-290/2015/17, 4 September 2015, for the construction of an outage container complex (*Gradbeno dovoljenje Upravne*

enote Krško št. 351-290/2015/17, 4.09.2015, za gradnjo remontnega kontejnerskega kompleksa)

131. Partial building permit issued by MOP, No. 35105-13-2016-14 1093-04 TŠ, 30 May 2016, for the reconstruction of the NEK weir *(Delno gradbeno dovoljenje MOP št. 35105-13-2016-14 1093-04 TŠ, 30.05.2016, za rekonstrukcijo jezovne zgradbe NEK)*
132. Building permit issued by MOP, No. 35105-52/2016/5 1093-04 TŠ, 3 August 2016, for the construction of cable connections between the AB-MHE30 and BB1 facilities at NEK (*Gradbeno dovoljenje MOP št. 35105-52/2016/5 1093-04 TŠ, 3.08.2016, za gradnjo kabelskih povezav med objektoma AB-MHE30 in BB1 v NEK*)
133. Building permit issued by the Krško Administrative Unit, No. 351-329/2016/10, 26 September 2016, for the reconstruction of the rainwater pumping station and the fecal sewage system of NEK (*Gradbeno dovoljenje Upravne enote Krško št. 351-329/2016/10, 26.09.2016, za rekonstrukcijo črpališča meteorne in fekalne kanalizacije NEK*)
134. Partial building permit issued by MOP, No. 35105-13/2016/17 1093-04 TŠ, VML, 3 February 2017, for the reconstruction of the NEK weir (*Delno gradbeno dovoljenje MOP št. 35105-13/2016/17 1093-04 TŠ, VML, 3.02.2017, za rekonstrukcisjo jezovne zgradbe NEK)*
135. Partial building permit issued by MOP, No. 35105-70/2017/5 1093-04 TŠ, 8 September 2017, for the reconstruction and vertical extension of BB1, and the construction of cable connections between the BB1 building and the AB facility at NEK (*Delno gradbeno dovoljenje MOP št. 35105-70/2017/5 1093-04 TŠ, 8.09.2017, za rekonstrukcijo in nadzidavo BB1 ter izvedbo kabelskih povezav med objektom BB1 in zgradbo AB v NEK)*
136. Partial building permit issued by the Krško Administrative Unit, No. 351-254/2017/30, 8 November 2017, for the reconstruction / vertical extension of the protection wall along the Potočnica stream (*Delno gradbeno dovoljenje Upravne enote Krško št. 351-254/2017/30, 8.11.2017, za rekonstrukcijo oz. nadzidava varovalnega zidu ob potočnici*)
137. Building permit issued by the Krško Administrative Unit, No. 351-129/2018/14, 21 May 2018, for the removal of a section of Hangar 71, the Phase II construction of an equipment storage facility, and grading and paving works (*Gradbeno dovoljenje Upravne enota Krško št. 351-129/2018/14, 21.05.2018, za odstranitev dela hangarja 71, gradnjo skladišča za opremo faza II in zunanjo ureditev*)
138. Building permit issued by MOP, No. 35105-68/2018/8 1093-04 TŠ,HČ, 24 July 2018, for the construction of the BB2 facility (*Gradbeno dovoljenje MOP št. 35105-68/2018/8 1093-04 TŠ,HČ, 24.07.2018, za gradnjo objekta BB2*)
139. Building permit issued by MOP, No. 35105-29/2018/6 1093-04 TŠ,HČ, 24 July 2018, for the Phase I construction of the BB2 facility – building pit (*Gradbeno dovoljenje MOP št. 35105-29/2018/6 1093-04 TŠ,HČ, 24.07.2018, za 1. fazo izgradnje objekta BB2 - gradbeno jamo*)
140. Building permit issued by MOP, No. 35105-63/2018/6 1093-04 TŠ,HČ, 9 August 2018, for the replacement of an above-ground fuel tank for the auxiliary steam system, Phases I and II (*Gradbeno dovoljenje MOP št. 35105-63/2018/6 1093-04 TŠ,HČ, 9.08.2018, za zamenjavo nadzemnega rezervoarja goriva za sistem pomožne pare, 1. in 2. faza*)
141. Building permit issued by MOP, No. 35105-11/2019/9 1096-05, 14 May 2019, for the new construction of the facility's foundations with an oil containment tank and a transformer pit (*Gradbeno dovoljenje MOP št. 35105-11/2019/9 1096-05, 14.05.2019, za novogradnjo objekta temelja z lovilno skledo in jamo za transformator T3 v NEK)*

142. Building permit issued by MOP, No. 35105-25/2020/57, 23 December 2020, for an on-site dry storage facility for spent fuel (IG) (*Gradbeno dovoljenje MOP št. 35105-25/2020/57, 23.12.2020, za objekt za suho skladiščenje izrabljenega goriva IG v območju NEK*)