NEW NUCLEAR POWER PLANT AT THE JASLOVSKÉ BOHUNICE SITE

PRELIMINARY STUDY FOR THE PROPOSED ACTIVITY

February 2014

JADROVÁ ENERGETICKÁ SPOLOČNOSŤ SLOVENSKA, a.s.

Document Annotation

The submitted document involves a Preliminary Study for the proposed activity pursuant to Section 22 and Annex No. 9 of the Act No. 24/2006 Coll. on the Environmental Impact Assessment as amended.

Subject to the proposed activity is the *New Nuclear Power Plant at the Jaslovské Bohunice site*, including the construction of a new nuclear power plant and all related building structures and technological facilities.

The new nuclear power plant (new NPP) is in line with the key strategic documents of the Slovak Republic in the energy sector.

The proposed activity is situated in the western region of the Slovak Republic in Trnava Self-Governing Region; the area for siting the new NPP neighbours is in the vicinity of the existing Jaslovské Bohunice nuclear facilities site (Jaslovské Bohunice Nuclear Power Plant), whereas it also uses a part of the shut-down NPP Bohunice A1 and NPP Bohunice 1,2. From the technical perspective, it is III+ generation power plant with pressurized water reactor (PWR). The maximum total installed capacity is considered to be 2,400 MW either with single or double reactor blocks. The operational lifetime of the power plant will be 60 years. The project will be solved in a way that ensures the performance of all relevant legislative regulations and safety standards in line with the regulations and requirements as set out by the Nuclear Regulatory Authority of the Slovak Republic, IAEA and WENRA. The activity will be considered in one alternative for the location and the technical solution.

This Preliminary Study offers, in line with the requirements of the above stated Act, the basic characteristic of the proposed activity; basic data on the current state of the environment in the area where the activity is to be performed, as well as in an area, which will be influenced by the proposed activity; basic data on the expected impacts of the proposed activity as well as on the possible extent of impact on the components of the environment; basic evaluation of alternative solutions for the proposed activity and proposals of measures to be taken in order to exclude or decrease the adverse impacts of the proposed activity at the implementation, operation and operation termination stage. The Preliminary Study takes the nature of the proposed activity (which is the nuclear facility) into account as well as the site specifics (where a group of other nuclear facilities are located). From this perspective, a special attention paid to the issue of impacts on the public and public health (mainly in the area of the ionizing radiation impacts) in the Preliminary Study, including the respective cumulative impacts of the proposed activity together with other existing or planned site activities.

With reference to the selection of the considered technology for the new NPP, the existing impact of the current nuclear facilities at the site and negligible contribution of nuclear energy to the public exposure, no negative radiation impacts on the health of the public are expected under the concurrent impact of other nuclear facilities on site. With respect to the location of the proposed activity outside the residential territories, no significant negative impacts are expected, either from the perspective of the non-radiation factors (this covering mainly the air and noise pollution). From the perspective of the impacts on soil, the soil occupation will be the most significant one, which is determined by the delimitation of the area for building the new NPP. Based on the performed assessments and the existing experience of the operated nuclear power units in the area concerned, there are no expected significantly negative impacts on other components and parts of the environment (surface and ground waters, fauna, flora, ecological systems and protected land areas, rock environment and natural resources, cultural monuments and tangible property). At all stages of the new NPP life cycle, regular monitoring of the individual components of the environment will continue to take place.

The potentially most likely areas and the groups of population to be considered are situated close to the proposed site; therefore, the emergence of significant cross-border impacts is practically excluded or is very unlikely.

A detailed impact assessment of the new NPP on the individual components of the environment and the health of the incomplete population will be carried out based on detailed analyses at the next review stage, hence in the Environmental Impact Assessment Report processed pursuant to Section 31 of the above stated Act and pursuant to the determined scope of assessment as set out by the Ministry of Environment of the Slovak Republic.

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the Slovak Republic

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Table of Contents

Identification Data of the Customer

Business name:	Jadrová energetická spoločnosť Slovenska, a. s. Tomášikova 22 821 02 Bratislava Slovak Republic
registered	in the Business Register of the Bratislava I District Court, Section: Sa, Insert No. 4930/B
Place of business:	Slovak Republic
Company Reg. No.: Tax Reg. No.: VAT Reg. No.:	45 337 241 202 293 79 39 SK 202 293 79 39
Bank connection: Account number: IBAN code: BIC(SWIFT):	Poštová banka, a.s., Prievozská 2/B, 821 09 Bratislava 20311017/6500 SK4765000000000020311017
Represented by:	Ing. Štefan Šabík Chairman of the Board of Directors Ing. Petr Závodský Vice-Chairman of the Board of Directors
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Identification Data of the Supplier

Business name:	AMEC s.r.o. Křenová 58 602 00 Brno Czech Republic
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Place of business:	Czech Republic
Reg. No.: Tax Reg. No.: VAT Reg. No.:	262 11 564 CZ 262 11 564 CZ 262 11 564
Bank connection: Account number: IBAN code: BIC(SWIFT):	UniCredit Bank Czech Republic, a. s., Divadelní 2, Brno 1002064985/2700 CZ812700 0000 001002064985 BACX CZ PP
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Introduction

General Data

Preliminary Study for the Proposed Activity ("Preliminary Study")

NEW NUCLEAR POWER PLANT AT THE JASLOVSKÉ BOHUNICE SITE

("activity") is elaborated pursuant to Section 22 of Act No. 24/2006 Coll. on the Environmental Impact Assessment as amended[1] ("the Act").

The purpose of this Preliminary Study is, in line with the Act, to submit:

a) basic characteristics of the proposed activity,
b) basic data on the current state of the environment in the area, where the activity is to be performed, as well as in the area, which will be influenced by the proposed activity,
c) basic data on the expected impacts of proposed activity, mainly the requirements for soil occupation, energy and raw materials, as well as on the extent of pollution of or damage to the components of the environment,
d) basic evaluation of the advantages and disadvantages of the alternative solutions of the proposed activity,
e) proposals for measures in order to exclude or decrease the adverse impacts of the proposed activity at the implementation, operation and operation termination stage[2].

The Preliminary Study is the first document prepared in the environmental impact assessment process.. It brings all the basic data required by the Act and serves as the basic document for the determination of scope for the assessment of the proposed activity pursuant to Section 30 of the Act.

The purpose of this Preliminary Study is to provide detailed or extensive information about the environmental impact of the proposed activity. The purpose is to introduce the proposed activity, area concerned, state of the environment in the area concerned and to identify potential impacts of this activity on the environment and human health including the cumulative and synergic impacts.

A detailed environmental and public health impact assessment of the proposed activity will constitute the following documents, which are under preparation during the environmental impact assessment of the proposed activity. This will in particular be the Environmental Impact Assessment Report, which will be processed pursuant to Section 31 of the Act and will hence include complex findings, description and assessment of the expected impacts.

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1 Act No. 24/2006 Coll. of 14 December 2005 on the Environmental Impact Assessment and on amendments to certain acts as amended (amendments: 275/2007 Coll. effective as of 1 July 2007, 454/2007 Coll. effective as of 1 December 2007, 287/2009 Coll. effective as of 1 September 2009, 117/2010 Coll. effective as of 1 May 2010, 145/2010 Coll. effective as of 1 May 2010, 258/2011 Coll. effective as of 3 August 2011, 408/2011 Coll. effective as of 1 December 2011, 345/2012 Coll. effective as of 1 January 2013, 448/2012 Coll. effective as of 1 January 2013, 39/2013 Coll. effective as of 15 March 2013 and 180/2013 Coll. effective as of 1 October 2013.

2 While processing this Preliminary Study, inconsistency arising out of various definitions of "operation termination" occurred.
- In the field of environment, this term designates generally the period in the sense of this word (as the third stage of the life cycle - operation - operation termination),
- in the field of the nuclear energy, this term is not used, the term "decommissioning" is used instead.

In this Preliminary Study based mainly on the Act on Environmental Impact Assessment, the term "operation termination" is used jointly in all areas of the environment, whereas in the areas, as applicable, it is to be understood as "decommissioning" in the meaning of the legislative regulations for the field of nuclear power.

Formal Structure of the Preliminary Study

The structure of the Preliminary Study corresponds to the requirements as set out by the Act. The Preliminary Study is divided in line with the Annex No. 9 to the Act (Content and structure of the preliminary study), and its requirements have been strictly respected. The headlines of the chapters to this Preliminary Study corresponding to the statutory structure are individually are framed in boxes (for example: **IV.1. Requirements on Inputs**), whereas in some cases the names of the chapters have been purposefully shortened. The exact statutory wording is then always stated below the header of the chapter (e.g.: *1. Requirements on Inputs (e.g. soil occupation, water consumption, other raw material and energy resources, transport and other infrastructure, labour forces requirements, other requirements).*)

This statutory structure is subdivided into sub-chapters. This sub-division is not set out by the Act but opted for by the Supplier of the Preliminary Study with the aim to present data in a well arranged way. The headlines of the chapters to this Preliminary Study corresponding to the sub-divisions are not individually marked by frames (for example: **IV.1.1. Soil occupation**).

Factual Content of the Preliminary Study

The factual content of the Preliminary Study deals, in line with the statutory requirements, with all the relevant components of the environment including the public health. It takes the nature of the proposed activity (which is the nuclear facility) into account as well as the site specifics (where a group of other nuclear facilities are located). From this perspective, special attention is paid to the issue of impacts on the public and the public health (mainly in the area of the ionizing radiation impacts) in the Preliminary Study, including the respective cumulative impacts of the proposed activity together with other existing or planned site activities.

Methodological Processing of the Preliminary Study

One of the basic methodological approaches in the field of environmental impact assessment and in the field of nuclear power industry is the focus on safety of the assessment. The Preliminary Study preparation (and subsequently also the Environmental Impact Assessment Report) is consistently subject to the conservative approach. This consists in the fact that all data used for the assessment are considered from the environmental perspective as rather less favourable. Only in such case is it guaranteed that the assessment processes will cover all impacts of the proposed activity at their potential maximum.

One of the applications of the conservative approach is also the choice of parameters of the units of possible power plant contractors used for the impact assessment. It proceeds in such way that the least favourable out of all the facilities' parameters of all the potential contractors are selected (e.g. the largest water extraction, the highest radioactive discharges, the biggest dimension for the assessments of impacts on landscape etc.) and those are in many cases further conservatively rounded up. Such arisen "Plant Parameters Envelope" is used for the impact assessment. The facility's parameters of the subsequently selected contractor will be in all indicators better than (or at least the same as) the parameters used for the environmental impacts assessment. The results of the assessment will hence cover all facilities of the potential contractors[3]. This "envelope method" is used for the impact assessment of nuclear power plants worldwide (recently e.g. in Canada, Finland, the USA and the Czech Republic) and is also accepted by the regulatory bodies.

[3] To avoid any doubts, there is also a description of the technical solution of all individual potential contractors stated in the Preliminary Study (and subsequently also in the Environmental Impact Assessment Report). However, it is generally applicable that a power plant contractor may be any manufacturer, whose project meets the envelope parameters used for the evaluation of impacts on the environment (subject to the fulfilment of all other statutory requirements, naturally).

I. BASIC DATA ON THE CLIENT

I. Basic data on the Client

I.1. Name

1. Name

Jadrová energetická spoločnosť Slovenska, a. s.

I.2. Identification Number

2. Identification Number.

45 337 241

I.3. Registered Office

3. Registered Office.

Tomášikova 22
821 02 Bratislava
the Slovak Republic

I.4. Authorized Agent of the Provider

4. Name, surname, address, phone number and other contact data of the authorized agent of the provider.

Ing. Štefan Šabík
Chairman of the Board of Directors, Director General

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I.5. Other Contact Data

5. Name, surname, address, phone number and other contact data of the contact person, from whom it is possible to obtain relevant information about the proposed activity and place for consultations.

Ing. Tomáš Vavruška
Member of the Board of Directors, Head of the Safety and Quality Section

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II. BASIC DATA ON THE PROPOSED ACTIVITY

II. Basic data on the proposed activity

II.1. Name

1. Name.

New nuclear power plant at the Jaslovské Bohunice site

II.2. Purpose

2. Purpose.

Electricity generation.

II.3. User

3. User.

Jadrová energetická spoločnosť Slovenska, a. s.

II.4. Nature

4. Nature of the proposed activity (new activity, change of activity, etc.).

New activity.

Pursuant to Annex No. 8 to the Act, the activity is classified as follows:

Section:	2. energy industry
Departmental body:	Ministry of Economy of the Slovak Republic
Item:	4. Nuclear power plants and other facilities with nuclear reactors (excluding research facilities for the production and conversion of fission and enriched materials with a maximum thermal output not exceeding 1 kW of continuous thermal output) including their decommissioning and disposal. Nuclear power plants and nuclear reactors stop being such facility if nuclear fuel and other radioactive contaminated components are permanently removed from their sites.
Maximum values:	Part A (obligatory assessment) - without limitation

II.5. Siting

5. Siting of the proposed activity (region, district, municipality, cadastral area, land parcel number).

The proposed activity is situated in the western region of the Slovak Republic. It is located in the area of the following territorial entities:

Region	*District*	*Municipality*	*Cadastral area*
Trnavský	Trnava	Jaslovské Bohunice	cadastral area Jaslovce cadastral area Bohunice
		Radošovce	cadastral area Radošovce
	Hlohovec	Ratkovce	cadastral area Ratkovce
		Červeník	cadastral area Červeník
		Madunice	cadastral area Madunice
	Piešťany	Pečeňady	cadastral area Pečeňady
		Veľké Kostoľany	cadastral area Veľké Kostoľany cadastral area Zákostoľany
		Dubovany	cadastral area Dolné Dubovany
		Drahovce	cadastral area Drahovce
		Piešťany	cadastral area Piešťany

The stated calculation represent the territorial entities where all parts of the proposed activity will be sited (hence the area for the siting and construction of the Newbuild NPP as well as the corridors of the related infrastructure). Whereas the extent of areas for siting all parts of the proposed activity is set out conservatively (by its maximum possible extent) its actual extent will be smaller. As a result, no land parcel numbers of the properties concerned are stated (because of large number of them).

II.6. Siting Situation Overview

6. The siting situation overview of the proposed activity (scale 1 : 50,000).

The siting situation overview of the proposed activity within the scale 1 : 50,000 is attached in Annex No. 1 to this Preliminary Study.

II.7. Deadline for the Construction and Operation Commencement and Completion

7. Deadline for the construction and operation commencement and completion of the proposed activity.

The expected deadlines are as follows:

Deadline for construction commencement:	2021
Deadline for launching trial operation:	2027
Deadline for launching continuous operation mode:	2029

II.8. Brief Description of the Technical and Technological Solution

8. Brief description of the technical and technological solution.

II.8.1. Scope of the Activity

The proposed activity is a new nuclear power plant at the Jaslovské Bohunice site including all related areas, construction sites and technological facilities for the operation and construction of the power plant.

The following components are a part of the activity:

Power plant units:

type:	pressurized water reactor (PWR)
generation:	III+
installed electric power:	up to 2400 MW_e
operation period:	60 years

One unit with electric power of up to 1x1700 MW_e or 2 units of electric power up to 2x1200 MW_e fit these parameters. There will be commercially accessible contractors' units used, whereas the list of their references is stated below in chapter II.8.4.1.3. The basic data on the reference projects (page 28 of this Preliminary Study). The contractor will be subsequently selected at other stages of the project preparation, the choice of the contractor is not subject to the environmental impact assessment. The parameters used for the impact assessment conservatively covers (or will cover) facilities of all the considered contractors.

All necessary building structures and technological facilities of the primary circuit, secondary circuit, cooling circuit, auxiliary structures and operations constitute the parts of the units.

The area for unit siting and construction including the related structures and operations are part of the area for siting and construction of Newbuild NPP, which is marked in Annex No. 1 to this Preliminary Study.

Electrical connections:

Electrical power outlet:	overground electric line of 400 kV
back-up power supply of own consumption:	overground/underground transmission of 110 kV

The electric power of the units will be transmitted outwards via a 400 kV overground electric line to the new Jaslovské Bohunice electric power plant. This plant will be a part of the transmission grid of the Slovak Republic, which is administered by SEPS, a.s. Hence, it is not subject to the proposed activity.

The back-up power supply of own consumption will be solved via a 100 kV underground or overground electric line from the same electric power plant.

All the components necessary for the connection of the power plant units to the power grid of the Slovak Republic are a part of the electrical connections.

The corridor for the electrical connections siting is marked in Annex No. 1 to this Preliminary Study.

Water management connections:

water supply:	underground piping, the existing infrastructure
waste water and precipitation water drainage:	underground piping

The supply of raw water will be through a new underground pipeline from the water source (Sĺňava dam water reservoir).

The supply of drinking water will be carried out via a connection to the existing infrastructure at the site.

The waste water drainage will be done via a new waste water collector to the recipient (the Váh river or the Drahovský kanál).

The precipitation water drainage will be carried out by means of a new precipitation water collector to the recipient (the Dudváh river).

All components necessary for the supply of the power plant with raw and drinking water and the drainage of waste technological, sink and precipitation waters will constitute a part of the water management connection.

The corridors for the water management connections siting is marked in Annex No. 1 to this Preliminary Study.

Furthermore, the areas and facilities for construction (construction site equipment), including all components necessary for the construction contractor in the flow of the building or construction activity constitute a part of the proposed activity.

The construction site equipment will be performed at the areas immediately connected to the construction area of the power plant objects. The area for the construction site equipment siting is a part of the area for siting and construction of Newbuild NPP, which is marked in Annex No. 1 to this Preliminary Study.

To make the picture complete, the operation termination (decommissioning)[4] of the proposed activity has to be mentioned. We may expect that at this stage, no additional need for the land occupation and construction of new objects or technological facilities outside the area for the siting and construction of Newbuild NPP will occur.

II.8.2. Overview of the Considered Alternatives

The proposed activity is designed in one implementation alternative, which is based on the construction of the new NPP at the Jaslovské Bohunice site. The choice of this alternative consists in considering the following potential possibilities of the alternative solution:

- Newbuild NPP siting alternatives within the Slovak Republic,
- Newbuild NPP siting alternatives within the Jaslovské Bohunice site,
- Newbuild NPP capacity (of net electric power) alternatives,
- Newbuild NPP technical solution alternatives,
- referential alternatives (other means of electricity generation and/or electricity savings),
- Newbuild NPP connected system alternatives (connection to the surrounding infrastructure),
- zero alternative.

The analyses of these potential possibilities results in the following facts:

Newbuild NPP siting alternatives within the Slovak Republic: Siting the Newbuild NPP at the Jaslovské Bohunice site is presumed by *Government Decree No. 948/2008, Proposal on the energy policy of the SR, Conception of land use development of the SR and a Proposal on the land use planning documentation of the Trnava Self-Governing Region*. No other alternatives of the Newbuild NPP siting are currently expected in the governmental and strategic documents of the SR. The Jaslovské Bohunice site satisfies the legislative requirements for nuclear facility siting; it has been used for the electricity generation in nuclear power plants and for the construction and operation of other nuclear facilities in the long term and all the necessary areas and infrastructure are accessible within it. The choice of this site thus represents an effective use of the accessible resources from the environmental point of view. The Client, Jadrová energetická spoločnosť Slovenska, a.s., was established, according to the shareholders contract, as a company with the purpose of preparing a new NPP at the Jaslovské Bohunice site.

The Newbuild NPP siting alternatives within the Jaslovské Bohunice site: The *Supporting document to the Government Decree No. 948/2008*, deals with the siting localisation at this site, whereas it considers two areas – an area with south-western aspect from the A1 NPP to be decommissioned and an area with a north-eastern aspect from the existing NPP Bohunice 1,2. It further states that the final siting shall be determined based on the conclusions of the Feasibility Study, whereas it is not excluded that its conclusions will recommend an alternative which will be different from the two given alternatives. The Feasibility Study processed in 2012 defines one area for the construction, an area involving both of the above stated areas in it. This area will be used for the construction of the new NPP including all the related and induced investments as a whole. The proposal on the land use planning documentation of the Trnava Self-Governing Region also considers the same area.

[4] The operation termination (decommissioning) is not subject to the proposed activity. Pursuant to Act No. 246/2006 Coll. on the Environmental Impact Assessment as amended, decommissioning is an individual activity subject to review. It will thus be at the relevant time subject to an individual EIA process. The operation termination (decommissioning) is hence solved only on an informative and general, conceptual level.

The Newbuild NPP capacity (of installed electric power) alternatives: The net installed electric power of the new NPP at the Jaslovské Bohunice site of up to 2,400 MW_e is presumed by *the Proposal on the Energy Policy of the SR and by the Proposal on the Land Use Planning Documentation of the Trnava Self-Governing Region*.

The Newbuild NPP technical solution alternatives: The new NPP is only considered to be with a pressurized water reactor (PWR) of the III+ Generation. The reason for this lies in the fact that such NPPs currently represent the best available technology. The PWR type reactors represent significantly the most frequently used type of plant with a plenty of safety advantages worldwide and in Europe. The long-term operational experience also counts towards the advantages in the conditions of the Slovak Republic. Such a plant may be supplied by a variety of manufacturers, whereas their selection is not subject to the EIA. The selection of a contractor will be carried out at the next stages of the project preparation, where none of the applicants may be excluded and at the same time, the participation of none of the manufacturers can be demanded, either. The environmental impacts of all the commercially accessible plants with a PWR III+ Generation reactor are similar in terms of quantity and quality. In the EIA process, a common conservative envelope of all characteristics, which are likely to influence the environment, is (or will be) considered. The same applies to the safety requirements laid upon the legislative regulations for nuclear plants.

The referential alternatives (other means of electricity generation and/or electricity savings): The proposed activity addresses a generally accepted demand for this kind of plant (as nuclear plant), expressed in the relevant strategic documents of the Slovak Republic including government decrees. The Client, Jadrová energetická spoločnosť Slovenska, a.s., was established, according to the shareholders contract, as a company with the purpose of preparing a new NPP at the Jaslovské Bohunice site. Other plants (including the savings) are addressed in the approved strategic documents in the relevant context and by other investors.

The Newbuild NPP connected system alternatives (connection to the surrounding infrastructure): All the necessary infrastructure for the operation of the existing plants (mainly the electrical power outlet to the transmission grid and water management connection) is present at the Jaslovské Bohunice site. The infrastructure siting and route for the new NPP are thus unequivocally determined by the existing infrastructure corridors, whereas the use of the existing corridors represents an effective use of the accessible sources from the environmental perspective.

The zero alternative: The zero alternative is a situation which would occur if the proposed activity did not take place. This alternative is not in line with the strategic documents (mainly *the Government Decree No. 948/2008, Proposal on the Energy Policy of the SR, Conception of Land Use Development of the SR and a Proposal on the Land Use Plan of the Trnava Self-Governing Region*). Nevertheless, the evaluation of this alternative is considered, in line with the requirements set out by the Act. No. 24/2006 Coll. on the Environmental Impact Assessment as amended.

From the above and also with reference to the current state of the approved relevant strategic documents of the Slovak Republic; to the ones under preparation and to the accessibility of the best technologies, it may be concluded that no other real alternative solution for the proposed activity other than the proposed solution is available with respect to the site or the technology.

II.8.3. General Data

This chapter describes the generally applicable data and requirements relating to the nuclear energy industry and nuclear power plants with a PWR reactor type.

II.8.3.1. Basic Data on Nuclear Power Plants with a PWR Reactor Type

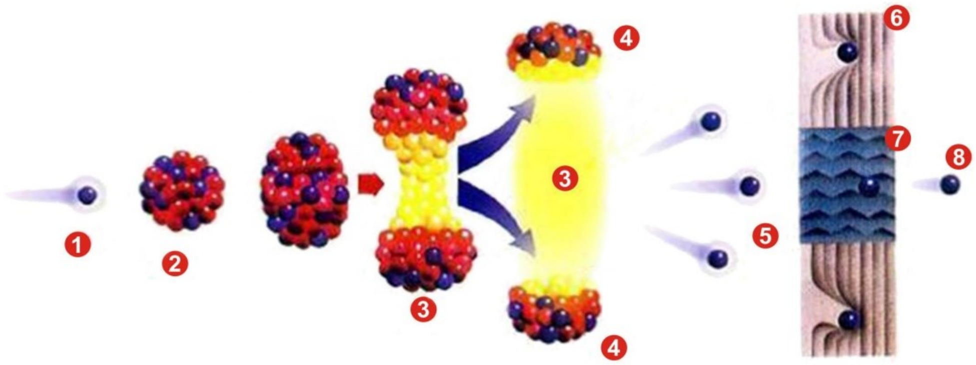
II.8.3.1.1. Physical Principle of a Nuclear Power Plant with a PWR Reactor Type

The principle of electricity generation in a nuclear power plant corresponds the principle of any other thermal power plant. It may be described in a simplified way by means of this chain (the components of the nuclear power plant are marked in *italics*):

- the primary source of energy - fuel (e.g. coal, oil, gas, *nuclear fuel,* geothermal energy etc.),
- use of fuel for the production of thermal energy (coil boiler, burners, *nuclear reactor* etc.),
- use of thermal energy for the generation of steam (boiler, *steam generator* etc.),
- use of steam for the generation of kinetic energy (*turbine*),
- use of kinetic energy for the electricity generation (*turbo generator*).

The basic element of nuclear power plants is the *nuclear reactor*, where a nuclear reaction takes place, creating heat. In nuclear reactors, which are currently used worldwide, invariably fission nuclear reaction is the source of the heat (the use of fusion nuclear reaction is still subject to research). The principle of a fission nuclear reaction is illustrated in the following figure:

Fig. II.1: Schematic illustration of fission reaction



1	Slow neutron	**5**	Fast neutrons
2	Uranium ^{235}U nucleus	**6**	Absorber
3	Fission generating heat	**7**	Moderator
4	Fission products	**8**	Slow neutron

The essence of fission nuclear reaction is that the atom nucleus (typically a uranium ^{235}U) is split by a slow neutron. Through this fission, the original nucleus is usually divided into two fragments, whereby a part of the binding energy is released in the form of heat (which is further on used for the steam generation) and at the same time, other fast neutrons are released. The released neutrons may potentially split other nuclei, and therefore the reaction is called the chain reaction. This process is controlled in the nuclear energy utilization in such manner, so that each neutron released in the fission would be slowed down and would hence induce the next fission reaction. This way, the fission reaction follows continuously as the number of fissions in a unit of time does neither rise, nor fall. The other neutrons, which are released in the fission, are captured in the materials of the reactor bare core. By changing the geometry and composition of the reactor bare core materials, where the neutrons are captured, is it possible to reach a change of the fission reaction intensity, this is utilized when the reactor capacity is changed or when it is shut down.

The substance used for fission is called *the nuclear fuel*, the substance, which slows the fast neutrons down, is called *moderator*, the substance, which captures neutrons is called *absorber* and the heat transferring medium letting the heat out of the reactor is called *coolant*.

The nuclear power plants with a PWR reactor type (Pressurized Water Reactor) utilize uranium as the nuclear fuel, whereby there is an increased concentration of the uranium isotope ^{235}U to a level of up to approximately 5% ^{235}U by means of its enrichment. A fuel rod is the basic element, where the heat is released in the reactor. It consists of uranium dioxide pellets (UO_2), which are sealed in a zirconium tube. The fuel rods are arranged in the fuel assemblies, which are laid in the reactor's bare core.

In the PWRs, a demineralised water (H_2O) is utilized as the coolant and it also serves as a moderator and as the absorber carrier (whereas the absorber is an additive of hypoboric acid). The water heats up during its flow through the reactor, it enters the steam generators, where it transfers a part of its thermal energy through the heat transfer surface area and finally it returns back to the reactor. This coolant circuit is called *primary circuit*. In this circuit, the cooling water is kept under high pressure (so that it would stay in a liquid stage at temperatures above 300°C, this is why it is called a pressurized water reactor). The space in the reactor, where the fission reaction occurs, is called *bare core*. The heat transfer from the reactor to the steam generators is provided for by several pressurized cooling loops, where the coolant circulates by means of circulating pumps.

In the steam generators (which work as heat exchangers between the primary and secondary circuit), the heat from the primary circuit is utilized for heating up water in the secondary circuit, which is changed into steam at lower pressure. The pressurized steam is further on transmitted to the turbine, which it sets into movement. After the energy transfer, the steam condensates to water the condensate is once again pumped into the steam generator, where it once again changes into steam and the cycle is repeated. This circuit is called *secondary circuit*.

For the purpose of after-cooling and secondary circuit steam condensation, the *tertiary coolant circuit*, where the cooling water circulates through the cooling towers, in which the low-energy heat is transferred to the atmosphere by means of vaporization[5]. Any decrease (mainly water vapour) of the tertiary water is supplemented by treated raw water from a suitable source (in the case of the Jaslovské Bohunice site, from the Váh river – Sĺňava dam water reservoir).

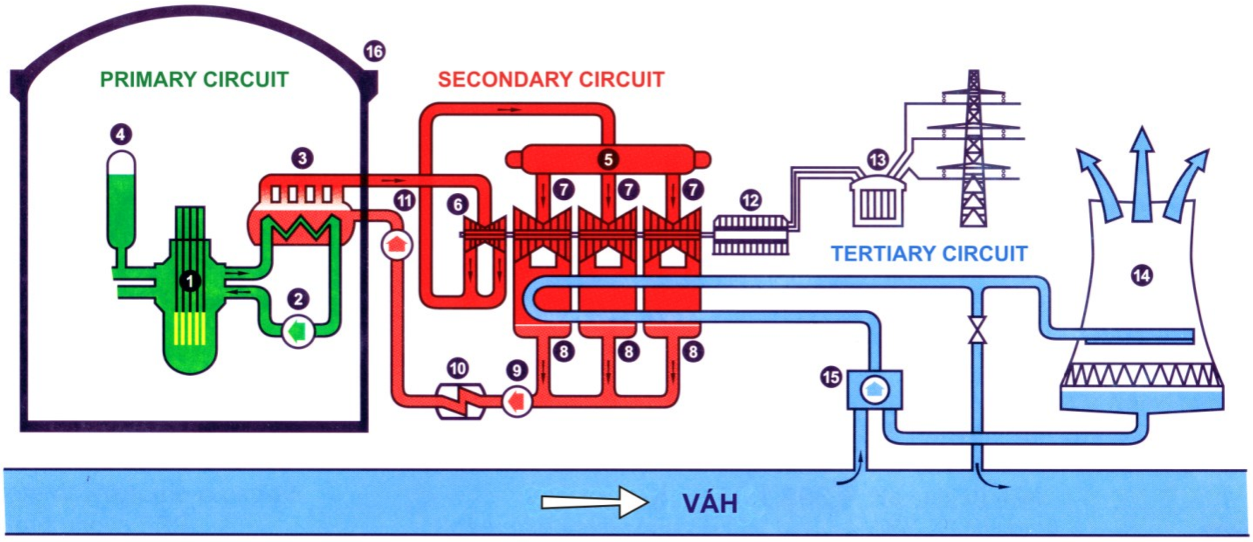
The turbine kinetic energy is utilized as a drive mechanism of the *electric generator (turbo generator)* and the generated electricity is let out to the power grid.

With regard to the safety requirements on nuclear power plants, the facilities of the reactor and of the primary circuit (so called *nuclear island*) are located in *a containment*, its purpose is to prevent a leakage of radioactive substances into the environment in case of fuel and primary circuit disruption. The containment quality requirements in the III and III+ generation reactors technology are very high and apart from the protection against internal risks (resulting from own technology failures), the containment provides also for the protection against external risks (e.g. extreme weather conditions or human activity impacts – blast wave, aeroplane crash etc.).

The principal diagram of a PWR nuclear power plant, is shown in the following figure:

5 Alternatively, river (or sea) water can be used for condenser cooling in the tertiary circuit directly, without using the cooling towers. The low-energy heat is in such case transferred to these waters directly. This, however, is not feasible at the Jaslovské Bohunice site because the Váh river is not (because of its hydrological conditions – flow rate) a suitable heat recipient and it could be disproportionately heated up. On the other hand, nuclear power plants at the Danube river (Paks, Kozloduy, Cernavoda), which have a sufficient flow rate, are cooled directly from the river.

Fig. II.2: Principal diagram of NPP with a pressurized water reactor



PRIMARY CIRCUIT		SECONDARY CIRCUIT		TERTIARY CIRCUIT
1 Reactor	**5**	Separator, pre-heating equipment	**14**	Cooling tower
2 Cooling loop, circulating pump	**6**	High-pressure part of the turbine	**15**	Pumping station
3 Steam generator	**7**	Low-pressure part of the turbine		
4 Volume compensator	**8**	Condenser		
16 Containment	**9**	Condensate pump		
	10	Heat regeneration		
	11	Feeding pump		
	12	Electric generator		
	13	Transformer, electric power outlet		

II.8.3.1.2. Statistical Data on Nuclear Power Plants Worldwide

At present, there are over 430 operational nuclear power units in service in 31 countries of the world, with a total installed (net) electric power of more than 370 GW_e. Nuclear power plants generated 2012 approximately 2,346 TWh of electricity, representing around 11.3% of the worldwide electricity generation.

Several dozens of other units are under construction. After 2004, the construction of 64 nuclear units has been launched, whereof 56 are PWR type. It is apparent that the vast majority (more than 85%) of the new power plants represent the PWR type reactors. This is mainly given by their safety and economic advantages.

II.8.3.1.3. Development Generations of Nuclear Reactor Technologies

The electricity generation from the energy released from the uranium fission has an over sixty-years long history, since the launch of the demonstrable nuclear power plants. The nuclear reactors' technology of the commercial nuclear power plants is according to the grade of their technical development divided into categories called generations. The characteristics of the individual generations is as follows:

Generation I: Generation I includes reactors, which were designed in the 1950's – 1960's. This generation also involved the A1 NPP at the Jaslovské Bohunice site. The last reactor of this generation to be still operated is unit 1 of the Wylfa nuclear power plant in Great Britain.

Generation II: The design and construction of nuclear power plants with reactors of Generation II started in the 1970s. Power plants with Generation II reactors currently have the most significant share in the electricity generation within the nuclear power plants. More than a half of these nuclear power plants is made of PWR type pressurized water reactors. This generation also involves PWR reactors constructed and operated in the former Czechoslovakia (the succession states are SR and CR).

The safety level of the nuclear power plants with Generation II reactors, compared to Generation I reactors, is markedly higher, mainly when it comes to the reliability of the safety systems designed for managing non-standard situations. Also the technical-economic parameters of the power plants with these reactors are more favourable.

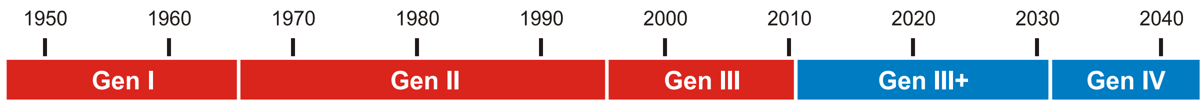
Generation III: Generation III encompasses reactors designed in the 1990s. In those projects, which stem from the best practice obtained from the construction and operation of the Generation II reactors, the best available technology is utilized. Improvements focus on a more efficient utilization of the nuclear fuel; on achieving higher heat efficiency and on the utilization of standardized projects aimed at lowering the requirements for the time of construction as well as on lowering the requirements for servicing and maintenance during the operation. The increase in safety of the Generation III reactors (as compared to the II generation reactors) is achieved e.g. by a more extensive utilization of passive elements in the design of the protection systems, by means of a robust double containment with a higher resistance against external risks and by means of utilizing specific systems designated in the project for managing severe accidents.

Generation III+: Generation III+ immediately follows the Generation III reactor in its development. The projects of this generation reactors currently represent the best available techniques and will be put into operation in the upcoming period. They offer an improvement in economic indicators (a simplified standard project, which will lead to shortening the licensing period and to lowering costs for construction and operation) as well as other significant benefits for safety (higher level of inherent safety, higher utilization of passive safety, containment resistance against a large aeroplane crash, prolonged period without the necessity of intervention by the operators in the event of failures and project accidents, higher seismic resistance, which results in lowering the risk of accidents) and also a lower production of radioactive waste. This generation also covers the reactor (i.e. the power plant), which is subject to the proposed activity.

Generation IV: Generation IV projects are still only subject to concepts and development. The launch of their operation is according to the development state expected to take place between 2030 – 2040.

The following figure illustrates the gradual development of the nuclear reactor technology.

Fig. II.3: Development generations of nuclear reactor technology



II.8.3.1.4. Safety and Economic Characteristics of Generation III or III+ PWR Reactors

The power plants of Generation III or III+ reactors currently utilize the best accessible technologies based on the proved Generation II reactor types. The main differences from Generation II are:

- A standardized design, lowering the necessary licensing period of individual power plants and the necessary investment costs and construction period.
- The simplified (but concurrently more robust) design enabling easier servicing and higher operational reserves.
- Higher operational availability (90% and more), higher net efficiency (of up to 37%) and longer lifetime (a min. of 60 years).
- Lower accident risk with a severe damage of the bare core (below 10^{-5}/year).
- Higher resistance against external events.
- Facilitating the power plants with specific systems for the prevention and consequences mitigation of severe accidents.
- Providing for higher fuel utilization (higher burn-up of up to 70 GWd/tU) and lowering the amount of the produced radioactive waste.

- Lengthening the periods between outages for reloading and replacing fuel by using burnable absorbers (of up to 24 months).
- An improved operation economy.

Concurrently, they utilize the general advantages of PWR reactor types:

- Stability as a result of the existence a negative feedback (the increase in temperature works against power increase).
- Passive system of emergency shut-down. The control rods are held in the upper position by electromagnets and when necessary, they are inserted to the reactor's bare core by means of its own weight. After their insertion, the nuclear reaction is safely stopped.
- Primary and secondary circuit separation. The secondary circuit is separated from the primary circuit (by the steam generator), hence the water in the secondary circuit practically does not involve radioactive substances, which restricts the leakage of radionuclides to the environment.

II.8.3.2. Basic Legislative Requirements for Nuclear Power Plants

The basic legislative regulations, which set forth the conditions for nuclear power utilization, are Act No. 54/2004 Coll. on the Peaceful Use of Nuclear Energy (the Atomic Act) as amended and Act No. 355/2007 Coll. on Protection, Support and Development of Public Health as amended. Pursuant to these acts and the related regulations, all the requirements have to be met in nuclear energy utilization, mainly the requirements for:

- nuclear safety,
- radiation protection,
- physical protection and
- emergency planning.

The basic data on these requirements are stated in the following text.

II.8.3.2.1. Requirements for Nuclear Safety

Nuclear safety, in line with Act No. 54/2004 Coll. on the Peaceful Use of Nuclear Energy (the Atomic Act), means *"technical condition and capability of a nuclear facility or transport facility as well as the ability of their operator to prevent the prohibited leakage of radioactive substances or ionising radiation into the working environment or environment and the ability to prevent events and to mitigate consequences in nuclear facilities or during the transport of radioactive materials"*.

The basic principles for safe use of nuclear energy are with the cooperation of international experts summarized in the IAEA document Fundamental Safety Principles (SF-1) and are elaborated to a one complete system of internationally accepted requirements and instructions aimed at safe use of nuclear energy, which are published and kept by IAEA in a series of documents called the IAEA Safety Standards.

The conditions for a peaceful use of nuclear energy in the Slovak Republic are specified by the above mentioned Atomic Act defining the conditions and obligations subject to which legal entities and natural persons may use nuclear energy and introducing the obligation to perform supervision over nuclear safety. This supervision is carried out by the Nuclear Regulatory Authority of the Slovak Republic (ÚJD SR).

Specifically for siting, construction, launching, and operation of a NPP but also for its decommissioning, the future operator of the nuclear power plant has to obtain a permit in line with the provisions of the Atomic Act. The content and purpose of the documentation for the license system, which will be assessed in the process of issuing the permit, are defined in Annex to the quoted Atomic Act and in the follow-up directives of the ÚJD SR. At each assessment stage before issuing the relevant permit (licensing), the operator has to submit documentation involving detail safety evaluation, corresponding the level of the NPP project preparation status.

Detailed requirements concerning the nuclear safety, the fulfilment of which has to be documented and controlled when licensed, are specified in the binding directives issued by the ÚJD SR.

These are systematically updated and with each innovation, they are harmonised with the safety recommendations of the Western European Nuclear Regulators Association (WENRA), with the requirements for nuclear safety, which are issued by the IAEA in the series of its safety standards and finally before these directives are issued, they are provided to the EU Member States for opinion pursuant to the rules of the European Commission.

Apart from the directives, the ÚJD SR also issues safety guides (series of documents labelled BNS), which include recommendations on how to correctly meet the requirements.. When elaborating the BNS guides, the relevant guides issued by the IAEA are used (Safety Guides) but also the best practices from approaches of renowned countries, which utilize the nuclear energy in the long-term (e.g. the US NRC guides, guides of the Finland's Radiation and Nuclear Safety Authority guides, etc.).

The first step of the licensing process is *the nuclear power plant siting permit*. The future operator submits at this stage a documentation, a part whereof is the *Final Statement from the Proposed Activity Assessment* (pursuant to Act on Environmental Impact Assessment) and *the Safety Analysis Report* (involving the information on the evaluation of siting suitability of the NPP; further involving an overview of nuclear safety requirements that the NPP project has to meet and involving also the main technical parameters of the power plant).

Another licensing step is *permitting the construction of a nuclear power plant*. This stage is based on the fact that there are the basic technical documents on the project of a future nuclear power plant available. The basic documents on safeguarding nuclear safety in the nuclear power plant project create the basis for elaborating *the Preliminary Safety Report*, where the future operator proves the fulfilment of all requirements for nuclear safety as well as the fulfilment of all safety targets. Based on a positive assessment of the safety report and the set of other documentation, which the applicant submits in line with the Atomic Act, the ÚJD SR issues a permit for NPP construction.

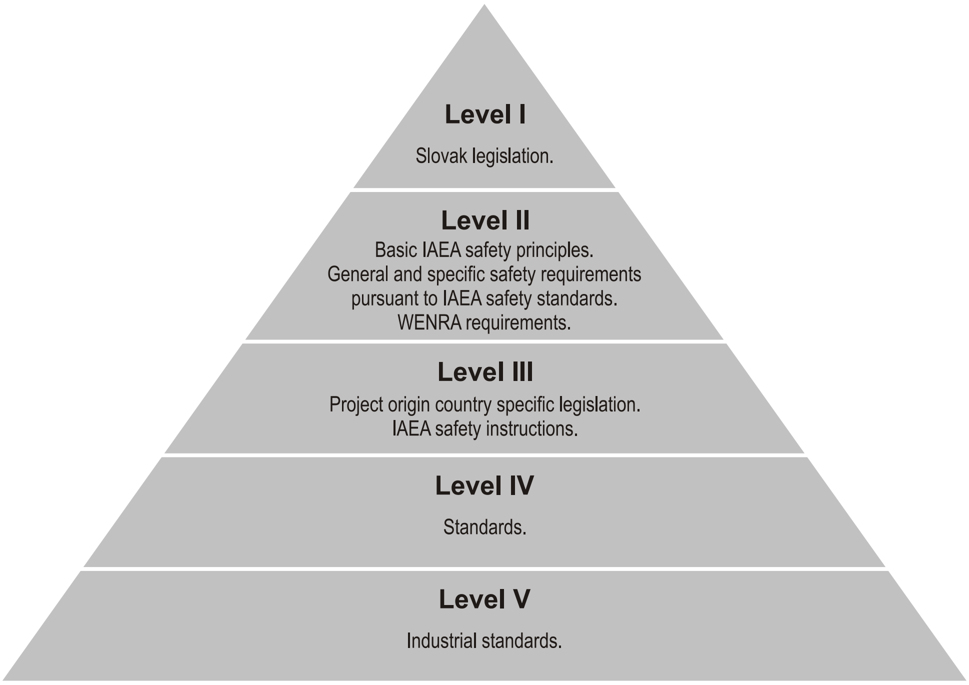
The following significant licensing step represents *the Nuclear Power Plant Launch and Operation Permit*, which the ÚJD SR subject to assessing *the Operational Safety Report*. This involves the safety assessments of the actual, already constructed, facility, which is ready for future operation, hence based on the entry data from the operational project. This safety report involves also the quality assessment of the project implementation and an assessment of potential changes to the project as compared to the state assessed in the Preliminary Safety Report.

Similar licensing steps are carried out before and during the operation termination stage, when the permit for activities related to decommissioning is issued.

Within the demand, the potential contractor offers his typical project, which has normally been already licensed in the country of project origin and also in other countries. Thus there will be performed only such changes to the project as required by the Slovak legislation, and changes necessary for incorporating the project at the Bohunice power plant site.

The hierarchy of requirements, which the new NPP has to meet, is listed in the following figure. In principle, the requirements on top of the pyramid are binding and the importance of meeting the requirements starts decreasing from the level II to V.

Fig. II.4: Hierarchy of regulations and standards valid for the area of construction and operation of nuclear power plants in the SR



Level I (Slovak legislation[6]): The first and most important level involves requirements resulting from statutes (mainly the Atomic Act), ordinances (mainly the ordinances of the Nuclear Regulatory Authority of the SR) and government orders, which refer to the activities relating to the nuclear energy utilization, i.e. also to siting, construction, launch and operation of a nuclear power plant (further also to its operation termination and decommissioning).

Level II (Basic IAEA safety principles, general and specific safety requirements pursuant to the IAEA safety standards, WENRA requirements): The second level includes the generally recognized international documents, where the basic requirements for safety are defined:

- the document IAEA Fundamental Safety Principles (SF-1) defines the basic safety target of nuclear energy utilization like the protection of the public and environment from harmful effects of ionising radiation and it develops it further to more detailed objectives and principles of safeguarding nuclear safety.
- The documents IAEA General Safety Requirements directly link to the above mentioned document and it defines the above mentioned targets and principles in more detail for the areas of legislation and supervising, safety control, radiation protection, safety assessment and handling radioactive waste.
- The documents IAEA Specific Safety Requirements involve specific requirements for the assessment of the NPP site, requirements for the project and operation of the NPP with nuclear fuel and for the transport of radioactive materials.
- The WENRA documents involve recommendations of priorities when safeguarding nuclear safety of both the operated NPPs and the NPPs under preparation and they elaborate the IAEA for NPP projects performed in the WENRA member states (the Slovak Republic is a member) in more detail.

6 The Slovak Republic is a member of the European Union, the Slovak legislation is hence harmonised with the European Union directives.

Level III (legislation of the country of the project origin and IAEA Safety Guides): The third level of requirements for nuclear safety includes requirements for nuclear safety valid in the country of the project origin and potentially also requirements for safety valid in some of the EU countries, where the NPP project was licensed (or where the licensing process of the particular project is ongoing). These requirements for the NPP nuclear safety will become binding for the new NPP project if reflected to the nuclear facility's quality requirements accepted (approved) by the ÚJD SR. This level also includes IAEA recommendations published in the series of IAEA safety guides (IAEA Safety Standards – Safety Guides), which involve detailed international recommendations for safeguarding nuclear safety of NPP systems, constructions and components.

Level IV (standards developed specially for the nuclear industry): The fourth level of requirements is composed of regulations and standards valid for the nuclear industry (national standards and standards used in the licensing process in the country of the nuclear technology; internationally recognized standards and standards for the nuclear area) e.g.: ISO, EN, IEC, IEEC.

Level V (industrial standards): The fifth level is made up of valid industry standards, mainly standards harmonised in Europe (the Euro Norms). They will be applied mainly in the secondary part of the NPP project and in the project of the follow-up systems.

The above mentioned requirements refer not only to the currently valid regulations in the period concerning preparation, design and construction of the power plant but also to potential new requirements for nuclear safety, for the design of the power plant at any stage of its life cycle. The current state of technical standards is hence continuously allowed for in line with the development of the best accessible technology including the lessons learnt from the potential non-standard or accident events at the nuclear facilities worldwide.

The primary measure for the prevention of accidents and mitigation their consequences (if the accidents occur) is the *in-depth protection concept*. The in-depth protection concept is based on the fact that the performance of all activities important for safety is divided into several levels. A failure, if applicable, will be either found and compensated or its correction will be safeguarded by means of measures on various protection levels.

In nuclear power plant projects, this in-depth protection concept is applied and as an important safety principle elaborated in detail, whereas the efficiency of this principle is constantly verified and assessed. The principle of the in-depth protection within the nuclear power plant projects depends on the utilization of multiple physical barriers, which restrict the radioactive substance leakage and on safeguarding the integrity of all these barrier systems of technical and organizational measures, which are designed on five levels.

The organizational measures and physical barriers are provided so that in case of failure of technical measures or physical barriers on a lower level, technical measures and physical barriers on higher levels are applied. The application of the in-depth protection principle in a nuclear power plant project safeguards that in case of a multiple failure of the facility or staff – even on a number of levels – the population and environment are not endangered.

The technical and organizational protection levels in the nuclear power plant project are as follows:

First level of protection: The aim of the first level of protection is to prevent deviations from standard operation and system failures. The fulfilment of this aim leads to the requirement of a sensibly and conservatively designed, constructed, maintained and operated power plant, in line with the relevant requirements for reliability and quality in accordance with good technical practice.

Second level of protection: The aim is to recognize and manage deviations from standard operation so that escalation of the anticipated operational events into an accident is prevented. In order to prevent such operational events or in order to minimise their consequences with the aim to renew a safe condition of the facility, it is required that specific management and limitation systems and elaboration of complex operational regulations are implemented.

Third level of protection: It is made up of measures for managing design incidents (if some events, which were not managed on the previous level, escalate). In the nuclear power plant project, the occurrence of design incidents is postulated and it is required to safeguard:

- such measures (inherent safety characteristics and/or protection systems and regulations), which, on an individual occurrence in the project of postulated incidents, enable the prevention of damage on the bare core and avert the radioactivity leakages to external environment above the permitted limit and enable setting the unit into safe condition;
- additional measures (safety technical systems and regulations), which, on the occurrence of the postulated multiple failures, enable to avert such development of incidents that would be followed by the damage on the bare core.

Fourth level of protection: The aim is to mitigate consequences of accidents, which result from a failure on the third level of protection. The most important role on this level is trapping the radioactive materials. The fourth level of protection involves measures for managing accidents falling above the project and focuses on maintaining the containment integrity.

Fifth level of protection: The aim is mitigating radiological consequences of significant radioactive material leakages, which may occur within the accident conditions. The measures on this level represent emergency plans and safeguarding an adequately equipped emergency control centre.

The levels of physical barriers in the PWR reactor type project, which prevent the radioactive substances leakage to the external environment, are as follows:

The first barrier: Fuel matrix (nuclear fuel material).

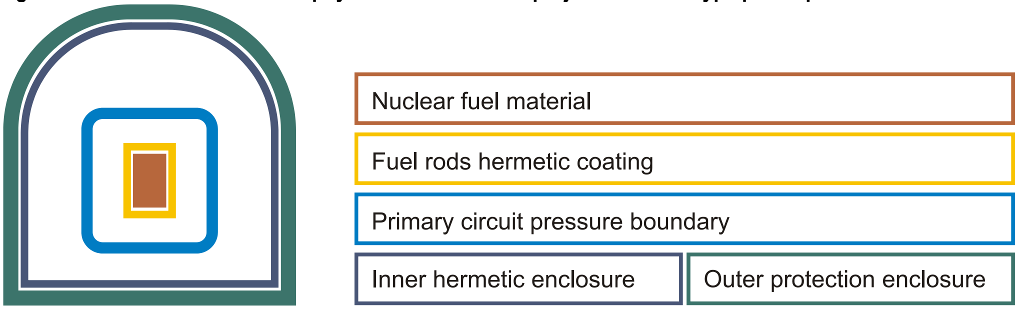
The second barrier: Fuel rods sheathing.

The third barrier: Reactor coolant pressure boundary (RCPB).

The fourth barrier: Containment (composed of an inner and outer containment).

The schematic illustration of the physical barriers in the PWR reactor type nuclear power plant project is illustrated in the following figure:

Fig. II.5: Schematic illustration of physical barriers in the project of a PWR type power plant



The purpose of these physical barriers is to gradually avert the radioactive material leakage from the spot of its occurrence to the external environment. Each physical barrier is designed conservatively (with considerable design reserves against damage) and its state is continuously monitored during operation.

II.8.3.2.2. Radiation Protection Requirements

Radiation protection, for the purpose of the Government Order No. 345/2006 Coll. on Basic Safety Requirements for Protection of Health of Workers and the Population from Ionizing Radiation, means *"the protection of people and environment from radiation and its effects including measures for its achievement"*.

Radiation (radiological) protection system, with the planned activities pursuant to the valid legislative regulations of the SR, is based on the following general principles:

1. The justification principle: Each practical activity involving radiation exposure should create a sufficient benefit to the radiated persons or society, which would balance the harm caused by radiation (justification of the practical activity).
2. The optimization principle: Exposure of people to radiation from any individual source should be maintained as low as reasonably achievable (ALARA principle), whereas the technical, economic and social factors are taken into account.
3. The not-exceeding-the-limits principle: Exposure of individuals to radiation resulting from a combination of all relevant sources of radiation shall not, under normal conditions, exceed the set limits for individual amount and risk.

The project of the new nuclear source will hence be solved in such manner, that all exposures will be maintained on a minimum reasonably achievable level after taking the economic and social aspects into account. The relevant irradiation limits set by the relevant regulatory bodies will be respected.

II.8.3.2.3. Physical Protection Requirements

Physical protection, under the Act No. 541/2004 Coll. on Peaceful Use of Nuclear Energy (the Atomic Act), means *"a set of technical, regime or organizational measures necessary for the prevention of and detection of unauthorized activities with nuclear facilities, nuclear materials, special materials and facilities; during the manipulation of radioactive wastes, spent nuclear fuel; during the transport of radioactive materials, as well as during unauthorized entry to the nuclear facility and sabotage"*.

It deals with a set of technical resource systems and a set of measures including administrative measures, which are designed so that they would safeguard protection of assets and protection of nuclear power facility containing nuclear material. The purpose of the physical protection system is to safeguard:

- access to guarded space, protected space and inner space only to persons or vehicles with an issued entry or drive-in permission to the defined space,
- so that the authorized persons entering the guarded space, protected space and inner space would not abuse this permission for an unauthorized activity;
- an early detection of an intruder and slowing their progress down, thus to foster the emergency squad to stop them before an unauthorized activity is performed, by combining the electronic safety system with mechanical preventive resources.

The physical protection is a specific activity, where the selected areas are subject to classified facts and control of access to information classified pursuant to the legislative regulations administering the manner of safeguarding physical protection as well as pursuant to the Act on the Protection of Classified Information. The physical protection system of the new nuclear source will be globally come under the physical protection of state safeguarded for the Slovak Republic on the highest level by the safety and armed corps and it will consist of mechanical preventive resources, technical systems, emergency protection, administrative measures, operational regulations and of an agreement with the police force on safeguarding emergency protection.

II.8.3.2.4. Requirements for Emergency Planning

Emergency planning, under the Act No. 541/2004 Coll. on Peaceful Use of Nuclear Energy (the Atomic Act), means *"the ability to develop and perform an activity and measures, which lead to the identification and management of incidents and accidents at nuclear facilities or during the transport of radioactive materials and to mitigate the possibilities of endangering the life, health or property of population and the environment, whereas such an ability has to be documented in an emergency plan"*.

It covers the organization of emergency planning in the areas of staff on-the-job-training, organizational and material-technical provision, with the aim to reach preparedness for accepting preventive measures focused on decreasing radiation consequences of incidents or accidents, which might occur during the implementation, operation or operation termination of the nuclear facility.

II.8.4. New NPP Specific Data

This chapter describes specific data and requirements related to the new nuclear power plant at the Jaslovské Bohunice site.

II.8.4.1. Technical Data

II.8.4.1.1. Basic Technical Data

The basic technical data of the new nuclear power plant are summarised in the following points:

- Nuclear power plant unit will be equipped with a Generation III+PWR reactor.
- The total installed power of up to 2,400 MW, with a one-unit arrangement (1x1,200 MW up to 1x1,700 MW) or a double-unit arrangement 2x1,200 MW.
- Minimum 60 years lifetime.
- An existing project at the implementation stage at a different site.
- A turnkey contract or supply of technological islands with coordination function of the contractor of the nuclear island.
- Supply of technology together with nuclear fuel supply with the consideration of the nuclear fuel contractor diversification.
- Safeguarding the licensing process will be in line with the legislative regulations of the Slovak Republic and utilizing experience and recommendations of international institutions.
- The power plant will work on the basic part of the daily load diagram and it will be authorized to provide the contractor of the superior transmission grid with support services corresponding the primary, secondary and tertiary active power regulation.
- The units will be able to work long-term at a capacity varying from 50 to 100% of the rated output and to change to the island regime in the event of failure at the transmission grid.
- The unit capability factor (UCF) for a 12-month period will be higher than 0.9 (period throughout which the unit is able to be in service divided by a whole calendar year).

II.8.4.1.2. Basic Safety Data

Basic Safety Targets

The new NPP project will be designed in such a manner so that the satisfaction of the basic safety targets is safeguarded in line with the legislative regulations and requirements of ÚJD SR, IAEA and WENRA for new power plants.

The basic safety target is to protect persons, society and environment from an unfavourable impacts of ionizing radiation. In order to achieve the highest reasonably accessible level of safety, it is necessary to:

- prevent the uncontrolled exposure of persons and release of radioactive substances to the environment.

- minimise the probability of events, which might lead to the loss of control over the bare core of the reactor, over the fission chain reaction, radioactive source or over any other source of radiation.
- In case of such events, to manage them in a manner that would minimise their consequences.

Compliance with the basic safety target will be considered at all stages of the nuclear facility's life cycle, i.e. planning, siting, designing, manufacturing, constructing, commissioning, operating and decommissioning. It also includes the transport of the radioactive material and handling radioactive waste.

Probabilistic Safety Measures

All referential nuclear units considered for the new NPP are designed with regard to the requirements for Generation III+ sources and in line with the IAEA and WENRA requirements for new power plants.

It is required for the new NPP that the core damage frequency (CDF) (probability of its occurrence), while considering all possible scenarios of failures and their combinations, would be lower than 10^{-5}/year and at the same time, that it would be almost excluded that the bare core damage might be followed by a great and early leakage of radionuclides from the containment. The frequency of such an event would in any case be lower than 10^{-6}/year.

Seismic Resistance

All referential nuclear units considered for the new NPP are designed with regard to the seismic effects and the project will be further adapted to the characteristics of the Jaslovské Bohunice site.

The seismic qualification of the buildings, systems and components will be adapted according to the legislative regulations of the SR and the IAEA standards considering the site-specific conditions. The seismic specifications for the proposal of the new power plant is available from surveys carried out for the existing nuclear facilities at the site. Furthermore, an update on seismic data has been performed regarding new knowledge about the site as well as new assessment methodologies pursuant to the valid IAEA regulations (SSG-9 Seismic Hazards in Site Evaluation for Nuclear Installations, 2010).

In line with the ÚJD SR regulations and IAEA recommendations, there are two design earthquake levels set for the new NPP at the Jaslovské Bohunice Nuclear Power Plant site, SL-1 and SL-2. The SL-1 level represents a lower seismic load at the occurrence of which, regarding the local geological and seismic conditions, is it possible to consider throughout the designed lifetime of the power plant. After such seismic event, the nuclear facility has to be capable of being put into operation again (after the respective controls are made). The SL-2 level represents a maximum seismic load, which, according to the analyses and assessment, may theoretically occur at the site and whereby it is required to safely shut down the nuclear power plant.

The SL-1 level has a return period of 475 years, the SL-2 level has a return period of 10^4 years.

Extreme Climatic Impacts and Floods

All referential nuclear units considered for the new NPP are designed with regard to the load of extreme climatic conditions and the project will be further adapted to the characteristics of the Jaslovské Bohunice site.

These extremes involve maximum and minimum temperatures, wind speed, torrential rains and snow cover load. Furthermore, the design values for meteorological phenomena, such as lightning and tornadoes are specified. Apart from extreme torrential rains at the site, also the extreme level and flow rate on the nearby watercourses (including the maximum water level in an event of dam breaks or watercourse obstruction through ice) the resulting floods are specified and assessed.

For the new NPP site, there is a detailed assessment of meteorological and hydrological conditions available, including the derivation of design values relating to climatic extremes. For the statistic processing of the individual meteorological characteristics, there are data from the monitoring station networks of the Slovak Hydrometeorological Institute (SHMÚ) available. The methods of statistical processing are based on the valid IAEA standards (SSG-18 Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations, 2011).

In line with the IAEA standards and the common international practice, the effects of climatic impacts are set for two of the proposed levels. This is the so called design and extreme load. In case of the design load, the considered repeatability of their occurrence is once in 10^2 years, for extreme calculation loads, the repeatability of the occurrence is considered to be once in 10^4 years.

External Impacts Induced by Human Activity

All referential nuclear units considered for the new NPP are designed with regard to the load of impacts induced by human activity and the project will be further adapted to the characteristics of the Jaslovské Bohunice site.

These impacts have their source in the surroundings of the new NPP site and they also involve the possible source of hazard on its premises. They originate mainly from industrial and agricultural activities in the given region, from the transport of hazardous substances on transport routes in the surroundings of the power plant (roads, railways) and from a potential aeroplane crash. Potential sources of hazard within the site of the power plant are mainly from the storage and internal transport of toxic, explosive, combustive, oxidizing, smothering and radioactive substances typically involving hydrogen, ammonia, oil, hydrazine, oxygen, nitrogen, other chemical substances used in the power plant and also from the transport of radioactive waste and spent fuel. A specific internal source of hazard represent incidents on other nuclear facilities on the premises relating to the leakage of radioactive substances to the surroundings.

External project events are defined as events, where the probability of their occurrence equals 10^{-6} per year or higher and their potential impacts are so severe that they may influence the power plant safety.

A hazard of intentional attacks (sabotage, terrorist act) will be addressed and eliminated by standard measures and procedures of physical protection in line with the international and national legislative regulations.

II.8.4.1.3. Basic Data of Reference Projects

The power plant with Generation III+ units may be delivered by a some of the worldwide renowned manufacturers. The following project solutions are considered referential:

- AP1000,
- EU-APWR,
- MIR1200,
- EPR,
- ATMEA1,
- APR1400.

The power plant contractor will be subsequently selected at other stages of the project preparation; the choice of the contractor is not subject to the environmental impact assessment. The environmental as well as safety requirements for all types of reactors are identical and their impacts are considered at their potential maximum (this means that the parameters used for the impact assessment will conservatively cover parameters of facilities of all contractors and number of units taken into account).

The basic data of reference projects based on the data presented by their contractors are stated in the following text.

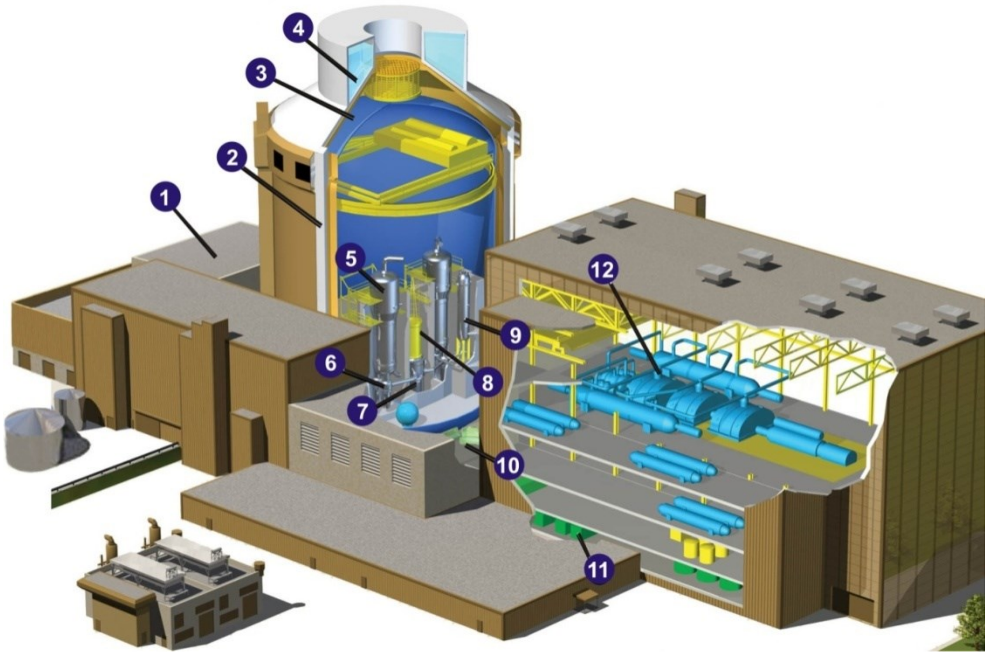
AP1000 Project

This is a project of Westinghouse Electric Company LLC, USA. The heat capacity of the unit stands at approximately 3,415 MW_t, with the net electric output of approximately 1,100 MW_e.

The main project characteristics of AP1000 may concisely be summarized in the following: prolonged life time of the power plant; utilization of passive technology; simplification of the project; increased independence of the power plant from external support; multiple protection levels and solving severe accidents on the project level. The AP1000 project achieves improvement in the project economy by means of simplification. When it comes to safety, the project is based on the utilization of passive systems. These systems involve a passive cooling system of the containment and a passive system for the after-heat removal.

The passive systems utilize the natural driving forces such as compressed gas, gravitational flow, natural circulation flow and convection and they do not use active components (such as pumps, vents or diesel generators) and they are designed so that they would work without any other active support systems. The containment integrity is in case of severe accidents safeguarded by the activity of three systems: by the hydrogen control system, which is designed for design accidents and severe accidents; by the system of reactor shaft flooding, where the melt is stabilized in the reactor's pressure vessel and by the system of passive containment cooling. The number and complexity of any operational interventions required for the control of the protection systems is minimised. Passive protection systems are designed so that they would work without operational interventions for 72 hours after a design incident. The reactor cooling system is made up of two loops for heat transfer; each of the loops has a steam generator, two main circulating pumps, one hot leg and two cold legs for the reactor's coolant circulation. Apart from that, the reactor cooling system includes volume compensator, cross-tie pipelines, valves and devices for operational control and for the start-up of safety devices.

Fig. II.6: Layout of the AP1000 unit



1	Fuel handling building (FHB)	**7**	Reactor
2	Containment building	**8**	Integrated upper block of the reactor
3	Containment	**9**	Volume compensator
4	Coolant inventory tank of the passive containment cooling system	**10**	Unit control room
5	Steam generators	**11**	Feed pumps
6	Main circulating pumps	**12**	Turbo generator (turbine and generator)

The energy unit is composed of five main buildings: the nuclear island, the machinery room, the auxiliary building, the diesel generator building and the building for radioactive waste. Each of these structures is built on individual foundation plates. The nuclear island is made up of the containment building, the protection building and the auxiliary service building, whereas all of them are built on a foundation plate. Facilities related to safety are situated only in the containment building, in the auxiliary service building and in the diesel generator building.

The main systems, which are located in the containment building, are: reactor cooling system; passive cooling system of the bare core and containment and part of the system of reactor's coolant purification system and the chemical and volume control system (CVCS). The main turbine, generator and the related piping and electrical systems are situated in the machinery room. The machinery room also includes the system of the injected coolant purification.

For the AP1000 reactor, the designer performed a detailed assessment of a large commercial aeroplane crash. The assessment states that based on the realistic calculations, an aeroplane crash would not interfere in the cooling ability of the AP1000 bare core; it would not disrupt the containment integrity and it would not disrupt the integrity of the spent fuel pond.

EU-APWR Project

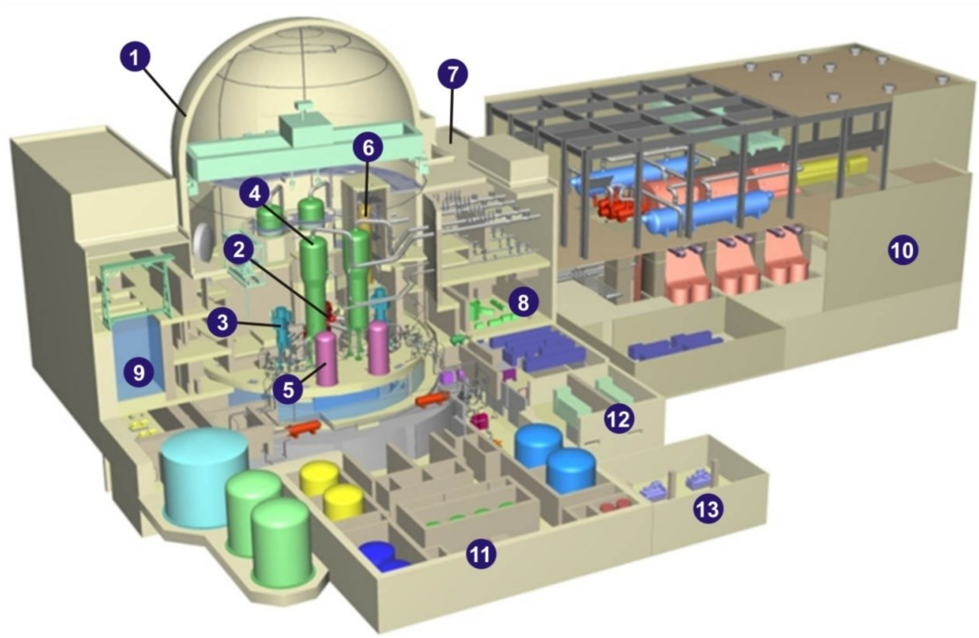
The EU-APWR is a European model of pressurized water reactor of Mitsubishi Heavy Industries (MHI), Japan. The heat capacity stands at approximately 4,466 MW_t, with net electric power of approximately 1,600 MW_e.

The APWR reactor project is based on a tried project of 4-loop PWR reactors and it utilizes innovated technologies with the purpose to increase safety, reliability, economy and to minimise its impacts on the environment. EU-APWR is furthermore modified so that it would correspond the EUR requirements and so that conformity with individual national requirements would be simplified when being licensed in the European countries. Thanks to the implemented technical solutions, EU-APWR has the main safety parameters improved, such as the core damage frequency (CDF) and at the same time, it marks an increase in electric output. High economy of the EU-APWR is reached by the optimized utilization of nuclear fuel, by the improvement of the steam generators' efficiency and by the utilization of a modified high-efficiency turbine of higher output.

The primary circuit of the EU-APWR reactor consists of four identical heat transfer loops connected parallel to the pressurized reactor vessel. Each loop involves a steam generator, main circulating pump and the relevant pipes and valves. The primary circuit furthermore involves a volume compensator, a pressurized relief tank, safety valves, connecting pipe and instrumentation equipment. All the above mentioned components are located in the containment.

The protection systems use a combination of active and passive systems. They consists of a emergency core cooling system (ECCS), a system of the after-heat transfer, a system of emergency steam generator feeding, containment system, containment spray system and filter system of containment envelope interstitial space. The emergency core cooling system involves a hydro-accumulator system, high-pressure injection system and emergency release system. In case of a severe accident, the EU-APWR units are equipped with a system of reactor shaft space cooling system. This system injects boric water to the reactor shaft in order to transfer heat and to keep the melt in the reactor shaft.

Fig. II.7: Layout of the EU-APWR unit



1	Containment building	**8**	Unit control room
2	Reactor	**9**	Spent nuclear fuel storage pond
3	Main circulating pump	**10**	Machinery room
4	Steam generators	**11**	Auxiliary service building
5	Advanced hydro-accumulators	**12**	Emergency generators
6	Volume compensator	**13**	Entrance building
7	Reactor building		

The nuclear island contains a reactor building, containment, emergency generator (gas turbines) building, an auxiliary service building and an entrance building.

The containment covers all components of the reactor cooling system and its internal steel-reinforced concrete walls protect the facilities from flying fragments and they also provide a biological shield wall to the maintenance workers. There are protection systems located in the reactor building and facilities important for safety. The protection systems are situated in four quadrants surrounding the containment construction. Each of the quadrants is divided by a physical barrier.

The containment and the reactor building are located on a common foundation plate and are designed to resist a large transport aeroplane or war plane crash. The containment, reactor building and the emergency generator buildings are designed as seismically resistant.

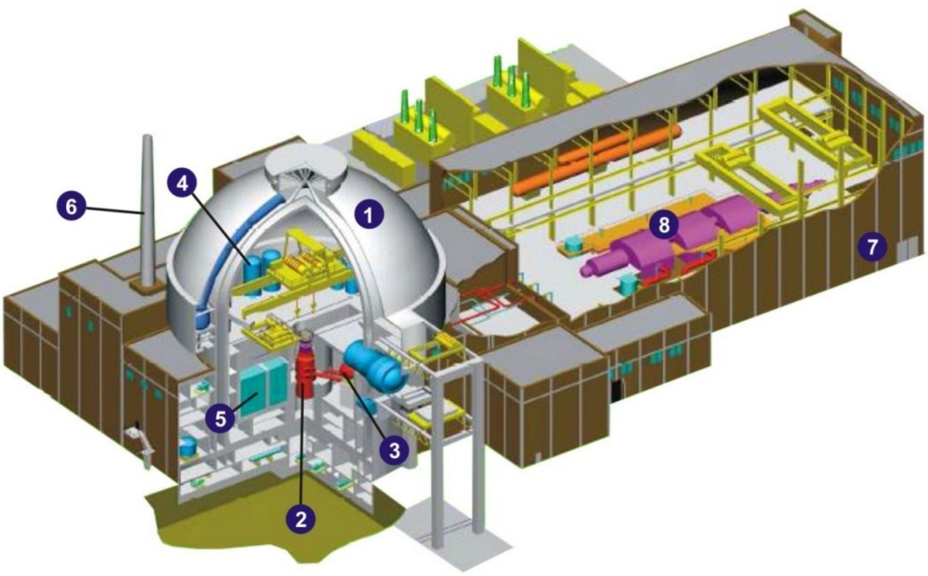
MIR-1200 Project

This is a project by a consortium of the companies Škoda JS/JSC Atomstroyexport/JSC OKB Gidropress, the Czech Republic/Russia. The heat capacity stands at approximately 3,212 MW_t, with the net electric power of approximately 1,114 MW_e.

The MIR-1200 project is a result of the WER-1000 pressurized water reactor technology development, beginning with the V-320 type (operated e.g. in Temelín). The AES-91 project with a WER-1000/V-428 reactor, now operates 2 units at Taiwan power plant in China. Furthermore a WER-91/99 project with a WER-1000/V-466 reactor with a prolonged lifetime of up to 60 years, which was offered for the Olkiluoto site in Finland and a current AES-2006/MIR1200 reactor type with a lifetime of 60 years and a higher output, which is, similar to the WER 1200/V491 under construction at the Leningrad Nuclear Power Plant 2 and the WER1200/V392M under construction at the Novovoronezh Nuclear Power Plant. 2.

MIR-1200 is a pressurized water reactor with four heat-transfer loops; each with a horizontal steam generator and a main circulating pump. The volume compensator is connected to the hot leg of one of the circulation loops. The reactor, the main facilities of the primary circuit, the passive part of the emergency core cooling system, the passive system heat transfer tanks, the fuel replacement and storage system are situated in the double containment.

Fig. II.8: Layout of the MIR-1200 unit



1	Containment	**5**	Spent nuclear fuel storage pond
2	Reactor	**6**	Venting stack
3	Steam generator	**7**	Machinery room
4	Hydro-accumulator	**8**	Turbo generator

The MIR-1200 safety concept is based on a priority utilization of active protection systems for managing design incidents and a combination of active and passive safety system utilization for preventing and managing of severe accidents.

Other safety improvements include an increased (four times) redundancy of safety systems; protection against large aeroplane crash; higher resistance against an earthquake and other common cause failures; realistic consideration of human factor etc. In order to manage severe accidents, the MIR-1200 project is equipped with a facility for capturing reactor core meltdown, a system for decreasing the hydrogen concentration and a passive system of heat transfer from the containment.

The double containment and the reactor building are situated on a common foundation plate. The primary (inner) containment is a pre-stressed concrete cylinder with a dome, which functions as the bearing construction taking the tensile stress caused by excessive pressure in case of an incident with the loss of coolant inside the containment. The secondary (external) containment is made of a monolithic ferro-concrete and provides protection against external hazards.

Although the project does not have an EUR certificate, , such a certificate was awarded to AES-92/V-392 and currently the AES-2010/V-510 TOI is in certification process. The potential contractors declare that they meet the EUR requirements to full extent.

EPR Project

This is AREVA NP project from France. The heat capacity stands at approximately 4,616 MW_t, with the net electric power of approximately 1,660 MW_e.

The EPR reactor is a pressurized water reactor (PWR) development type designed by AREVA NP. The EPR project is based on using a combination of design and operational experience of AREVA NP, which is constituted by the former Framatome and Kraftwerk Union (KWU, Siemens). The EPR reactor meets the safety requirements of the French nuclear regulatory authority adopted in 2000 with the participation of German experts and known as the “Technical Guidelines for the design and construction of the next generation of nuclear power plants with pressurized water reactors” or also known as EUR requirements.

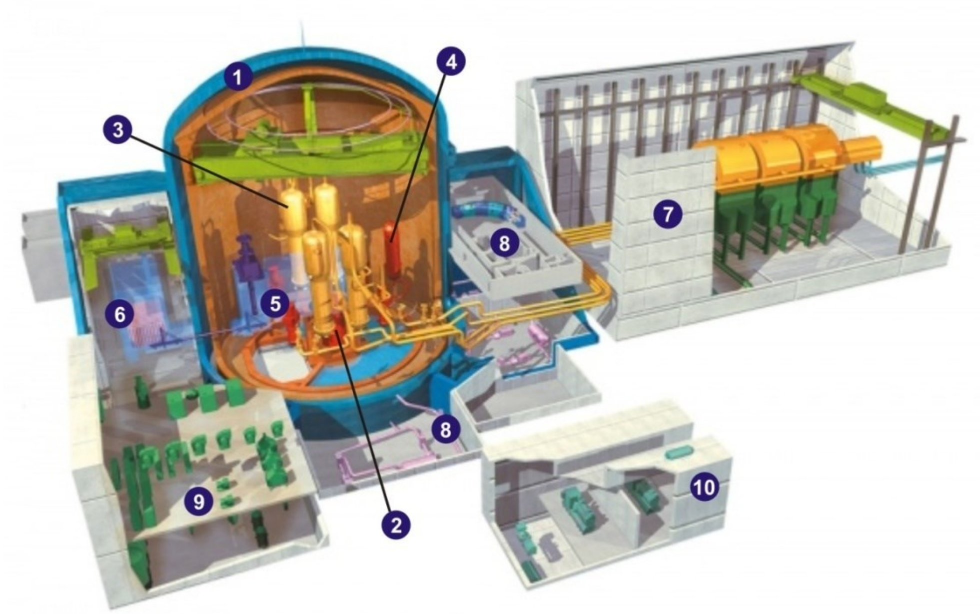
The EPR project may be characterized as an advanced reactor with increased safety and better economic indicators with an accent laid upon the active protection systems and with higher redundancy. Project innovations are focused in two directions: improvement of economic characteristics and increase in the power plant's safety.

The main safety innovations involve measures for the prevention of active zone meltdown and for the mitigation of potential consequences; increased resistance against external risks, mainly against the crash of a war plane or large transport aeroplane and a higher level of redundancy in the active protection systems. Each of the four divisions of the protection systems is protected against the spread of internal hazards (e.g. fire, high-pressure pipelines ruptures, floods) from one division to another. This requirement leads to each divisions being sited to a particular area and an individual building, which is separated from the other divisions.

The EPR project also solves the possibility of a core melting accident involving a failure of the pressurized reactor vessel. The project also includes special elements for capturing and stabilization of the reactor core meltdown inside the containment, managing hydrogen concentration and long-term heat removal from the containment.

The organization of the reactor's cooling system consists of four conventional loops. The volume compensator is connected to one hot leg through a surge pipe and to two cold legs through injection pipes. The pressurized reactor vessel, volume compensator and steam generators have an increased ratio of volume to the size of the bare core, this inherently prolongs the time for heat transfer from the bare core in the case of secondary circuit failure.

Fig. II.9: Layout of the EPR unit



1	Containment building	**6**	Spent nuclear fuel storage pond
2	Reactor	**7**	Machinery room
3	Steam generators	**8**	Protection system building
4	Volume compensator	**9**	Auxiliary service building
5	Main circulating pump	**10**	Diesel generators

The EPR nuclear island consists of a reactor building, containment and four protection system buildings and a fuel handling building, whereas all of them are located on a common foundation plate. The containment is a double concrete construction consisting of an internal primary containment and an external secondary containment. The auxiliary service building, two buildings with emergency diesel generators, radioactive waste processing building and two premises for the intake and pumps of the essential service water are located on individual foundation plates. The same applies to two essential service water coolant buildings. The entrance building with a connection to the controlled zone is also a part of the nuclear island. The machinery room is built independently of the nuclear island.

ATMEA1 Project

It is a common project between AREVA NP of France and Mitsubishi Heavy I of Japan. The heat capacity stands at approximately 3,150 MW_t, with the net electric power of approximately 1,125 MW_e.

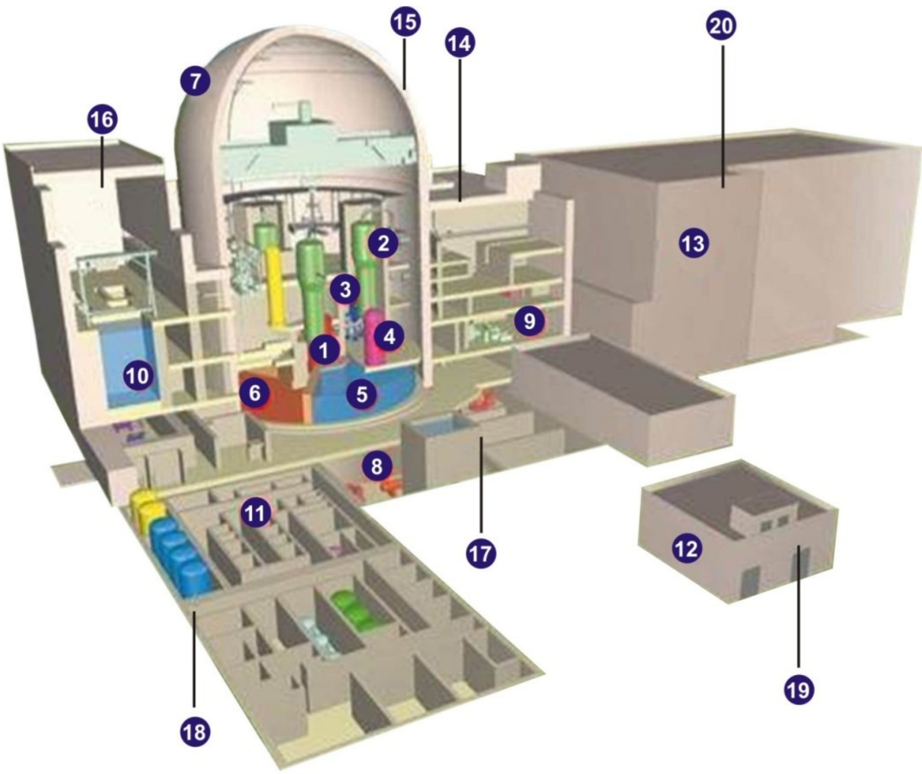
ATMEA1 is a reactor with a basic set of common design characteristics adaptable to specific commercial requirements and requirements of regulatory authorities of each country. It involves three redundancies of the emergency core cooling. The systems of the primary circuit and the protection systems are located inside the containment and buildings with protection systems, which are protected against large commercial aeroplane crash. A system for capturing the active zone meltdown in order to mitigate severe accidents is located inside the containment. The containment is made of pre-stressed concrete with an inner metal jacket. An under-pressure is maintained in their interstitial space and this facilitates a filtration of any potential leakages.

The ATMEA1 reactor's cooling system consists of three primary cooling loops, each with a reactor cooling pump, a steam generator, a hot leg pipe and a cold leg pipe. The volume compensator is connected to the hot leg of one of the loops of the reactor's cooling system.

The contractor further states that the ATMEA1 project has an optimum combination of passive and active safety systems for the restriction of incident consequences, with a preference of the active systems.

The passive functions are used only in case of testified facilities for [pressurized water reactor (e.g. for the utilization of hydro-accumulators for the emergency core cooling). An important development goal was also to safeguard competitiveness of electricity generation when compared to the alternative energy sources.

Fig. II.10: Layout of the ATMEA1 unit



1	Reactor	**11**	Auxiliary service and waste storage systems
2	Steam generators	**12**	Emergency electric generators
3	Main circulating pumps	**13**	Turbo generator
4	Advanced hydro-accumulators	**14**	Protection system building
5	Containment coolant rack	**15**	Reactor building
6	Melt catcher	**16**	Fuel handling building (FHB)
7	Containment	**17**	Protection system building
8	Protection systems	**18**	Auxiliary service building
9	Unit control room	**19**	Emergency feed building
10	Spent fuel storage pond	**20**	Turbine hall and machinery room

The ATMEA1 nuclear island consists of:

- a reactor building, protection system building and a fuel handling building, which are located on a common foundation plate,
- an auxiliary service building, two emergency feed buildings, buildings for processing radioactive waste and input buildings, which are located on common foundation plates.

The reactor building consists of a containment and is located in the middle of the nuclear island. The containment is surrounded by buildings of safety systems and the fuel handling building. There are the main components and pipes of the primary circuit, of the steam generation system and protection systems located in the containment. The buildings of the nuclear island are designed so that they would resist internal events as well as external hazards including an earthquake. The containment building is furthermore designed so that it would resist a crash of a large transport aeroplane. The common foundation plate of the reactor building, of the safety systems buildings and of the fuel handling buildings prevent a slant during a seismic event or in an event of a large transport aeroplane crash.

APR-1400 Project

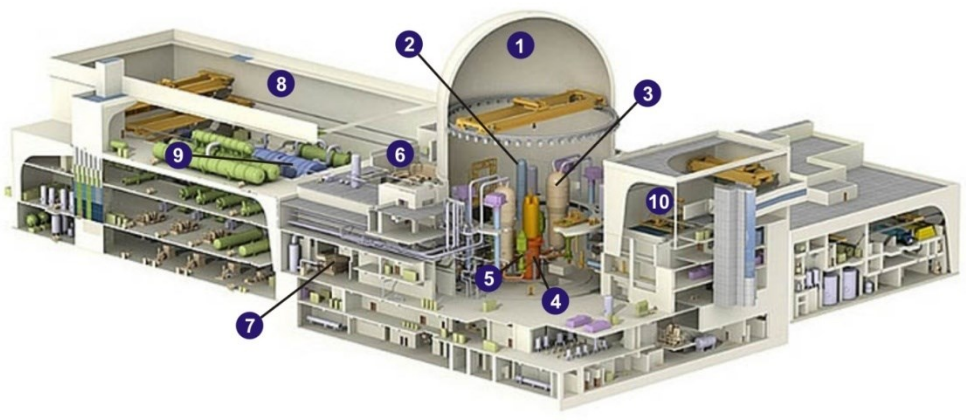
It is a project of Korea Hydro Nuclear Power (KHNP), South Korea. The heat capacity stands at approximately 4,007 MW_t, with the net electric output of approximately 1,400 MW_e.

The APR1400 project was developed on a verified technology and design, construction, operation and maintenance experience with the OPR1000 reactor (8 such units are in service and 4 units are under construction in Korea) and based on a 80+ project, which was certified by the US nuclear regulatory authority in June 1997. When designing the APR1400 project, mainly the requirements of the US and Korean operators were taken into account.

The APR1400 project involves numerous design adjustments and improvements. The design adjustments were performed with the purpose to meet the needs of operators from the perspective of safety, operational characteristics and maintenance, improvement of economic indicators and to meet the requirements of regulatory authorities and new permission conditions. The project considers the requirements for managing the conditions of a severe accident and risks related to the reactors shut-down regimes, etc. The following are the main design improvements:

- increased capacity; better utilization of the power plant's potential; longer interval between refuelling;
- utilization of modern materials and an increased lifetime of the power plant;
- higher redundancy of safety divisions when combining the optimized passive and active safety systems; containment coolant inventory tank; higher seismic resistance; increased heat reserves; prolonged period for the intervention by the operator and an ability to balance out a total loss of power the result whereof is a decreased probability of severe accidents;
- implementation of design measures for the mitigation of the consequences of severe accidents such as fully pressurized containment made of a pre-stressed concrete; a system for reactor shaft flooding; system for hydrogen disposal; safety depressurization and venting system; big reactor shaft adapted to capturing and cooling the remnants of the melt-down reactor core; standby emergency containment spray system and a system of external cooling of the reactor vessel.

Fig. II.11: Layout of the APR-1400 unit



1	Containment building	**6**	Unit control room
2	Volume compensator	**7**	Diesel generator
3	Steam generators	**8**	Machinery room
4	Reactor	**9**	Generator
5	Main circulating pump	**10**	Spent nuclear fuel storage pond

The layout of the APR1400 power plant may be divided into the nuclear island, turbine island and other facilities of the power plant. The nuclear island includes a containment, auxiliary service building and common premises. All components of the reactor cooling system are located in the containment. The inner steel-reinforced concrete walls of the containment protect the facilities from flying fragments and they also provide protection from the radiation.

The containment involves an inventory tank for cooling water. All floors or greater horizontal areas in the containment placed over the containment ground floor are designed as self-draining and all the water from there flows under gravity and returns to the inventory tank.

The components of the protection systems such as emergency injection system and emergency feeding system are located in the auxiliary service building. The auxiliary service building includes unit control room; emergency diesel generators and a separated room for handling fuel. The emergency diesel generators are spatially divided on the opposite sides of the premises. The auxiliary service building and the containment are situated on a common foundation plate.

The common premises are made up of entry control; a part for handling nuclear waste and active workshops. The turbine island includes a machinery room and an own-consumption substation, which are places on a common foundation plate. The machinery room involves a turbine, generator and other components creating the secondary circuit and serving the electric generation.

II.8.4.2. Technological Solution

II.8.4.2.1. Primary Part

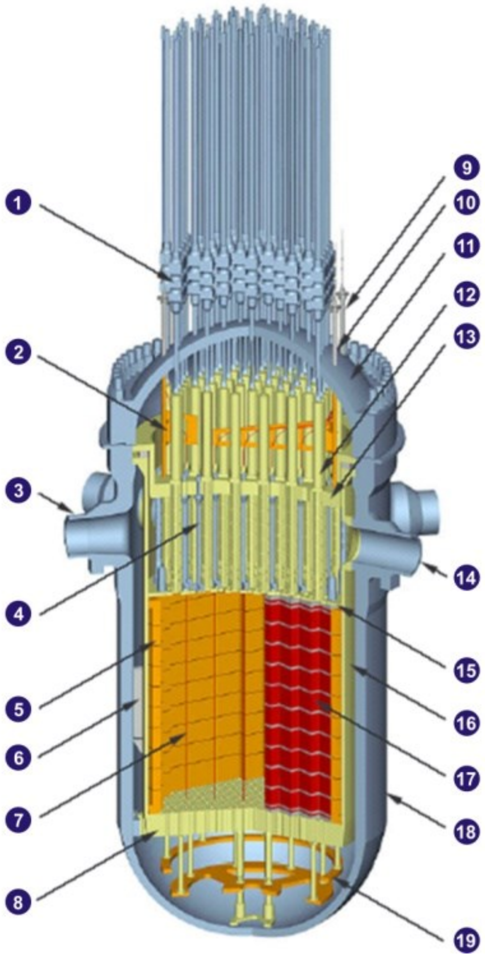
The primary part consists of the primary circuit, protection systems, auxiliary systems of the primary circuit and a containment building system. The main components of the primary circuit are: pressurized water reactor, steam generators, main circulating pumps, main circulating pipe and volume compensator. The primary circuit transfers, by means of forced water circulation under high pressure (main circulating pumps), heat generated by the reactor core to the steam generators. It hence provides for core cooling and heat transfer from the bare core to the steam generators. It further facilitates a control of coolant temperature in the bare core; coolant pressure control in the bare core; maintenance of integrity of the pressure interface; control of coolant flow rate through the bare core; control of the bare core reactivity and holding the reactivity through a third physical barrier (pressure threshold of the primary circuit).

Reactor

In the PWR power plant, the pressurized vessel consists of a vessel as such and a reactor cover head, inner structures are located in the reactor vessel and the drive mechanisms of the control rods and an instrumentation are located on the reactor head. The main function of the reactor is to contain and support the core (where the fission reaction takes place) and to contain a sufficient amount of moderator (which also serves as the coolant) necessary for keeping the fission chain reaction in the bare core.

The coolant enters the reactor via the inlet nozzles, it flows through the circular gap between the vessel and the core shaft and slows upwards to the bare core. When flowing through the bare core, the coolant is heated by the heat of the fission reaction of the nuclear fuel and flows out of the reactor via the outlet nozzles. A typical solution of the reactor set is illustrated in the following figure:

Fig. II.12: Typical construction solution of a PWR reactor, example of a fuel assembly solution



1	Control units drive mechanisms	**11**	Reactor head
2	Set of in-core reactor pipe instrumentation	**12**	Guide tube
3	Inlet nozzle	**13**	Upper support column
4	Upper core support columns	**14**	Outlet nozzle
5	Neutron reflector	**15**	Upper core plate
6	Spot for witness samples	**16**	Core shaft
7	Instrumentation thimble guide	**17**	Fuel set
8	Lower core plate	**18**	Reactor vessel
9	Thermal sleeve	**19**	Radial support
10	Sleeve of in-core reactor instrumentation		

A controlled fission reaction takes place in the bare core where the transfer of the heat incurred by this reaction also takes place. The bare core consists of fuel sub-assemblies, which are usually placed in a rectangular or hexagon grid. The fuel sub-assemblies consists of fuel rods, guide tubes, spacer grids and heads. The fuel rods are composed of fuel pellets, which are hermetically enclosed in tubes made of special alloy, usually on the basis of zirconium. The purpose of the shell is to maintain the geometry of the fuel rod; to enable heat transfer from the fuel to the coolant and to maintain the radioactive fission products in the fuel tubes (it hence creates the second physical barrier against the leakage of radioactive substances to the external environment). The guide tubes create channels for the introduction of either the bundle of control rods, the neutron source of the rods with burnable absorber. The measurement tube is usually placed in the fuel assembly in a central position and creates a channel for the introduction of neutron detector.

The fuel charge machine places or reloads the fuel at the time of the reactor outage.

The reactor output is managed by a combination of inherent nuclear characteristics of the bare core, by its thermal-hydraulic characteristics and by the capability of the control system and of the reactor trip system.

Steam Generator

The steam generator is a pressurized vessel either of horizontal or vertical design with a separate of feed water and emergency feed water systems, heat-exchanging area is made up of tubes and a steam system consists of moisture separator and steam collector.

The steam generator serves as a heat exchanger between the primary and secondary circuit. The hot coolant from the primary circuit enters the hot collector of the steam generator, from where it is distributed to the heat exchanging tube bundle. During the transit through this bundle, the primary coolant transfers the heat to the feed water of the secondary circuit and then it enters the cool collector. After that it enters the cold leg of the primary circuit loop and it returns back to the reactor. A dry steam is formed from the feed water on the secondary side of the steam generator and flows towards the turbine.

Main Circulating Pump

The main circulating pump is conventionally a vertical, centrifugal one-stage pump with a seal shaft unit and an asynchronous electric motor. The main circulating pumps safeguard circulation of the necessary amount of coolant in the primary circuit in line with the reactor thermal output in various operational regimes.

Volume Compensation System

The volume compensation system serves for maintaining a constant operational pressure and for the restriction of pressure deviations in the primary circuit.

Auxiliary Systems of the Primary Circuit

The auxiliary systems of the primary system are made up of:

- a primary circuit coolant make-up and purification system and a system for maintaining chemical regimes;
- radioactive waste processing system (RWPS);
- a coolant pond cooling and purification system;
- air-conditioning systems.

The primary circuit coolant make-up and discharge system and the system for the modification of the coolant chemical composition are necessary for the long-term control of the fission reaction and for maintaining the required purity of the coolant. This system maintains the necessary balance of the coolant through the discharge or injection during all operational regimes of the unit; it controls the hypoboric acid concentration in the coolant; it removes all fission and activation products from the coolant and provides for the injection of chemicals to the coolant as a result of controlling the chemical regimes (coolant pH, degassing). The hypoboric acid concentration control of the coolant enables the control of reactor reactivity inventory and that is necessary for the long-term fission chain reaction control.

The RWPS processing system safeguards the treatment of radioactive wastes in a gaseous, liquid or solid forms. After its purification, the major part of the coolant and a part of chemicals are utilized again in the primary circuit. Further data on handling RWPS in the new NPP are stated in the chapter II.8.4.4.2. Radioactive Waste Management (page 47 of this Preliminary Study).

The system of cooling the fuel storage pond provides for the heat transfer from the spent fuel during its storage in the spent fuel storage pond (for a period necessary for the decrease of delayed heat), during refuelling even in the case of emptying the whole bare core from the reactor. Furthermore, the system maintains a sufficient level for shielding of the operators from the fuel radioactive radiation. The purification system maintains the quality of the cooling water and it consists of ion exchange lines.

The ventilation systems provide for such parameters of the environment, which create conditions necessary for the operating personnel and for correct functioning of the technological facility throughout the operational states and emergency conditions.

Protection Systems

The protection systems of the primary system are made up of:

- reactor trip system;
- emergency core cooling system (ECCS);
- emergency power supply system;
- decay heat removal system;
- safe depressurization system;
- essential service water system;
- emergency steam generator feed system.

The reliability of these systems in nuclear power plant projects require meeting the highest demands.

The reactor trip system servers for a quick interruption of the fission reaction. The reactor is equipped with a safety protection system, which is made up of absorption rods and of the relevant control circuits. The scram system is put in service automatically in cases when control parameters are exceeded in an inadmissible way. The scram system may be put in operation also if the operator presses a button at the unit or emergency control rooms. Because the absorption rods are kept in the upper positions through a motor drive mechanism during the operation of the reactor, in the event of a scram, they fall passively (by means of its own weight) to the bare core and thus stop the fission reaction within several seconds.

The emergency core cooling system protects the bare core from thermal damage and also during incidents when the coolant leaks from the primary circuit. During such incidents, it safeguards the supply of cooling water and boron to the reactor.

The emergency power supply system consists of diesel generators or gas turbo-generators and electric batteries. The system connects the protection systems and the important control systems in case of loss of the working and auxiliary power supplies.

The decay heat removal system removes the heat generated in a shutdown reactor as a result of radioactive changes of fission products present in the fuel and provides aftercooling of the reactor under normal operational conditions, under abnormal conditions and under design accident conditions, while maintaining the tightness of the primary circuit.

The safe depressurization system serves for decreasing the pressure in the primary circuit in a controlled way, which is necessary for the correct functioning of the emergency core cooling system during incidents, where the pressure in the primary circuit does not fall spontaneously, whereas a functioning emergency cooling is required.

The intermediate cooling circuit is a closed up cooling system, which provide for heat transfer from the systems of the primary circuit to the essential service water system and they create a protection barrier against radioactivity leakages into the service water systems.

The essential service water system provides for decay heat removal from all the important systems of the unit, where a longer lasting cooling outage cannot be allowed. In case of incidents, the heat is transferred from the emergency core cooling system or from the decay heat removal system. The heat is transferred from the system to the end heat trap, which is usually represented by the cooling towers or sprinkler system ponds.

The emergency steam generator feed system provides for the fact that the steam generators are fed by water in case of the outage of the main or auxiliary steam generator feed system. It safeguards the heat transfer from the primary to the secondary circuit during incidents without losing the primary circuit coolant.

Containment Building System

The containment building system consists of an inner hermetic containment and outer containment.

The inner hermetic containment consists of its own construction and of hermetic nodes (feed-through, penetrations, shut-off elements) and the systems for heat and pressure control inside the containment (e.g. the passive heat transfer, spray systems, hydrogen combustion, etc.) which are located in its inner space.

The inner hermetic containment is designed so that it restricts, under emergency conditions related to radionuclides leakages (including severe accidents), such leakages into the surroundings in order to minimise the radiation impacts on the environment.

The construction of the external containment is designed so that the reactor vessel, the primary circuit and other facilities important from the nuclear and radiation safety perspective, which are placed in the containment, would be protected from external events (explosion, fire, aeroplane crash, extreme weather conditions etc.), the occurrence of which cannot be excluded with sufficient probability.

The containment building system also functions as a biological shielding.

II.8.4.2.2. Secondary Part

The secondary part consists of the secondary circuit, auxiliary secondary circuit systems and the main cooling circuit (tertiary circuit).

Secondary Circuit

The basic function of the secondary circuit is to produce and transport the steam and then transform its energy into a mechanical energy of the steam turbine rotor; which is subsequently transformed into an electric power in the generator. The steam and energy conversion system facility is located in the machinery building. The secondary circuit consists of the following systems:

- main steam supply system;
- turbo generator (turbine and generator on a common axis);
- condensation and vacuum system;
- main steam generator feed system.

The main steam supply system (main steam header) delivers the steam from steam generators to the high-pressure part of the turbine within flow rates and pressures which include all operational regimes (varying from system warm-up to operation at a maximum power output). The steam supply system includes the main steam pipes; fast acting isolation valves; safety valves and the follow-up steam piping and steam distribution piping. The main steam pipes are dimensioned and routed so that they would safeguard uniform steam pressure at the turbine inlets. The system also includes inlet steam pipe routes to the dump stations to the condenser. The transmission to the condenser provides for an outward transmission of steam power away from the turbine.

The turbo generator transforms the thermal energy of the steam into electric power. The steam turbine is condensing type, of tandem arrangement, with a separated moisture condensate and re-heater behind the high-pressure part. The generator is directly connected to the turbine shaft. The oil supply for the turbine and the generator is placed in the machinery room, the facilities are protected from oil leakage from the system.

The purpose of the main steam generator feed system is to supply the steam generators with the feed water of the required parameters. The feeding station includes main feed pumps and auxiliary feed pumps and the follow-up piping systems and valves. The feed water pipeline routes leading to the steam generators are installed feed control stations, which in cooperation with the feed pump, provide for maintaining the required feed water level in the steam generator.

Auxiliary Systems of the Secondary Circuit

The auxiliary systems of the secondary systems are:

- intermediate cooling circuits in the machinery room;
- non-essential service water system;
- chemical water treatment plant;
- ventilation systems.

The intermediate cooling circuits in the machinery room serve for the heat transfer from the selected pumps and other facilities placed in the machinery room and they transfer this heat to the non-essential service water circuit.

The non-essential service water system is used for cooling the secondary circuit appliances, the emergency supply of sources not important from nuclear safety point of view and from the intermediate cooling circuit.

The demineralised water is prepared and stored in the chemical water treatment plant and it serves as an additional feed water to the primary and secondary circuit.

The ventilation systems safeguard such parameters of the environment, which create conditions necessary for the operating personnel and for correct functioning of the technological facility throughout the operational states and emergency conditions.

Main Cooling Circuit (Tertiary Circuit)

The tertiary circuit system involves a cooling water pumping station, the necessary connection to the machinery room, turbine condenser cooling, pipeline connection to the cooling tower, cooling towers, inlet channels of cooled-up water from the cooling towers to the pumping station and others. The circulating cooling water circuit is closed-up with a make-up of losses within the circuit from the cooling water treatment plant of the new NPP. Each nuclear unit has an individual cooling circuit; these cooling circuits may be connected both on the side of the cooled-up water channels and on the side of the discharge pipes from the machinery room and cooling tower.

During the heat transfer to the atmosphere, an Iterson type of natural draught cooling tower is utilized. This is equipped with a warmed-up water distribution system, spray nozzles, cooling system made up of plastic units and effective eliminators, which restrict the drift of water drops into the atmosphere.

II.8.4.2.3. Electrical Systems

The electric system consists of sources and distribution systems, which are according to their function divided as follows:

Outward Transmission of Power

The outward transmission of power from the power plant's generator is realized via the main transformer and an external 400 kV power line. The power will be transmitted to the new Jaslovské Bohunice power station, which will be a component of the transmission grid of the Slovak Republic.

Operating Power Supply for the Own Consumption

A branch of the outward transmission of power will be utilized for the operating power supply for the own consumption.

Back-up Power Supply for the Own Consumption

The back-up power supply for the own consumption will be taken from the 110 kV grid. The connecting link between the operating and back-up power supply will be controlled by a quick automatic stand-by power system.

Secure Power Systems for Systems Important from the Perspective of Nuclear Safety

Multiple secure power systems will be a part of the unit; usually consisting of diesel generators and batteries installed in several mutually divided redundancies.

Alternative Power Supply Systems

The alternative power supply systems are necessary for managing and mitigating the beyond-design-basis and severe accidents. They usually consist of separated diesel generators and batteries with a long autonomous operating time, substations and substation facilities.

II.8.4.2.4. Management Control System

A modern system based on digital technology will be used as the management control system. The information and management systems will be equipped with devices so that they would enable the monitoring, measurement and control of the operational parameters important for the nuclear safety during normal and abnormal operation and under emergency conditions. The systems will be resistant against failures with a sufficient degree of reliability and in a quality necessary for safeguarding the safety and operability of the power plant.

The systems will use a high degree of automation, however, it will be safeguarded that the primary management activities of the power plant will remain in the hands of the operator. The operator will be fully informed about the state of the power plant and he may, at any time, enter the management process apart from the safety functions.

The reactor units will be equipped with protection systems, which will:

- Be able to detect abnormal conditions and to put the relevant systems into operation so that the design limits are not exceeded.
- Able to recognise emergency conditions and put the relevant systems designed for the mitigation of these conditions into operation.
- The superior activities of the management systems and of the operation of the nuclear facility, in all states considered in the nuclear facility proposal, whereas the operation will be able to put the protection system into action manually.

The protection systems will be separated from the management systems so that a failure of the management systems would not influence the ability of the protection safety systems to carry out the required safety function. The solution of the protection safety systems will be performed with a highly functional reliability, by means of back up and by means of independence of the individual channels so that no simple failure would cause a loss of the protective function of the system. In order to restrict the impact of a failure in digital system resulting from a common cause, diversity – both in function (recognition of abnormal state by means of various parameters and events) and in equipment – will be applied.

The Human-machine Interface (HMI)

For the operation management of the new facilities, a modern man - machine interface will be applied, which will enable the operators of the power plant to react, on time and correctly, to all states of the nuclear facility and power plant systems. For the support of the operators' decision-making, there will be information available organised in an appropriate way, so that the operation would have an immediate overview of the state of the whole unit for its safe and effective management. Information about the operation and indication of the arisen operational situation or abnormal state will be arranged so that the burden on the operators is be minimised. In order to manage the emergency conditions, the operators will have available sufficient means and measures, either redundant or diverse, directly in the unit control room and the back-up centre.

Management and Service Centres

The power plant will be in all states monitored and managed by the operators from the unit control room. The unit control room will be equipped with a modern technology based on computer systems. The process management will be performed through monitors, the important parameters will be viewed on conventional display systems. Individual safety parameter display system (SPDS) with conventional elements will be used for the protection systems. In case of a computer system failure, the important monitoring and control features will be backed up on the display systems, equipped with conventional elements. The operator will always have all the necessary data available, he will always be informed about the state of the power plant and he will always have measures available for putting the power plant in a safe state and maintain it like that.

For the situation when control from the unit control room is not possible, the power plant is equipped with a back-up centre (emergency control room). The design of equipment of the emergency control room is for the main part identical or as close as possible to the equipment of the unit control room

For the support of operators in case of an incident or accident, the technical support centre will still be performed. This will be equipped with information systems similar to the control room with a possibility of remote control of the facilities necessary for the management of severe accidents.

II.8.4.3. Building Solution

II.8.4.3.1. Concept of the Power Plant's Civil Part Solution

The civil part of the power plant is in principle divided into these parts:

- nuclear island;
- conventional island (CI);
- other premises.

Nuclear Island

The premises of the nuclear island are located in the closest surroundings of the reactor (which is the dominant component of the nuclear island) and include technologies immediately relating to the operation of the nuclear part of the nuclear facility. The nuclear island premises involve facilities of the primary circuit and facilities, where the nuclear fuel is located (reactor building, auxiliary service buildings, space for manipulation with fresh and spent fuel etc.). These premises are, in the seismical category I, hence they meet the requirements for seismic resistance of the SL-2 level.

From the construction perspective, they are designed as spatially monolithic constructions with panelled ceilings. The reactor building (including the reactor) and auxiliary service buildings in the immediate surroundings, share one massive foundation plate so that the stability of the structures is assured.

The containment is designed as a multilayer construction. The inner (primary) containment, from the construction perspective, consists of pre-stressed body with a dome (alternatively a wall steel construction), providing for tightness and resistance against internal missile impacts. The protection predominantly from external impacts is composed of an external (secondary) steel-reinforced concrete cylindrical building with a dome ceiling. If the containment has a single-layer solution, it fulfils all functions at the same time. In such case, it is again a pre-stressed body and dome; whereas this solution offers one additional annulus built around the bottom part.

Other buildings related to the nuclear island (the entrance building, back-up power building etc.), which are not immediately next to the containment, are solved according to their importance from the construction perspective. These are mostly spatially monolithic constructions with panelled ceilings already on the foundation plates. A skeleton frame is used for buildings of lower importance (not connected with the nuclear safety of the unit). These structures are classified in the seismic category II from the seismical perspective and are arranged so that they would not jeopardize the category I structures.

The construction material used is mainly steel-reinforced concrete and pre-stressed concrete.

Conventional Island (CI)

The CI premises, also called turbine island (turbine hall, exchanger station, etc.) are located in a position related to the nuclear island. This involves machinery room with a turbo-generator and the attached technological service rooms. The CI buildings either create one single structure or they might share a common foundation plate. The solution of underground floors represents a monolithic skeleton frame. The floors above the ground level are designed as a steel skeleton frame with steel-concrete ceilings. The sheath consists of a sandwich panel. The conventional island constructions are from the seismical perspective usually classified as category II and the layout is such so that they would not jeopardize the category I structures.

The turbo-generator stand deserves special attention. There are two approaches to the solution of the stand. The stand consists of the base, which is separated from the foundation plate of the machinery room, alternatively, the base of the stand is resiliently mounted to the foundation plate of the machinery room.

The construction material used is mainly steel-reinforced concrete and steel.

Other Premises

Other premises provide for all other services, media and support functions necessary for the operation of the nuclear power plant. They are cooling towers, compressor plant, chemical water treatment plant, engineering networks, substations, administrative building, etc. They are arranged on the site so that the functional and safety requirements are met and so that the premises would not negatively influence each other. The arrangement of the premises towards each other is subject to the state of the site, hence the areas available for construction and the existing infrastructure. The structures and material used for the buildings are designed so that it would meet its purpose in as optimally as possible. The construction solution may be roughly identified with the type of the premises as follows:

- common halls (typically the compressor plant, storage facilities) – steel skeleton frame, steel-reinforced concrete foundations, sandwich sheath,
- special halls (chemical water treatment plant) – steel skeleton frame, steel-reinforced concrete bath, steel-reinforced concrete walls verging into the sandwich sheath,
- water management premises of ground nature (pumping stations) – steel-reinforced concrete skeleton frame, steel-reinforced concrete bath, beam filling or sandwich sheath, alternatively steel-reinforced concrete walls,
- administrative premises (administrative building, training centres, receptions, operation buildings) – steel skeleton constructions or steel-reinforced concrete constructions on foundation bases or belts,
- end heat traps (cooling towers) – draft chimneys of a hyperbolic shape; the steel-reinforced concrete sheath is placed on support pillars on a cooling water capture pond.

It is further necessary to mention the line constructions, networks and pipeline bridges etc. These constructions, however, mostly do not differ in their solution from similar, generally known constructions.

II.8.4.3.2. Main Building Structures and Complexes

The individual complexes involve structures mentioned below[7].

The nuclear island premises:

- reactor building (involves containment, sometimes also the unit control room),
- auxiliary service and safety systems building,
- fuel oil system building,
- power supply building (includes the emergency power supply sources),
- entrance building (includes entrance controls, laboratories),
- radioactive waste manipulation building,
- management system building (not necessarily as an independent object),
- safety system building (not necessarily as an independent object),
- essential service water pumping station building.

The premises of the conventional (turbine) island:

- turbine machinery room,
- exchanger station (often a part of the machinery room),
- own consumption substation (often a part of the machinery room).

Other premises:

- outward transmission of power,
- transformers and back-up transformers,

[7] It is necessary to view the range of the individual complexes within the individual projects in an informative way. The premises with different names in particular design solutions include similar technologies. In some particular cases, a building is not constructed because the technologies used may share common premises and the particular design solution does not require an individual building.

- chemical water treatment plant;
- workshops,
- storage facilities,
- cable channels and bridges,
- pipe ducts and bridges,
- cooling towers (end heat trap),
- cooling water channels,
- cooling water pipes,
- cooling water pumping stations,
- communications, pavements and parking lots,
- external lighting,
- rail siding,
- rainwater, industrial and sink pipe system,
- waste water treatment plant,
- oil, petroleum and pollutant separators,
- water management pumping stations,
- potable water pipe system,
- fire fighting pipe,
- heating water pipes,
- retention tanks,
- crane railways,
- entry barriers,
- garages,
- compressor plant,
- cooling station,
- office building,
- operation building,
- others.

II.8.4.3.3. Urban and Architectonic Solution

The area for the construction of the new power plant is next to the Jaslovské Bohunice nuclear facilities site which consists of the NPP A1, Bohunice 1,2 and 3,4 and other operations. The site is place and with reference to its existing use, it is of an industrial nature. The individual premises above ground are architecturally simple, of common geometric shapes. The engineering premises (networks) are solved as underground networks. The communications of the premises are solved as reinforced (bituminous) roads and pavements for pedestrians; the transport service is connected to public road and railway network, which are linked to higher routes. In front of the entrance parts to the A1, Bohunice 1,2 and 3,4 NPPs, there are platforms of the public bus station and car park reserved for the employees. The non-built up areas are covered in a greenery.

Fig. II.13: The existing structure of the Jaslovské Bohunice nuclear facilities site

The architectural concept of the new power plant will spatially and functionally supplement the existing structure also with regard to the similar nature of its operation. The spatial and height solution of the premises of the new plant will primarily correspond the requirements of the technology; in this regard, they will reflect (in their height, volume and colour) the existing premises in the Jaslovské Bohunice Nuclear Power Plant site so that they would not interfere with the current landscape scene. The cooling towers will possibly be located in such way that the view from the surrounding places would be balanced in its volume. The concept will also be connected to the existing transport infrastructure as clearly as possible.

All the solutions of the reference projects are similar in their layout. The mutual complexity of the premises will respect the shape of the site, local conditions and the technological-operational and safety requirements. The following items may be mentioned among the basic requirements:

- the orientation of the turbine axis always has to be such, that in the event of turbine failure, the rotor does hit neither the reactor building nor the safety system building;
- the auxiliary operations have to adjoin these building for easy manipulation with materials and media; the pumping station must adjoin the cooling towers;
- the cooling tower has to be sufficiently distanced from the substation and transformers because of the negative effect of the water;
- the outward transmission of power lines is either in the same direction as the axis of the machinery room or perpendicularly to the axis.

From the architectural point of view, the buildings will be designed as industrial buildings of simple geometrical shapes. The reactor building, in the concept of the nuclear and conventional island, will be dominant and the other structures will gradate towards the notional centre of the complex. The cooling towers }(1 or 2) will represent the dominant feature of the new power plant. The power plant will be architecturally mould the existing building complex of the Jaslovské Bohunice Nuclear Power Plant site.

II.8.4.4. Operational Solution

II.8.4.4.1. Nuclear Fuel and Spent Nuclear Fuel Management

The basic commodity for the operation of the new nuclear power plant is the nuclear fuel. This will be purchased on a world market, where there is a sufficient amount of the uranium resources for the lifetime of the new power plant.

The fresh nuclear fuel is transported to the nuclear power plant either by rail or by roads in the nuclear fuel assembly transport containers. It is stored in a sufficient quantity needed for the upcoming regular unit outages to replace the fuel depending on the selected fuel cycle, including the necessary reserves. The fresh fuel is stored either in dry storage bins in the fresh fuel storage facility or in storage positions below the water level in the reserved part of the spent nuclear fuel ponds. The storage facility is designed so that it protects the stored fuel from design events, such as an earthquake, flood, extreme climatic impact, etc. Facilities necessary for the manipulation with the fuel at its receipt and when transported to the reactor hall for refuelling are part of the storage facility. Furthermore, there are facilities for fuel control and its safe storage situated.

When the fuel is used in the reactor, the efficiency of the fission reaction utilization will gradually change, it is then necessary to reload the used up fuel assemblies for new/fresh one. The fuel in the reactor is usually reloaded seasonally, during an operational outage (once in 12, 18 or 24 months). All the fuel is not reloaded at once. When reloading, only a part of the fuel is exchanged and the rest of the fuel assemblies change their position in the bare core. An overall reloading takes place gradually over several years (normally over 4 to 6).

The nuclear fuel is considered spent after its exposure in the reactor core and after it is permanently removed from there. The spent fuel is in the Slovak Republic not implicitly regarded as radioactive waste. It may be considered a usable source (which might be modified) or it may be determined for storage (if declared for radioactive waste). The spent fuel remains a nuclear material, it is subject to the statutory control regime implemented through a system of international guarantees, which safeguards that it is not used for other than peaceful purposes.

After it is taken from the reactor, the spent fuel is placed in the spent fuel pond. This is located either next to the reactor in the reactor hall in the auxiliary fuel storage building, which is connected to the reactor hall through a transport corridor. The size of the pond corresponds the requirements for storing the spent nuclear fuel produced over a minimum of 10 years and throughout this time, it also provides an additional free space for storing all the fuel from the reactor's core when its complete removal is needed. The fuel is stored in the pond under the water containing hypoboric acid and in a compact grid, which includes an integrated material for the absorption of neutrons (this is usually steel with a boron alloy). Such an arrangement safeguards a subcriticality with a sufficient reserve and heat transfer from the decay of radionuclides.

Later on the spent nuclear fuel management will become a part of the existing systems and concepts and will hence be addressed on the state level. The spent fuel will be, after meeting the requirements for its safe transport and storage, handed over to a legal entity authorized to store radioactive wastes or spent fuel, i.e. JAVYS, for its further management without undue delay.

The intrastate concept of spent nuclear fuel management is mainly determined by the strategy of final part of nuclear power engineering. This strategy of final part of nuclear power engineering was elaborated pursuant to the provisions of the Act No. 238/2006 Coll. on the National Nuclear Fund in the wording as of the time of its elaboration. It was approved by the Government Decree No. 26 as of the 15 January 2014. The strategy assumes the storage of the spent nuclear fuel from the Slovak nuclear power plants in an interim storage facility for spent fuel in Jaslovské Bohunice, where its compacting should be completed. However, because of its limited capacity, it also assumes a construction of a new storage facility for the spent fuel around the year 2020. For the final stage of the spent nuclear fuel management, i.e. its storage in a deep geological repository, the construction of a Slovak deep geological repository is prioritized. Alternatively (according to the development in the relevant area), the participation in the activities leading to a development of a common storage facility of several states still remains a possibility.

It is to be noted that the adopted strategy does not address the preliminary study on the construction of the new power plant in more details. Therefore, the need of its update (no later than by August 2015) is apparent in a form of new intrastate programme – for this reason on the one hand and for the obligation of compliance with the current wording of the Act No. 238/2006 Coll. on the other hand. In this case, the responsible resort authority is the Ministry of Economy of the Slovak Republic .

II.8.4.4.2. Radioactive Waste Management

The radioactive waste are pursuant to the Atomic Act (Section 2(k), Act No. 541/2004 Coll. as amended) defined as “any unusable material in gaseous, liquid or solid form, which due to the content of radionuclides in them or due to the level of their contamination with radionuclides cannot be released to the environment”.

The Atomic Act also defines the notion “radioactive waste management” (Section 2 (h)(2)) based on a particular list of activities, such as their “collection, sorting, storage, treatment, conditioning, handling and disposal”, whereas the transport of radioactive waste is not considered as their management.

The power plant operator must appropriately sort his radioactive waste, whereas the relation with the statutory categorization of radioactive waste based on the level of its disposability has to be apparent. The power plant system safeguards the treatment of radioactive wastes in a gaseous, liquid or solid form. The purpose of the radioactive waste treatment is to reduce its volume, to set the radioactive components aside from the non-radioactive ones and to modify the characteristics for the purpose of its further treatment. This will in principle not differ from the approaches used in the currently operated nuclear power plants.

The gaseous waste is created mainly as a result of degasification of the primary circuit coolant from gases created by means of radiolysis in the reactor or created as gaseous fission products. Dust and humidity is removed from the gaseous waste through dust filters and subsequently the radioactive aerosols are removed through the absorption filters. Before it is released through the vent stack (in a controlled way based on authorized limits of gaseous discharges), the radioactive gases are held in so called gas decay tanks, where they naturally decay or where their activity is lowered.

The liquid waste is created mainly when the primary circuit coolant is purified. The coolant frees itself from the impurities on mechanical filters and ion exchangers; the emerged radioactive waste is subsequently thickened by vaporization. Another source of liquid radioactive waste is the contaminated work clothing, shower facilities, decontamination activities etc. This waste is treated in a similar way. The radioactive waste treatment in a nuclear power plant leads to a repeated utilization of the coolant and a part of the primary circuit chemicals, to the release of liquid discharges (in a controlled way, based on authorized limits of the liquid discharges) and to the storage of the radioactive concentrates and saturated ion-exchanger resin suspensions in tanks with suitable qualities before its further management.

The solid radioactive waste (RAW) from a normal operation represent saturated radioactive filters of all kinds; the activated or contaminated components of the technology exchanged during maintenance works and low-contamination materials from the controlled zone. The solid waste is collected at the collection points, it is sorted according to its activity and its further management, into e.g.: the burnable, compressible, non-burnable and non-compressible waste. Power plants are equipped with low-pressure presses for the volume reduction of compressible waste. The solid RAW is usually located within the power plant in the barrels and/or in shielded storage chambers before its further management.

The radioactive waste management is a part of the intrastate system and concept of RAW management. Pursuant to the relevant provision of the Atomic Act, the radioactive waste will be handed over for its further management within 12 months as of their emergence to a legal entity authorized to dispose of radioactive waste or spent fuel, i.e. to JAVYS.

The basic facility of the intrastate system for very low and low radioactivity waste is the National Radioactive Waste Repository in Mochovce. This represents a multi-barrier surface type storage facility designed for the final storage of the conditioned RAW emerged during the operation and decommissioning of the power plant in research institutes, industry and hospitals in the Slovak Republic. The National Radioactive Waste Repository will store also low-activity RAW from decommissioning alternatively from the operation of nuclear facilities in individual storage structures.

It is also necessary to mention that even though the principles for RAW management remain the same for the new power plant as for the existing nuclear power plants, the related state strategic and programme documents regarding RAW management will have to be updated. The department authority is in this case the Ministry of Economy of the Slovak Republic.

II.8.4.4.3. Conventional Waste Management

All the non-radioactive waste will be treated in line with Act No. 223/2001 Coll. on Waste, as amended and in line with the future internal documentation of the power plant, which will elaborate this Act and its implementation decrees in detail. A maximum effort will be made to restrict waste dumps and to offer the waste for further use as secondary raw materials.

II.8.4.4.4. Water Management Connection and Systems

It is necessary to safeguard the following for the needs of the new nuclear power plant:

- water supply systems and

- systems for waste and precipitation water treatment and drainage

Water Supply Systems

The water supply systems involve potable water system, fire-fighting water system and raw water system.

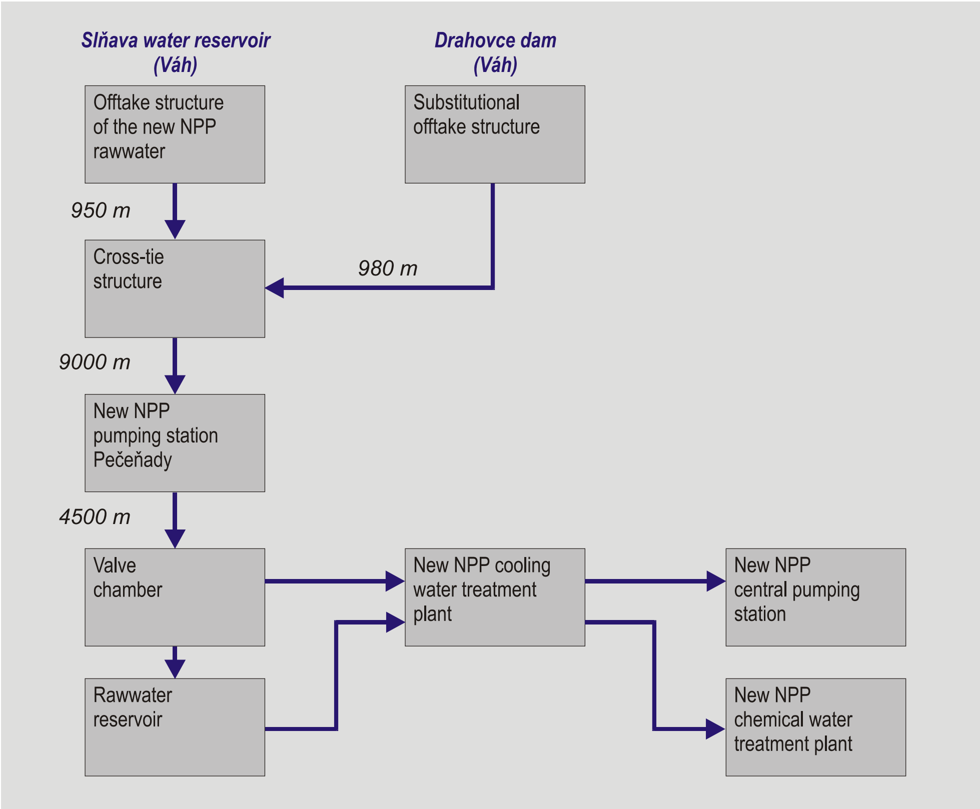
The potable water system will safeguard water supply for social purposes, hence for personal consumption of employees including covering the water supply for sanitation purposes and boarding. The potable water will also serve as service water e.g. for cleaning services. The new power plant will be supplied with potable water from the existing distribution lines, providing for the supply of the existing facilities at the Jaslovské Bohunice Nuclear Power Plant site. These are supplied with potable water through a remote water supply from water sources Dobrá Voda, Dachtice and Veľké Orvište.

The source of the *fire-fighting water* for the supply of external as well as internal hydrants at the new power plant site will be the circulating (tertiary) cooling circuit. The total water volume in the circulating cooling circuit, accumulated in the ponds of the cooling towers, will be big enough to cover the needs of water for the biggest fire-fighting intervention possible with a sufficient reserve. This volume will be replaced from the raw water system.

The raw water system will serve for the make-up of losses in the circulating cooling circuit, in the essential service water system, in the non-essential service water system and for the generation of demineralised water. The predominant part of the consumption (approx. 95%) consists of refilling the circulating circuit i.e. the coverage of losses composed of the blow-down of the circulation cooling water (CCW) and of the vapour from the cooling towers. For the purposes of the new nuclear power plant, a new raw water supply system will be built (independent of the existing facilities at the Jaslovské Bohunice Nuclear Power Plant site), the modern technical design and lifetime of which will meet the requirements for a safe raw water supply throughout the whole new power plant's operation. The source of raw water will be (similarly as for the existing Jaslovské Bohunice Nuclear Power Plant site supply) the Sĺňava dam water reservoir. The new raw water inlet structure will be placed on the right bank of this water dam, from where the water will be linked through new gravity feed systems of an approx. 10 km length to a site near the municipality Pečeňady, where the raw water pumping station will be built. The pumping station will be located near the existing Pečeňady pumping stations site. The raw water will be transported from the pumping station to the new power plant site by delivery pipelines of an approx. 4.5 km length. The raw water will be transported within the new power plant site to a reservoir, cooling water treatment plant and then to the cooling circuit system. A part of the treated water will be transported to the chemical water treatment plant so that looses of demineralised water mainly in the secondary circuit can be replaced. The reservoir will work as a water inventory for long-term after-cooling (a minimum of 30 days). For the planned release of the Sĺňava water reservoir, the raw water supply system will be backed-up by a substitute extraction system, which is based on the installation of high-performance submersible pumps in the water cushions of the Drahovce dam.

The principal diagram of raw water supply is stated in the following figure.

Fig. II.14: Principal diagram of raw water supply



Waste and Precipitation Water Treatment and Drainage Systems

These are systems for the collection, purification and drainage of industrial and sink (waste) water and additionally for the drainage of precipitation water from the new power plant site and from the river basin of the new power plant site.

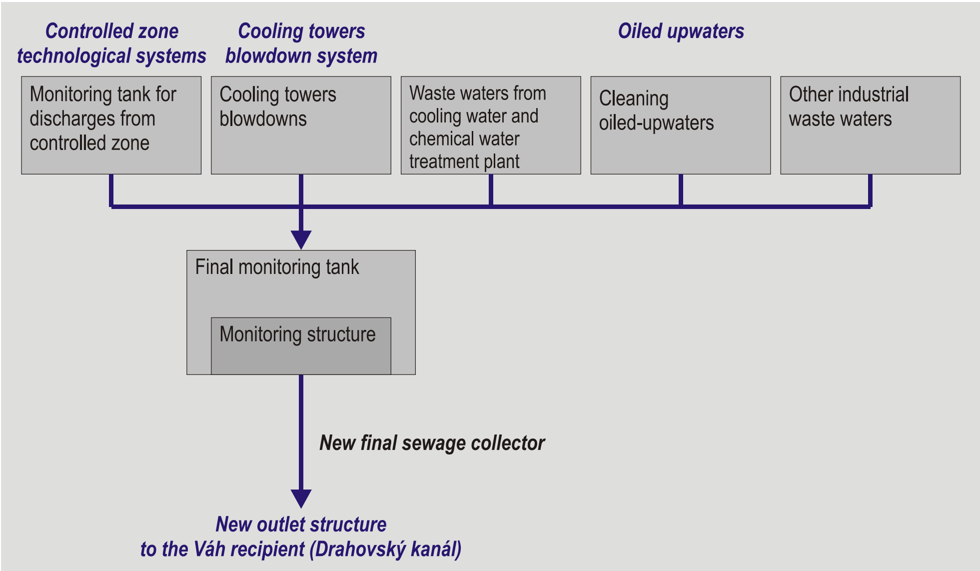
Within the operation of the new power plant, a range of *waste water of industrial nature* will emerge. These will mainly include the following kinds of industrial waste water:

- waste water from a controlled zone,
- blow-down water from the cooling circuit,
- waste water from the cooling and chemical water treatment plant,
- oiled contaminated waste water,
- other industrial waste water.

There will be industrial sewage systems build in the new power plant site for the collection and drainage of waste water depending on the individual types of the waste water. The industrial waste water will be, depending on its origin, drained to the new clean-up facilities and after its purification, it will be drained to the end monitoring tank. From here it will be released after a control justifying its release) to the environment together with the purified sink water. The end monitoring tank with a volume of approx. 500 m^3 will be located at a common site of the new power plant' water management sites and it will consist of a monitoring site serving for monitoring of the amount and quality of the water released from the new power plant. It will be working in a continuous regime and it will make it possible to stop the release in order to impose measures for disposing of the pollutants in case their unauthorized concentration is detected.

The principal diagram showing the concept of collection, purification and drainage of industrial waste water is apparent from the following figure.

Fig. II.15: Concept of waste water collection, purification and drainage



Apart from the industrial sewage system, the site will have a *sink water sewage system* for the collection of waste water from the social facilities and the canteen. The sewage waters will be drained to a new mechanical-biological waste water treatment plant located at the common site of water management premises of the new power plant. The waste water treatment plant will have all the sewage waters drained from the new power plant premises. The measurements of the amount and quality of the purified sewage water are performed at the outlet of the waste water treatment plant. The sewage water will further be released to the above stated end monitoring tank and after it is controlled (together with the industrial waste water) through the new sewage collector to the recipient (Váh river).

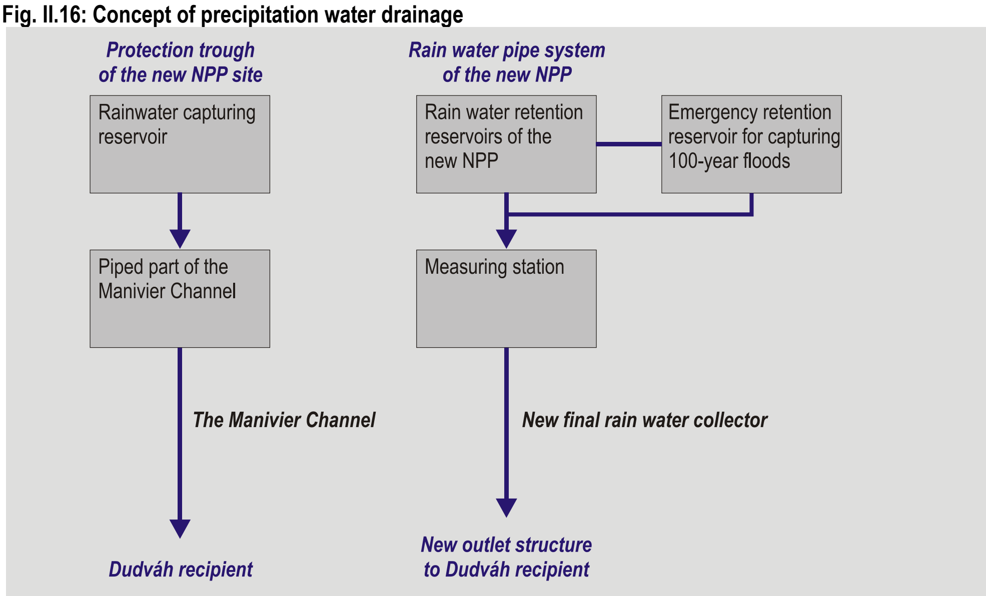
For *rainfall water* (which is not waste water) a system separated from the waste water system will be built.

For the disposal of rainwater from the new power plant site, a new external rainwater pipe system will be built, from where this water will be released to the retention tank, where a rough purification will take place (capturing run-offs – solid particles, which get into the sewage by means of runoffs mainly from the stabilised and non-stabilized areas including the roof of the premises). For the accumulation of extreme rainfall, the system will further be equipped with an emergency tank. Behind the run-off of the rainfall water from retention/back-up tanks and an emergency tank, there will be an affiliated measuring structure built, where the quality and quantity of the rainfall water flowing away from the new power plant site will be measured. The rainfall water will further be released by a new end pipeline header to the Dudváh recipient, i.e. to the same river, where all the rainfall water is released from the existing Jaslovské Bohunice Nuclear Power Plant site. A new pipeline is designed because the Manivier channel, through which the rainfall water is currently released from the Jaslovské Bohunice Nuclear Power Plant site, has only a limited capacity. The new end collector of the rainfall water will lead simultaneously with the new waste water collector (see above) and it will bypass the municipalities Žlkovce and Ratkovce, to avoid the residential area Žlkovce. The pipeline route will be approx. 5,000 m long and it will end with a new outlet structure built on the right bank of the river Dudváh.

In order to release the rainfall water from the external river basin of the new power plant site, there will be a safety capturing trough built in front of the site's fence (as an alternative to the safety capturing troughs existing at the Jaslovské Bohunice Nuclear Power Plant site). This ditch will be built on the north-western side and it will run into the capturing and retention tank, where the solid particles will be taken out (from the release channels from the surrounding fields) and before reaching the piped part of the existing Manivier channel, which is already built below the NPP Bohunice 1,2 site, retention will take place. This piping below the new power plant construction site will have to be lengthened and furthermore, it will be necessary to reconstruct its exiting part below the NPP Bohunice 1,2 site. After the rainfall water goes through the piped section, it will be released, together with the remaining rainfall water, from the existing NPP Bohunice 1,2 site through the bed of the Manivier channel to the Dudváh recipient.

The principal diagram of rainfall water drainage is stated in the following figure.

Fig. II.16: Concept of precipitation water drainage



II.8.4.4.5. Electrical Connections

The electrical power of the new power plant will be let out via a 400 kV line to the new Jaslovské Bohunice electric power station, which will be situated southwards from the new power plant site[8]. A back-up own-consumption supply of the new power plant will be safeguarded from the same electric power station via a 110 kV line.

II.8.4.4.6. Transport Connection

A communication of the new power plant will be linked to the public road and railway network.

The road connection is could come from two main directions. One of the main connections is through Jaslovské Bohunice to Špačince to the road II/560 following the direction to Trnava. Another direction is situated in the direction towards Piešťany via the communication to Žlkovce using the road I/61 Bratislava – Trenčín and further down to the D1 motorway. In order to connect the new power plant, it will be necessary to build a new two directional ground communication, linked via a level crossing to the class III road No. 50415 Žlkovce – Jaslovské Bohunice.

A connection to the *railway transport* is solved by a single-track rail siding, which leads to the railway station Veľké Kostoľany, where it is linked to the state railway no. 120 Piešťany - Trnava - Bratislava. It currently serves for the whole Jaslovské Bohunice Nuclear Power Plant site, it is approx. 8.1 km long and in order to connect the new power plant to it, it will be necessary to build a railway connection with new rail siding.

II.8.4.4.7. Personnel Safeguarding Operation

It is estimated that a maximum of around 600 persons are needed for one unit and a maximum of around 1,050 persons is needed for two units and their operation and maintenance. The actual number of workers will depend on the organisational structure of the operator and on the extent of services provided externally.

[8] This station will be a part of the transmission grid of the Slovak Republic, and will hence be the project of a different investor (SEPS, a.s.).

II.8.4.5. Data on Construction

During the construction of the new power plant, the building and construction activities will be performed within:

- the main construction site and
- corridors of the related infrastructure networks.

II.8.4.5.1. Works on the Main Construction Site

The main stages of the construction will be the following:

- preparatory works on the construction site,
- construction works,
- assembly of mechanical systems and facilities,
- assembly of electrical systems and management and control systems,
- tests.

The preparatory works on the construction site will be performed as a set of individual investments creating conditions for the construction of the new power plant. These investments lie mainly within the preparation and performance of the delimitation and control of the construction site, construction site equipment, material and power supply systems and furthermore in safeguarding the technological, personnel and transport services. The construction site will be equipped with required construction and assembly technology, it is assumed that a heavy ground mechanization and tower cranes will be utilized.

The actual construction of the new power plant will commence with a landscaping and excavation works related to the foundations. These works will be followed by founding the units, hence the reinforcement and concreting the foundation plate of the production unit (nuclear island). Analogical activities will be performed on the secondary part (turbine island) and other buildings. The extent and composition of the individual building structures will depend on the contractor of the construction. At the same time during the construction works, technological parts and components which cannot be installed additionally onto the complete construction (e.g. because of their dimensions), will be added and components in the construction will be embedded in concrete.

After the site preparation is complete, a gradual assembly of technology (of the operational complexes) will be followed by the assembly of an electric facility and control and management systems. The assembly works will be concluded by individual tests on the facilities and commissioning of the individual partial systems and verification of its readiness for putting the unit into operation. Other activities will be aimed at the verification of design functions while the non-nuclear and nuclear facilities are gradually put into operation on the respective power levels until its full design power.

After the construction is completed, the construction site equipment will be reclaimed.

The total estimated period for the construction is approx. 6 years (from the commencement of the construction until it is put into trial operation).

II.8.4.5.2. Works at Corridors of the Related Infrastructure Networks

These include the construction of lines for outward transmission of power, back-up own-power-consumption supply and pipelines for raw water supply and drainage of waste and rainfall water.

The construction of the electric grids will consist of concrete embedded foundations for individual pylons, pole constructions and stretching the wires. Alongside the whole line, space for mechanization (a temporary conveyor) will be safeguarded; after completing the works, landscaping will take place and the original use of the land will be re-established.

The pipeline routes of the water management connection will be carried out in a working lane of approx. 20 m width alongside the whole pipeline. Top soil and excavated soil will be deposited in this lane; an excavation for the pipeline will be in this lane as well as space for the pipeline assembly and for the mechanization operation. After the piping supports and filling in is performed, the ground will be shaped to its original level, top soil will be replaced on the agricultural land and the original purpose of the areas will be re-established.

The construction period in both cases will take not more than approx. 1 year.

II.8.4.6. Data on Operation Termination and Decommissioning

After the operation period terminates, the power plant will cease its activities and the facility will subsequently be decommissioned within the scope of the Atomic Act.

Pursuant to Act No 541/2004 Coll., the Atomic Act, as amended, the following is understood as:

Operation termination: A condition of a nuclear facility, when its use for the original purpose has ended and this process is irreversible.

Decommissioning: Activities following after the operation termination, designed to exempt the nuclear facility from the scope of the Atomic Act.

The operation termination precedes its decommissioning. The main activities at this stage involve mainly reactor shut-down and fuel removal to the storage pond in the power plant; storage of the spent nuclear fuel in the pond of the unit and its gradual discharge for further treatment (similar to the way as in the period of its previous routine operation); removal of the liquid from the non-operating systems; decontamination of the primary circuit for the purpose of reducing the dose rate; treatment of waste from the operation and its gradual discharge for its further treatment (in a similar way to the period of previous routine operation); monitoring and safeguarding activities; procurement of the basic facilities and materials for the purpose of the decommissioning activities and documentation preparation for proceedings aimed at permission of the decommissioning stage I. In the buildings, which are directly linked to the operation of the nuclear island, all the systems for the receipt, handling and storing the spent fuel (including all auxiliary purification systems) will remain in service, as well as the special ventilation systems including the ventilation stack, radiation control, waste water collection and purification systems, storage of liquid and solid radioactive waste, decontamination system and the physical protection system. It is necessary to note here that in accordance with the legislative regulations the operation termination is still considered a part of the operation.

The commencement of decommissioning is characteristic for a state when all the spent fuel is removed from the power plant I and also the removal of the operational RAW.

The legislative regulations reflect the worldwide approach to decommissioning when two kinds of decommissioning is considered:

- the immediate decommissioning, when the decommissioning activities are carried out simultaneously without time delay;
- the deferred decommissioning (decommissioning with reactor safe enclosure), where the selected technological units will be disassembled (e.g. the complex with reactors) later, after several decades.

The decommissioning concept will be addressed and particularized throughout the whole process of preparation, realization, putting into operation and of the new power plant's operation, thus in the documentation presented for the issuance of the relevant permissions pursuant to the Atomic Act.

The decommissioning of nuclear facilities is subject to a separate EIA process, which will be based on the updated Conceptual Decommissioning Plan, the latest before the operation termination, alternatively from the final plan of the decommissioning stage.

II.8.5. Data on Other Facilities and Preliminary Studies at the Site

This chapter describes specific data and requirements related to the other (existing or prepared) activities at the Jaslovské Bohunice site.

II.8.5.1. Overview of Other Facilities and Preliminary Studies at the Site

Premises of the companies JAVYS, SE and JESS are all located at the Jaslovské Bohunice site. They work as three individual entities with the five following nuclear facilities at different stages of their life cycle.

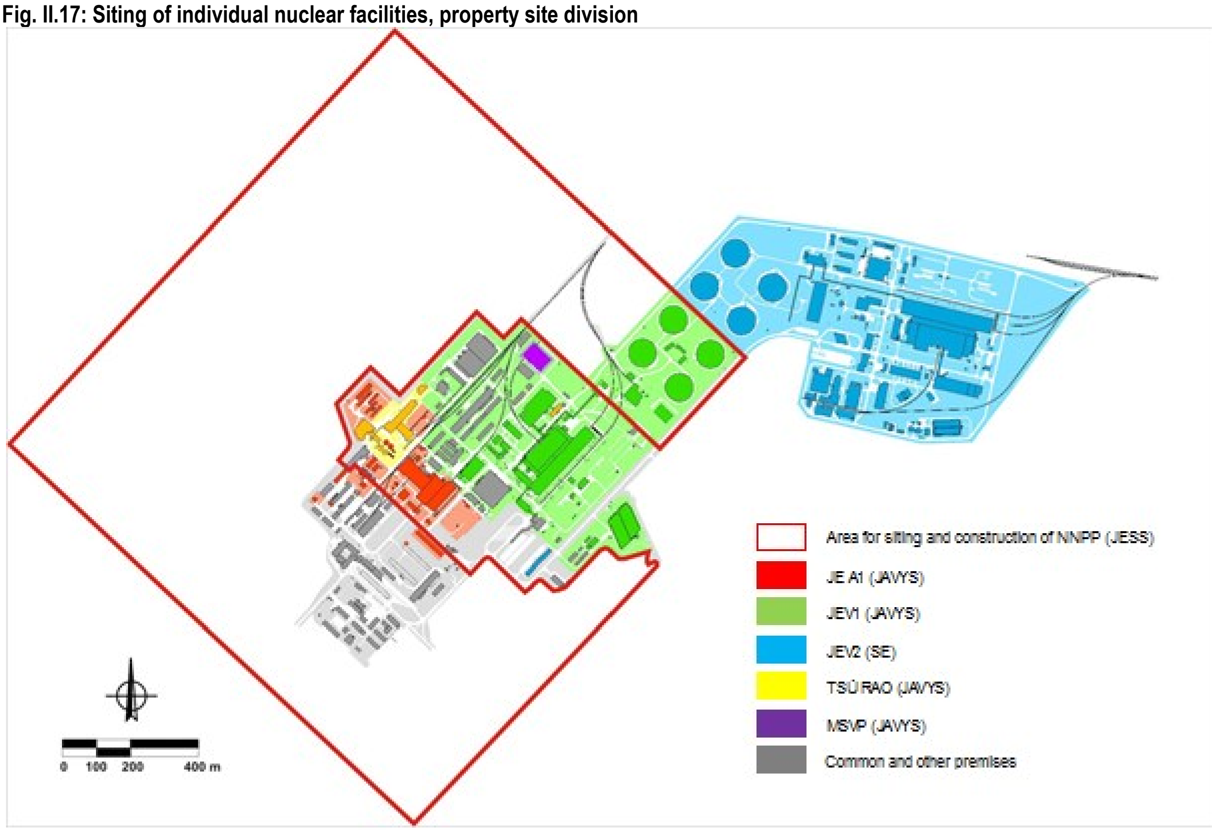
- NPP Bohunice 3,4 (the operator is SE),
- interim spent fuel storage facility (the operator is JAVYS),

- RAW processing and treatment technologies[9] (the operator is JAVYS),
- the NPP Bohunice A1 currently in decommissioning (the operator is JAVYS),
- the NPP Bohunice 1,2 currently in decommissioning (the operator is JAVYS).

There is no nuclear facility currently located in the individual complex of JESS (where the new NPP is planned).

The siting of the individual premises and facilities at the site is apparent from the following figure.

Fig. II.17: Siting of individual nuclear facilities, property site division



An integral RAW storage facility is considered to be built within the JAVYS premises (the completed EIA process is at the stage of project preparation).

The following proposed activities belong to the various project preparation stages: extended operational lifetime of the NPP Bohunice 3,4 (SE); change of liquid radioactive concentrates at the NPP Bohunice 3,4 (SE); decommissioning NPP Bohunice 1,2 – 2nd stage (JAVYS); construction of a new large-capacity fragmentation and decontamination facility NPP Bohunice 1,2 (JAVYS); increasing the capacity of the existing fragmentation and decontamination facilities (JAVYS) and the facility for re-melting the metal radioactive waste (JAVYS).

The concurrent impacts of these activities will be assessed when reviewing the impacts of the new nuclear power plant on the environment. The impacts of the operation of the power plants (the prepared new NPP, the NPP Bohunice 3,4 in service) are necessary to be considered as the most significant. The decommissioning activities within the nuclear power plants (A1, NPP Bohunice 1,2 and NPP Bohunice 3,4 after the operation is terminated) and other activities at the nuclear facilities sites are to be included as well. To give a complete picture, it is also necessary to mention activities outside the nuclear facilities site (e.g. the substations), which, however, have exclusively non-radiation character.

More detailed data on the above mentioned activities are stated in the following text.

[9] Including the performed adjustments and improvements of the technologies.

II.8.5.1.1. NPP Bohunice 3,4

The construction of the NPP Bohunice 3,4 with two WER 440 reactors of an improved V-213 type started in 1976. The third unit[10] was put into operation in 1984, the fourth unit a year later. The installed electric capacity of the power plant Bohunice 3,4 is currently (after the performed power upgrading) at 2x505 MW_e.

The reactor units of the NPP 3,4 represent, from the perspective of nuclear safety, an improved series of WER 440 units in comparison with the NPP Bohunice 1,2 units (see below).

The NPP Bohunice 3,4 is designed as a double unit. Both units have system for the localization of maximum design incidents installed, the reactors are located in hermetic boxes with a system of pressure suppression (bubbling tower). The WER 440 reactors have several inherent safety features and components, which are convenient for restoring the operation of the power plant in operational events. These components include the arrangement of the unit with six loops, which are separated by valves, which are located on each loop, and with two turbines reducing the severity of many transition states; utilization of horizontal steam generators enabling the transition of the core cooling to natural circulation in the primary circuit; large water inventory in the primary circuit and in steam generators mitigating the transient processes related to the imbalance between the heat generation and heat transfer and the provision of a sufficient time reserve for the NPP staff.

The NPP Bohunice 3,4 changed in 1987 to a combined power and heat generation thanks to the construction of a centralized heat supply system. The thermal feeder lines to Trnava, Jaslovské Bohunice and Malženice greenhouses compose a part of this system. 10 years later, the thermal feeder line to Leopoldov and Hlohovec was put into operation.

Emphasis has been placed on increasednuclear safety and operational reliability of the NPP Bohunice 3,4 from the start. Gradually, based on the increasing legislative requirements and operational reliability needs of the NPP Bohunice 3,4, a whole set of measures in line with the internationally accepted standards in the field of design, operation, maintenance, attention given to the facilities, process monitoring and regulatory supervision was performed. Extensive capital projects, carried out mainly in the last decade, were focused on further increase of nuclear safety (including the solution of severe accident issues), seismic resistance of the units and also on the increase of the unit capacity.

In 2010, a project of extending the design life of the NPP Bohunice 3,4 to 60 years has started. A decision to extend the operation is not yet made and therefore, for the purposes of the impact assessment of the new NPP on the environment (determining the period of concurrent impacts with the NPP Bohunice 3,4) it is conservatively assumed the concurrence with the operation of the NPP Bohunice 3,4 for a maximum period possible.

II.8.5.1.2. Interim Spent Fuel Storage Facility

The interim spent fuel storage facility represents a nuclear facility, which serves for a temporary (for decades) and safe storage of the spent nuclear fuel from the WER reactors. The spent nuclear fuel is stored in storage ponds in the environment of the demineralised water.

The interim spent fuel storage facility was put into operation in 1986and the active operation began in 1987. The spent fuel is transported to the interim spent fuel storage facility after approx. 4 to 7 years of cooling in the storage ponds of the main production unit of the nuclear power plants.

From 1997 to 1998, the interim spent fuel storage facility went through an extensive reconstruction with the aim to increase the storage capacity and for the purpose of seismic upgrading of the building. The total storage capacity of the interim spent fuel storage facility has almost tripled in comparison with the original capacity. The storage capacity makes for 14,112 spent fuel assemblies while it was originally 5,040. However, this storage capacity will not suffice for storing all the spent nuclear fuel from the NPP Bohunice 1,2 (currently in decommissioning), NPP Bohunice 3,4 and the Mochovce Nuclear Power Plant 3,4 (under construction). Therefore, preparatory works for building new capacities for the spent nuclear fuel storage are performed in the SR.

[10] The numbering of the units follows up on the previous two units of the NPP Bohunice 1,2.

II.8.5.1.3. RAW Processing and Treatment Technologies

The RAW Processing and Treatment Technologies serve for processing and treatment of low and medium level activity RAW from decommissioning of the A1 NPP (currently at the II decommissioning stage), NPP Bohunice 1,2 decommissioning (currently at the I stage of decommissioning) and RAW from the operation of nuclear facilities and from various areas of human activities, such as research, medicine, etc. (so-called institutional radioactive waste). They are technologically and spatially connected to the NPP A1 currently in decommissioning.

The RAW Processing and Treatment Technologies consist of:

- Two, almost identical, bituminous lines (BL) together with tanks and storage facilities.
- The Bohunice Treatment Centre, where are three basic RAW processing and treatment technologies: cementation facility, incineration plant and super compactor. The Bohunice Treatment Centre technologies aim to prepare RAW package, which currently represents the only form of storage in the National Radioactive Waste Repository: the approved RAW is cemented into cubic concrete containers reinforced by amorphous alloyed steel fibres with a 1.7 m edge and with an inner volume of 3.1 m^3. The containers are produced under the license of the French company, Sogefibre, in JAVYS.
- The metal RAW fragmentation and decontamination lines technologies and electric cable fragmentation technologies.
- The treatment of used-up air-conditioning filters.

Their components are also the relevant storage facilities or tanks. Over time, other premises of the NPP A1 will be added to the National Radioactive Waste Repository.

Over 2011-2013 the technologies of the Bohunice Treatment Centre have significantly improved due to : replacement of old technological components; capability to compact higher-activity RAW on a super compactor and an essential increase in efficiency and nuclear safety of the incineration plant as a result of the change of the heat medium and of the gaseous combustion products purification system..

II.8.5.1.4. The NPP A1 Currently in Decommissioning

The NPP A1 with a heterogeneous reactor, with the KS-150 label was designed for a power capacity of 143 MW. The fuel used was natural metallic uranium, heavy water was the moderator and carbon dioxide was the coolant. The NPP A1 was synchronised with the electric distribution grid in December 1972. After an incident in February 1977, it was decided not to renew the operation in NPP A1and activities targeted at putting the NPP A1 out of operation commenced. All the spent nuclear fuel, generated throughout the operation of NPP A1, was transferred to the Russian Federation based on a contract (the transfer was completed in 1999).

Currently, the NPP A1 in at the second decommissioning stage, it is assumed that the decommissioning activities will continue until 2033.

II.8.5.1.5. The NPP Bohunice 1,2 Currently in Decommissioning

The NPP Bohunice 1,2 is equipped with two WER 440 reactors of an older V-230 type. The first unit was put into operation in 1978, the second unit two years later.

Similarly to the case of NPP Bohunice 3,4, the NPP Bohunice 1,2 went through a numerous projects with the aim to increase safety and reliability of the operation; however, it was decided to close both NPP Bohunice 1,2 units because of the necessity to meet the conditions of the European Union Accession Treaty. The first unit terminated its operation at the end of 2006, the second one in 2008.

Currently, the NPP Bohunice 1,2 is at the decommissioning stage and at the same time, preparation of documentation necessary for permitting the second decommissioning stage is ongoing. Pursuant to the design schedule, the decommissioning works will last until 2025.

II.8.5.2. Considered Operation and Decommissioning Time of Other Nuclear Facilities at the Site

In order to specify the life cycle of the concurrent impact of the new NPP and the other facilities, an overview of the construction, operation and decommissioning of the individual nuclear facilities at the site is elaborated. This overview is based on the latest documents of JESS, SE and JAVYS and at the same time, it considers the document: Strategy for the Final Phase in the Peaceful Use of Nuclear Energy in the Slovak Republic. Based on these documents, the following existing and prepared nuclear facilities are included in the overview:

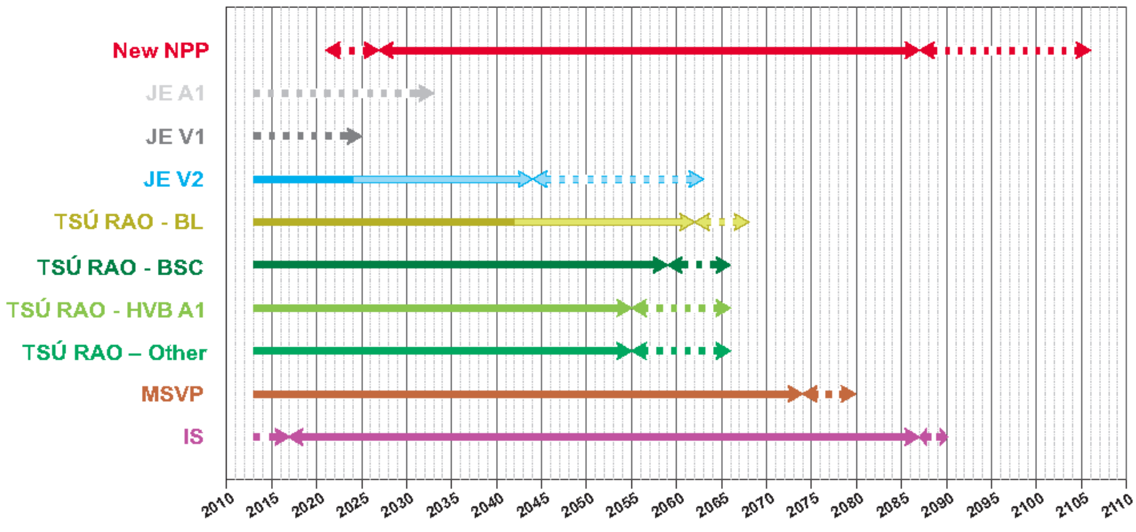
- new NPP (JESS)
- NPP A1 (JAVYS),
- NPP Bohunice 1,2 (JAVYS),
- NPP Bohunice 3,4 (SE),
- radioactive waste processing and treatment technologies (JAVYS),
- Interim Spent Fuel Storage Facility (JAVYS),
- RAW Processing and Treatment Technologies (JAVYS).

The preparatory stage (the Feasibility Study) involves the dry interim spent nuclear fuel storage facility (JAVYS). It has not been decided about the location of this nuclear facility yet, hence it is not included in the overview. It shows, that it will be necessary to put it into service around 2020.

The operation period of the NPP Bohunice 3,4 is considered in alternatives with regard to the open question upon its operational life. These alternatives also have an impact on the operation and decommissioning deadlines of other power plants at the site (radioactive waste processing and treatment technologies).

A graphic illustration of the course of concurrent impacts of the individual nuclear facilities at the Jaslovské Bohunice site is pictured in the following figure, beginning in 2013.

Fig. II.18: Course of concurrent impacts of the individual nuclear facilities at the Jaslovské Bohunice site



Note: Full line = the estimated operation time, dashed line = estimated time for construction/decommissioning.

It is apparent that the new NPP will have an a concurrent impact together with the NPP Bohunice 3,4 in the course of 0 to approx. 20 years (conservative estimation). The concurrent operation of both nuclear power plants (new NPP and NPP Bohunice 3,4) is to be considered the most significant concurrent impact, which will be considered in the Environmental Impact Assessment Report while the environmental impact assessment (EIA) is performed in a maximum possible extent (hence taking the higher of the values – 20 years – into account).

Furthermore, the impact of the new NPP operation will interfere with various life cycle stages (construction, operation, decommissioning) of other nuclear facilities at the site.

This concurrent impact will be less significant (with regard to the multiple-order lower levels of radioactive discharges of these facilities in comparison with the operation of the nuclear power plant), however, it will be also considered in the Environmental Impact Assessment Report.

II.9. Justification of the Need for the Proposed Activity

9. Justification of the need for the proposed activity at the respective site (its advantages and disadvantages).

II.9.1. General Data

It is stated in the European Commission document *Energy 2020*, determining the strategy for competitive, sustainable and secure energy that *"the affluence and prosperity of society, industry and economy depends on a safe, secure, sustainable and affordable energy".* The need for the proposed activity is, in this context, based on the need of safeguarding energy security of the Slovak Republic, especially in its very important area – electricity generation.

The electric power represents in its nature a decentralized source of energy. It is pure at the final consumption point (its use does not generate any harmful pollutants) and it is used universally (it is transformable into other forms of energy). The functions of all economy sectors and life condition of the citizens depend on the accessibility of electric power. The public interest in a reliable electricity supply is hence generally recognized; any potential deficiencies or failures in the electricity supply would touch the whole society. Electricity, however is not the primary source of energy. It has to be generated and transported to the final consumption point. The proposed activity hence represents an electricity generator, which:

- respects the relevant commitments of the Slovak Republic,
- respects all the energetic needs of the Slovak Republic given by the relevant state concepts,
- respects and uses the accessible infrastructure of the Jaslovské Bohunice site effectively,
- respects the anticipated consumption and electricity generation development in the Slovak Republic.

A more detailed information is given in the following sub-chapters.

II.9.2. Justification of the Need in Relation to the International Commitments of the Slovak Republic

From the perspective of the European Union energy policy, the aim of which is to decrease greenhouse emissions by 2050 by 80 to 95% in comparison with 1990, it is expected that electricity will play a central role in a low-carbon economy. According to the analyses of the European Commission stated in the document *Roadmap for moving to a competitive low carbon economy in 2050* (2011), electricity should contribute to a total elimination of CO_2 emissions and it could prospectively partially substitute fossil fuels in transport and heating/cooling. Pursuant to another document compiled by the European Commission *Energy Roadmap 2050* (2011), the nuclear energy will have to represent a significant benefit in the process of energy transformation in those member states, where it exists. From the view of its efficiency, the least costly scenarios involve ones with the highest portion of the nuclear energy.

Because of the European Union's plans to pass through to a competitive low carbon economy by 2050, it will be necessary to safeguard almost a complete elimination of emissions in the energy industry. The most appropriate for low carbon electricity generation are generally considered the renewable sources of energy, which may be, despite an increase in their use, considered in the Slovak conditions only as additional sources. An exception are the hydroelectric power plants, which may not represent an alternative for the traditional technologies of electricity generation because of their operational and also because of their costs characteristics.

Whereas the European Union is yet not able to guarantee energy security of its member states, as apparent from the gas crisis in 2009, it leaves it upon the states themselves to determine their energy policy and mainly the energetic mix for safeguarding its own energy needs. Therefore the Slovak Republic does not have any obstacles in nuclear energy utilization as the driving mechanism of its low carbon growth.

From a total of 74% of low carbon electricity generated in 2012, 54% came from the nuclear power plants in Slovakia.

Hence, if Slovakia aims to achieve a low-carbon economy, as defined in the above stated roadmap, it does not have any other alternative than to utilize nuclear energy, in the maximum possible extent appropriate for covering the consumption in the basic zone and for stabilizing the power grid of the Slovak Republic. In this sense the nuclear energy is similar to the renewable sources of energy, a non-carbon source of electricity but with its own characteristics.

II.9.3. Justification of the Need in Relation to the Energy Policy of the Slovak Republic

The proposed new NPP at the Jaslovské Bohunice site is in line with the key strategic documents of the Slovak Republic in the energy sector. It may be referred to as a project, which will significantly contribute to the progress of the Slovak energy sector towards the target to achieve energy security and competitive, low carbon and sustainable development. The need is mainly given by:

- necessity of substituting the capacities of the power plants in Slovakia, which are currently ending their lifetime, by a more modern sources;
- anticipated increase in power consumption (despite the economic measures);
- need of stable low carbon sources in the production mix;
- anticipated slump in fossil fuel power plants utilization as a result of their environmental unfriendliness and of the decreasing domestic coal reserves;
- unrealistic nature of safeguarding a sufficient and reliable power supply from the renewable sources and
- need to increase the energy security of the Slovak Republic.

The proposed activity fully respects the direction of the energy policy of the Slovak Republic as stated in the following strategic documents:

Building of a new nuclear power plant is one of the strategic priorities for the security of electricity supply in the years 2013 to 2030 as defined in the *Energy Security Strategy of the SR* as of 2008. Its construction is, within the Energy Security Strategy, also included in the recommended programme of the construction of sources by 2030, whereas it is expected to be put into operation in 2024 to 2025. The Energy Security Strategy further states that the nuclear power plants will continue to create the basis of the energetic mix of the SR as a significant element in safeguarding electricity supply security and permanently sustainable development. The electricity generation from nuclear power sources is considered an efficient and economically convenient way of safeguarding sufficient amount of electricity; and apart from high safety of fuel supply, stability of electricity production prices and low impacts on health and the environment, they also have a positive impact on the stability of the power grid.

Dated 17 December 2008, *the Government of the SR adopted a Decree No. 948/2008*, by means of which it expressly confirmed the correctness of the decision on the planned construction of the new nuclear power plant at the Jaslovské Bohunice site based on comparative analyses of costs for the construction and operation of the alternative sources for electricity generation and after considering all relevant legal, technical and regulatory factors. The intention to support the construction of a new NPP at the Jaslovské Bohunice site is also stated in the *Manifesto of the Slovak Government* for the years 2012 - 2016.

The draft *Energy Policy of the SR (September 2013)* should become, after its adoption, a strategic document, which will set the basic targets and frameworks of the energy sector development of the Slovak Republic by 2035. The utilization of the nuclear energy as a non-carbon source of electricity is set among the main priorities of the energy policy of the SR, whereas it contributes to the permanently sustainable development and decreases the dependence on fossil fuel imports. The construction of the new NPP belongs, pursuant to this draft, among the measures aimed at increasing energy security. Through its performance, it could also be contributed to achieving the targets of electric power industry, such as self-sufficiency and appropriate export-oriented ability in electricity generation; a flexible, low carbon and sustainable structure of the source basis and also appropriate, accessible and competitive end electricity prices.

II.9.4. Justification of Siting at the Jaslovské Bohunice Site

The Jaslovské Bohunice site satisfies the legislative requirements for the location of a nuclear facility.;

It has been used for the electricity generation in nuclear power plants and for the construction and operation of other nuclear facilities in the long term and all the necessary areas and infrastructure are accessible within it, including the source of raw water, electric power grid of the Slovak Republic and radioactive waste treatment systems. The choice of this site thus represents an effective use of the accessible resources from the environmental point of view.

It is necessary to emphasize the existence of over 55 years of actual experience of the population with the construction and operation of the nuclear power plants and that the local citizens support the use of the nuclear energy. From the technical perspective, the region disposes of a sufficiently developed infrastructure, both transport and technical, and a qualified labour force. In comparison with any other potential locations in another region, the Jaslovské Bohunice site has an advantage in the form of lower occupation of land, whereas the site of the NPP A1 and NPP Bohunice 1,2, currently in decommissioning, can be partially utilized and the part of building complexes and engineering networks located at this site can be utilized for the construction site equipment.

For these reasons, the construction of the new NPP will bring various advantages, which will hence contribute to the acceleration of as well as decrease in costs for the construction and this should be finally reflected in the lower electricity generation prices.

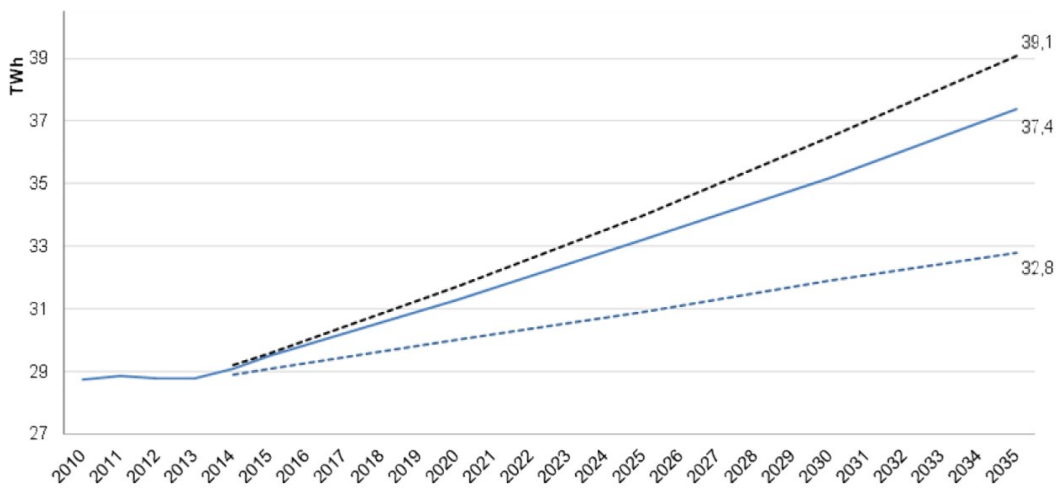
The location of the new nuclear power plant at the Jaslovské Bohunice site is explicitly anticipated by the above mentioned *Government Decree No. 948/2008* and also the draft *Energy Policy of the SR*.

Within the draft *Land Use Plan of the Trnava Self-Governing Region (2012)*, the proposed activity is located at the Jaslovské Bohunice Nuclear Power Plant site and in its nearby surroundings, whereas the siting and construction of the Newbuild NPP also uses the accessible premises of the existing Jaslovské Bohunice Nuclear Power Plant site.

II.9.5. Justification of the Need in Relation to the Electricity Generation and Consumption

Based on a professional estimation of the year-to-year increase of consumption, considering the European market in the draft of *Energy policy of the SR* (September 2013), there are presented three scenarios of the power consumption development by 2035, which differ mainly in the prerequisites in the economic growth: All scenarios count with a decreasing energy intensity and with natural power savings, resulting from the competitive market environment. no extraordinary situations are expected, which would significantly decrease the consumption, such as termination of the operation by one of the significant consumers. Because the industry is the largest electricity consumer, its structure will significantly influence the power consumption trend in Slovakia, whereas no significant deviation from the energy intense sectors can be actually presumed for the future. The low scenario presumed an average year-to-year growth rate of power consumption at +0.6 %, the referential scenario +1.2 % and the high scenario +1.4 %. The course of the consumption scenarios are presented in the following chart.

Fig. II.19: Forecast of the total electricity consumption development in the SR pursuant to individual scenarios



Whereas all scenarios currently (2013) expect a consumption growth by 2035 (ranging from 14% in the low to 36% in the high scenario), it will be necessary to safeguard sufficient power sources not only in order to cover this growth, but also as a substitution for the decommissioned power stations. The majority of the coal power plants and a noticeable amount of natural gas capacities in the Slovak Republic are approaching the end of their life. It is expected that by 202 44 % of the power generation capacity on the territory of the SR (as compared to 2010), will be decommissioned because their life will reach an end[11]. When substituting the energy sources, however, a factor of installed capacity utilization has to be taken into account, which determines the instantaneous availability of the source, hence the percentage off the maximum production capacity that is actually utilized. The installed capacity is the highest in nuclear power plants (90% in Slovakia), whereas other sources only attain 30 to 65%, which means in practice that 1 MW of the nuclear power plant's installed capacity can generate almost twice to three times more electricity than 1 MW of the other source's capacities.

The following overview offers the potential referential alternatives and reasons why these alternatives are not realistic.

Without the new NPP: Should the new NPP not be built, the Slovak energy sector could have a limited ability to meet the targets of the *Energy Policy of the SR* (draft as of September 2013) and *the Energetic Security Strategy* (2008), such as self-sufficiency, low carbon economy or the export-oriented balance in electricity generation and consumption. Not extending the life of the NPP Bohunice 3.4 would incur a severe situation.

Coal power plants: The domestic brown coal reserves are markedly limited and its mining is uneconomical, therefore it would need state support. The draft *Energy Policy of the SR* dated as of September 2013, not only does not count with the construction of new coal sources of electric power, but the facilities in this category will also be substituted by other low carbon sources.

Natural gas power plants: Because of the high natural gas prices and low electricity prices, the gas power plants became uneconomical. Some facilities in the SR were actually forced to interrupt their operation and for the future, the draft *Energy Policy of the SR* (September 2013) counts only with the construction of smaller sources based on a combined heat and power production because of the protection of the environment and because low carbon production is preferred. These facilities should be mainly important for the provision of support services.

Hydroelectric power plants: It is impossible to build hydroelectric power plants in such an extent in the Slovak conditions, which would provide for an amount of generated power comparable to the planned new NPP, because the total exploitable hydro-energetic potential of the Slovak water courses lies only at around 6,700 GWh a year, whereas already more than 70 % of it is already utilized nowadays. The hydroelectric power plants of larger installed capacities furthermore lead to significant negative impacts on the environment.

Solar power plants: Because the photovoltaic power plants belong to the unpredictable sources of electricity and because they severely endanger the safety of the transmission grid, their construction in Slovakia was limited by the legislation to small, decentralized sources and the draft *Energy Policy of the SR* (September 2013) does not count with a more significant increase in their production.

Wind power plants: The wind power plants are also an unpredictable source of electricity and its utilization is therefore limited by the possibilities of the transmission grid. Moreover, the exploitable potential of the wind power in Slovakia was estimated to amount to 600 GWh annually only (or 1,135 GWh in a more optimistic estimation) and this predetermines the wind power plants in the Slovak energy sector only to the role of an additional source.

[11] Ageing of the electricity generation basis is not only a problem in the Slovak Republic, but in the European Union as such. It is presumed that by 2025, the EU will necessarily have to substitute up to 267 GW of capacity, whereas the required investment in the power generation basis should reach up to EUR 750 billion by 2020. As a result of the ongoing financial and economic crisis in Europe, such investments are currently not made (with the exception of granted facilities such as the renewable sources of energy) and the risk of problems with safeguarding the electricity supply is increasing for the future. It is expected that by 2023, the EU will have almost one third of the current installed capacity of fossil fuel power plants, what could mean considerable problems for the EU power grid, both from the electricity generation perspective and from the perspective of providing back-up capacity for balancing the deviations in the production of unstable sources of electricity, such as the renewable sources of energy.

Geothermal power plants: Despite the fact that the electricity generation from the geothermal energy is more reliable and stable than the solar or wind power plants, its exploitable potential (6,300 GWh) is suitable in the conditions of the SR for heating purposes only. The chemical composition of the geothermal water also represents technical problems. That is why it is not anticipated that this form of energy would play a more significant role in the electric power industry.

Biomass power plants: Using biomass has from among the renewable sources of energy the greatest potential in the Slovak energy sector. However, if electricity generation was considered on such level as offered by the new NPP, there would be several essential disadvantages to resolve. These include mainly the increase in local air pollution, waste production in form of ash and the need to transport large volumes of fuel into the place of its combustion, which would markedly burden the transport routes and at the same time, greenhouse emissions would be produced. Last but not least, the increase in soil utilization for growing energy crops instead of producing foodstuffs could have an impact on the food security of the state. Electricity generation from biomass in an extent similar to the one of the new NPP is therefore in the conditions of the SR unrealistic.

From the above text it is concluded that building a new NPP at the Jaslovské Bohunice site is the most realistic and most suitable alternative for Slovakia while safeguarding energy security, appropriate export-oriented balance (which is necessary from the perspective of stability of the electric grid), low carbon mix in electricity generation and permanently sustainable development of the energy sector in Slovakia without knowing the exact date for the NPP Bohunice 3,4 decommissioning.

II.10. Total Costs

10. Total costs (rough).

approx. EUR 4 to 6 bn per 1 unit.

II.11. Community Concerned

11. Community concerned.

The communities concerned are those communities, where the proposed activity should be performed, i.e. on the territory of which all the components of the proposed activity are physically located, it is hence the area for siting and construction of the new NPP and the corridors of the related infrastructure including their immediate surroundings.

The communities concerned further refer to municipalities, which could be concerned by the proclaimed emergency planning zone. Even though this zone has not been determined yet (it will be, within the follow-up proceedings, outside the EIA process) but pursuant to the IAEA safety guides,[12] the recommended radius of the inner emergency planning zone for reactors with a power output of >1000 MW represents 3 to 5 kilometres. The communities concerned are hence conservatively considered those ones, which lie within a 5 km distance from the area of new NPP siting.

Finally, the communities concerned refer to municipalities, which could be concerned by significant impacts of the proposed activity. As the analyses of the potential impacts on individual components of the environment, which were carried out within the relevant chapters of this Preliminary Study, show, the extent of the significant impacts will not exceed the above stated extent of the proposed activity location and of the conservatively considered emergency planning zone.

With reference to the above, the following list of communities concerned has been determined:

[12] IAEA Safety Guide No. GS-G-2.1 Arrangements for Preparedness for a Nuclear or Radiological Emergency

Tab. II.1: List of the communities concerned

Region	District	Municipality	Area for siting and construction of Newbuild NPP	Corridor – raw water	Corridor – waste and rainfall water	Corridor – electro	5 km long zone from the new NPP area
Trnavský	Trnava	Jaslovské Bohunice	●			●	●
		Malženice					●
		Radošovce	●				●
		Dolné Dubové					●
		Kátlovce					●
		Špačince					●
	Hlohovec	Ratkovce	●		●		●
		Žlkovce					●
		Červeník			●		
		Trakovice					●
		Madunice		●	●		
	Piešťany	Nižná					●
		Pečeňady	●	●	●		●
		Veľké Kostoľany	●	●			●
		Dubovany		●			●
		Drahovce		●			
		Dolný Lopašov					●
		Chtelnica					●
		Piešťany		●			

The location of the communities concerned and their spatial relation to the proposed activity is apparent from the map in the Annex No. 1 of this Preliminary Study.

Address list of the communities concerned:

Jaslovské Bohunice	Obec (Municipality) Jaslovské Bohunice Námestie sv. Michala 36/10A 919 30 Jaslovské Bohunice +421 33 557 10 20, +421 917 814 918 www.jaslovskebohunice.sk
Malženice	Obec (Municipality) Malženice Malženice 294 919 29 Malženice +421 33 743 41 13, +421 905 898 197 obec@malzenice.sk www.malzenice.sk
Radošovce	Obec (Municipality) Radošovce Radošovce 70 919 30 Jaslovské Bohunice +421 33 559 23 03 www.obecradosovce.sk
Dolné Dubové	Obec (Municipality) Dolné Dubové 919 52 Dolné Dubové +421 33 559 21 16, +421 33 559 26 33 www.dolnedubove.sk

Kátlovce	Obec (Municipality) Kátlovce 919 55 Kátlovce +421 33 557 61 33 obeckatlovce@stonline.sk www.katlovce.sk
Špačince	Obec (Municipality) Špačince Hlavná 183/16 919 51 Špačince +421 33 557 31 23, +421 33 557 31 09 info@spacince.sk www.spacince.sk
Ratkovce	Obec (Municipality) Ratkovce Ratkovce 97 920 42 Červeník +421 33 743 41 76 ouratkovce@ratkovce.sk www.ratkovce.sk
Žlkovce	Obec Žlkovce No. 158 (community centre building) 920 42 Červeník +421 33 743 41 53 www.zlkovce.sk
Červeník	Obec (Municipality) Červeník Kalinčiakova 26 920 42 Červeník +421 33 734 11 27 cervenik@cervenik.sk www.cervenik.sk
Trakovice	Obec (Municipality) Trakovice Trakovice No. 38 919 33 Trakovice obec@trakovice.sk www.trakovice.sk
Madunice	Obec (Municipality) Madunice P.O. Hviezdoslava 8/368 922 42 Madunice +421 33 743 11 23 madunice@madunice.sk www.madunice.sk

Veľké Kostoľany	Obec (Municipality) Veľké Kostoľany M. R. Štefánika 800/1 922 07 Veľké Kostoľany +421 33 778 11 02, +421 915 107 289 velkekostolany@velkekostolany.sk www.velkekostolany.sk
Nižná	Obec (Municipality) Nižná Nižná No. 80 922 06 Nižná +421 33 778 82 27 ocunizna@gmail.com www.obecnizna.sk
Pečeňady	Obec (Municipality) Pečeňady Pečeňady No. 93 922 07 Pečeňady +421 33 778 11 15, +421 33 771 90 05 info@pecenady.sk www.pecenady.sk
Dubovany	Obec (Municipality) Dubovany Dubovany No. 200 922 08 Dubovany +421 33 77 961 01 dubovany@dubovany.sk www.dubovany.sk
Drahovce	Obec (Municipality) Drahovce Hlavná 429/127 922 41 Drahovce +421 33 778 35 21 oudrahovce@oudrahovce.sk www.drahovce.com
Dolný Lopašov	Obec (Municipality) Dolný Lopašov Dolný Lopašov 79 922 04 Dolný Lopašov +421 33 779 41 02 www.obecdlopasov.sk
Chtelnica	Obec (Municipality) Chtelnica Námestie 1. Mája 495/52 922 05 Chtelnica +421 33 779 41 25, +421 33 779 42 05 chtelnica@chtelnica.sk www.chtelnica.sk

Piešťany

Mesto (Town) Piešťany
Námestie SNP 3
921 01 Piešťany
+421 33 776 53 11, +421 33 776 53 01,02
msu@piestany.sk, sekretariat@piestany.sk
www.piestany.sk

II.12. Self-Governing Region Concerned

12. Self-governing region concerned.

Trnava Self-Governing Region

Trnavský samosprávny kraj
P.O. Box 128, Starohájska 10
917 01 Trnava
+421(0) 33 555 91 11
urad.vuc@trnava-vuc.sk
www.trnava-vuc.sk

II.13. Authorities Concerned

13. Authorities concerned.

The basic overview of the authorities concerned is stated in the following list:

- Nuclear Regulatory Authority of the Slovak Republic
- Public Health Authority of the Slovak Republic
- Public Health Regional Authority, Trnava
- Ministry of Health of the Slovak Republic
- Ministry of Environment of the Slovak Republic
- Ministry of Interior of the Slovak Republic
- National Labour Inspectorate of the Slovak Republic
- Labour Inspectorate, Trnava
- Technická inšpekcia, a.s., Nitra
- Presidium of the Fire and Rescue Corps of the Ministry of Interior of the Slovak Republic
- Regional Directorate of the Fire and Rescue Service, Trnava
- District Fire and Rescue Brigade Headquarters, Piešťany
- District Fire and Rescue Brigade Headquarters, Trnava
- District Office Trnava, relevant departments
- District Office Piešťany, relevant departments
- District Office Hlohovec, relevant departments

II.14. Approving Authority

14. Approving authority.

District Office Trnava

District Office Trnava
Department of Construction and Housing Policy
Kollárova 8
917 02 Trnava
+421(0) 33 556 43 29

Nuclear Regulatory Authority of the Slovak Republic	Nuclear Regulatory Authority of the Slovak Republic Bajkalská 27 P.O. Box 24 820 07 Bratislava +421(2) 5822 1111
Public Health Authority of the Slovak Republic	Public Health Authority of the Slovak Republic Trnavská cesta 52 826 45 Bratislava +421(2) 4437 2641

II.15. Departmental Body

15. Departmental body.

Ministry of Economy of the Slovak Republic	Ministry of Economy of the Slovak Republic Mierová 19 827 15 Bratislava 212 +421(2) 4854 1111

II.16. Requested Permit Type Pursuant to Special Regulations

16. Requested permit type of the proposed activity pursuant to special regulations.

The basic overview of the required permits pursuant to special regulations is stated in the following list:

- Permit for locating the construction of the nuclear facility (Nuclear Regulatory Authority of the Slovak Republic)
- Zoning Decision (District Office Trnava)
- Building permit, operation permit for the nuclear facility, RAW treatment permit, permit for the construction utilization (Nuclear Regulatory Authority of the Slovak Republic)
- Permit for activities leading to exposure (Public Health Authority of the Slovak Republic)

II.17. Statement on the Expected Cross-border Impacts

17. Statement on the expected cross-border impacts of the proposed activity.

The proposed activity is stated in the list of activities, which are subject to the compulsory international review from the perspective of their cross-border impacts on the environment (Annex No. 13 to Act No. 24/2006 Coll. on the Environmental Impact Assessment as amended) in the following manner:

Item 2. Thermal power plants and other combustion plants with a thermal output of 300 MW and more; furthermore nuclear power plants and other nuclear reactors (except for the research facilities for the production and conversion of fission and enriched materials, the maximum thermal output of which does not exceed 1 kW of permanent heat load).

Pursuant to Section 40 of the stated Act, it is hence subject to the cross-border impact assessment. The process of the cross-border review will be also in line with bilateral agreements entered into by the neighbouring states. The authority relevant for the review of the cross-border impacts is Ministry of Environment of the Slovak Republic.

The chapter IV.7 offers a closer note on the potential cross-border impacts. The Expected Cross-Border Impacts (page 140 of this Preliminary Study).

III. BASIC INFORMATION ABOUT THE CURRENT STATE OF THE ENVIRONMENT

III. Basic information about the current state of the environment in the area concerned

III.1. Natural Environment

1. The characteristics of the natural environment including the protected areas [e.g. the proposed protected bird areas, Special Areas of Conservation, coherent European network of protected areas (Natura 2000), national parks, protected landscapes, protected water management areas].

The proposed activity is located in a space connected to the existing Jaslovské Bohunice nuclear facilities site. The area concerned from the perspective of natural sciences is characterized mainly through its species-poor farmlands, hence the areas with intense agricultural activities, between which there are small islands of bushes and trees, primarily composed of linear features following water courses and roads.

The area for siting the proposed activity partially consists of the aforementioned species-poor agro-ecosystem and partially of industrial areas in connection with the existing Jaslovské Bohunice nuclear power plant site. The same applies to the components of activities (the related water management and energy corridors). The site does not directly interfere with any of the protected areas either on the national or on the European level (protected landscape area, national park, protected site, nature reserve, national heritage monument, protected landscape element, special area of conservation, protected bird area); neither does it interfere with any other elements of nature protection (protected trees, protected landscape elements, wetlands, biosphere reserves and sites of UNESCO world cultural and natural heritage).

A more detailed data on the natural characteristics of the area concerned are stated below in the chapter III.4.9. Fauna, flora and ecosystems (page 104 of this Preliminary Study).

III.2. Landscape

2. Landscape, landscape character, stability, protection, scenery.

The proposed activity is located in a space connected to the existing Jaslovské Bohunice nuclear facilities site. It is located in the landscape area of Trnavská pahorkatina (Trnava Downs), delimited from the west by Malé Karpaty (the Small Carpathians), by Podunajská rovina (Danubian Flat) from the south, by Dolnovážska niva (Lower Váh River Plain) from the east and by Považské podolie (Váh Valley Land) from the north. It is an agricultural-residential land, where the developed area regularly alternates with the vast agricultural lands. A dominant element of the current landscape structure is the large arable land; elements of technical infrastructure are represented quite significantly as well. The most distinct anthropogenic elements of the landscape structure of the area concerned are the Jaslovské Bohunice Nuclear Power Plant site and a great number of ground electric transmission system components.

Forest vegetation is completely absent and the non-forest woody plants are markedly missing as well. The most distinct elements of the greenery consist of linear bands of vegetation near the water courses and tree-lined avenues near the roads. The hydric natural elements in the broader area of interest consist of the water courses Váh (with its lateral Drahovský channel), where the Sĺňava water work is located; then the Dudváh, Blava, Dubovský potok, and Manivier Channel. A low degree of ecological stability is closely linked to the low, almost deficit, representation of positive landscape elements (areas and lines of greenery, protected areas, elements of the territorial system of ecological stability). The low diversity of landscape elements also contributes to the low diversity of landscape character, which is, with regard to the small vertical segmentation of the relief, very easily observed. Mainly the Jaslovské Bohunice Nuclear Power Plant premises are quite well visible under good weather conditions, mainly the cooling towers with their typical steam clouds.

A more detailed data on the landscape characteristics of the area concerned are stated below in the chapter III.4.10. Landscape (page 109 of this Preliminary Study).

III.3. Population

3. Population, its activities, cultural-historical values of the area.

The proposed activity is located in a space connected to the existing Jaslovské Bohunice nuclear facilities site.

The area concerned is not densely populated. The relation of the urban area (cities and municipalities) has been concentrated over an extended period. The distance of the urban area from the nuclear facilities site or from the area for siting and construction of the new nuclear power plant, is sufficient.

The age structure and health status of population in the area concerned is not significantly different from the values in other parts of Slovakia.

The area concerned is located in the productive agricultural region of the Slovak Republic, which is also marked by a vast industrial structure (automotive, electrical and energy industry). The result of the above is quite a positive unemployment rate, which is markedly lower as compared to the rest of the Trnava Self-Governing Region as well as to the rates around Slovakia.

No special cultural-historical monuments are located in the area concerned, which could be concerned by the proposed activity.

A more detailed data are stated in the following chapters below: III.4.1. Population and Public Health (page 70 of this Preliminary Study), III.4.12. Transport and Other Infrastructure (page 111 of this Preliminary Study) and III.4.11. Tangible Property and Cultural Monuments (page 111 of this Preliminary Study).

III.4. Current Status of the Quality of the Environment including Health

4. S Current Status of the Quality of the Environment including Health

III.4.1. Population and Public Health

III.4.1.1. Demographic Characteristics

III.4.1.1.1. Methodical Input Data

The demographic data are shown for three areas:

Area concerned: The cadastral area of municipalities within 5 km from the NNPP site and municipalities, through whose cadastral areas the routes of corridors of NNPP's technical infrastructure are considered. Therefore, it means communities concerned as defined in Chapter II.11. Community Concerned (page 63 of this Preliminary Study).

Remote area: Zone of the cadastral area of municipalities following the area concerned and reaching up to 30 km from the NNPP site.

Total area: The total area includes the cadastral areas of municipalities in the distance of 0 to 30 km from the NNPP site, i.e. joint areas of the area concerned and remote area.

A circle with 5 km or 30 km radius is located in the centre of assumed area for the NNPP's main reactor building and individual areas include municipalities whose cadastral area is at least partially touched by the respective circle[13].

[13] Apart from municipalities with the cadastral area within 5 km, the "area concerned" section includes in addition also municipalities, through whose

The data from the Statistical Office of the Slovak Republic are used for assessment of demographic, health, social and economical status of the population.

Area Concerned

19 municipalities belonging to 3 districts (Hlohovec, Piešťany, Trnava) of the Trnava Self-Governing Region fall within the area concerned. They are these municipalities (the approximate direct distance of the developed area of the settlement from the NNPP is shown in brackets):

Trnava Self-Governing Region, Trnava district: Jaslovské Bohunice (2.3 km), Malženice (4.7 km), Radošovce (2.0 km), Dolné Dubové (4.0 km), Kátlovce (4.7 km), Špačince (6.6 km).

Trnava Self-Governing Region, Hlohovec district: Ratkovce (4.6 km), Žlkovce (4.6 km), Červeník (7.1 km), Trakovice (6.7 km), Madunice (8.0 km).

Trnava Self-Governing Region, Piešťany district: Nižná (3.8 km), Pečeňady (3.7 km), Veľké Kostoľany (3.9 km), Dubovany (5.4 km), Drahovce (9.6 km), Dolný Lopašov (8.4 km), Chtelnica (8.0 km), Piešťany (13.7 km).

Remote Area

The remote area includes 212 municipalities belonging to 13 districts and 4 self-governing regions - the Bratislava Self-Governing Region (BASGR), the Trnava Self-Governing Region (TTSGR), the Trenčín Self-Governing Region (TNSGR) and the Nitra Self-Governing Region (NRSGR). The Záhorie military zone, reaching the remote area with its north-eastern corner, is excluded from the list of municipalities (the reason for exclusion is absence of permanently inhabited residential structures in its area). The districts of the remote area of the NNPP are the following (the brackets contain the number of municipalities in the district falling under the remote area):

BASGR: Malacky district (3 municipalities), Pezinok district (11 municipalities), Senec district (4 municipalities),

TTSGR: Galanta district (18 municipalities), Hlohovec district (19 municipalities), Piešťany district (19 municipalities), Senica district (11 municipalities), Trnava district (39 municipalities),

TNSGR: Myjava district (13 municipalities), Nové Mesto nad Váhom district (25 municipalities),

NRSGR: Nitra district (20 municipalities), Šaľa district (2 municipalities), Topoľčany district (28 municipalities).

III.4.1.1.2. Population and Population Density

Area Concerned

The change of the population and population density in the area concerned is evident from the following table.

Tab. III.1: Population and population density of the area concerned for the period of 2008 - 2012 (as of December 31)

Area [km^2]	2008		2009		2010		2011		2012	
	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]
308.50	54,067	175	54,141	175	54,286	176	53,282	173	53,382	173

cadastral areas the routes of corridors of NNPP's technical infrastructure are considered (in addition, Červeník, Drahovce, Madunice and Piešťany municipalities).

Based on the data above, compared to 2008, the total population in 2012 decreased by 685 inhabitants, the average population density decreased from 175 inhabitants/km^2 in 2008 to 173 inhabitants/km^2 in 2012.

In 2012, the settlements with the highest population were the city of Piešťany (28,149 inhabitants) and the Veľké Kostoľany municipality (2,723 inhabitants), the fewest inhabitants (331) had the Ratkovce municipality. Between 2008 and 2012, the decrease in population was recorded in the city of Piešťany (by 1,391 inhabitants) and in 4 municipalities - Žlkovce (decrease by 7 inhabitants), Drahovce (decrease by 26 inhabitants), Pečeňady (decrease by 6 inhabitants) and Chtelnica (decrease by 19 inhabitants).

In 2012, the settlement with the highest population density was the city of Piešťany (637 inhabitants/km^2), the municipalities with the highest population density were Madunice (182 inhabitants/km^2), Červeník (163 inhabitants/km^2), Trakovice (127 inhabitants/km^2), Veľké Kostoľany (112 inhabitants/km^2), Špačince (110 inhabitants/km^2), Drahovce (107 inhabitants/km^2) and Jaslovské Bohunice (103 inhabitants/km^2). The municipalities with the lowest population density in 2012 were Dolný Lopašov (42 inhabitants/km^2), Radošovce (57 inhabitants/km^2) and Pečeňady (60 inhabitants/km^2).

Remote Area

The change of the population and population density in the remote area is evident from the following table.

Tab. III.2: Population and population density of the remote area for the period of 2008 - 2012 (as of December 31)

Area [km^2]	2008		2009		2010		2011		2012	
	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]
3214.61	439,202	137	440,108	137	441,000	137	436,552	136	436,903	136

Based on the data above, compared to 2008, the total population in 2012 decreased by 2299 inhabitants, the average population density decreased from 137 inhabitants/km^2 in 2008 to 136 inhabitants/km^2 in 2012.

In 2012, the settlements with the highest population density were the cities of Trnava (924 inhabitants/km^2), Leopoldov (734 inhabitants/km^2), Nové Mesto nad Váhom (621 inhabitants/km^2) and the municipalities of Píla (671 inhabitants/km^2) and Biely Kostol (618 inhabitants/km^2). The lowest population density in 2012 had the municipalities of Nová Lehota (11 inhabitants/km^2), Stará Lehota (14 inhabitants/km^2), Hubina (18 inhabitants/km^2) and Lošonec (22 inhabitants/km^2).

Total Area

The change of the population and population density in the total area is evident from the following table.

Tab. III.3: Population and population density of the total area for the period of 2008 - 2012 (as of December 31)

Area [km^2]	2008		2009		2010		2011		2012	
	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]	Population [1]	Density [1/km^2]
3523.12	493,269	140	494,249	140	495,286	141	489,834	139	490,285	139

Based on the data above, compared to 2008, the total population in 2012 decreased by 2984 inhabitants, the average population density decreased from 140 inhabitants/km^2 in 2008 to 139 inhabitants/km^2 in 2012. Compared with the average population density of the Slovak Republic (110 inhabitants/km^2), the total area is above average.

III.4.1.1.3. The Age Structure of Population

3 demographic indicators, which represent the basic characteristics of the demographic profile, are selected to describe the age structure of population:

- preproductive age,
- productive age,
- postproductive age.

During the selected period (i.e. between 2008 and 2012), the Statistical Office of the Slovak Republic changed the methodology of division of age groups of inhabitants into these indicators. While the productive age was in 2008 to 2010 defined as 15 to 59 years for men and 15 to 54 years for women, in 2011 is the productive age defined uniformly as 15 to 64 years. No change was made in the definition of the preproductive age (0 to 15 years), the above mentioned changes applies for the postproductive age class (it follows the productive age).

Therefore, the step changes in the numbers and population structures below reflect the change in methodological techniques between 2010 and 2011.

Area Concerned

The change of the age structure of population in the area concerned is evident from the following table.

Tab. III.4: The age structure of population of the area concerned for the period of 2008 - 2012 (as of December 31)

Year	Population	Economic age groups					
		No. of persons [1]			structure [%]		
		preproductive age	productive age	postproductive age	preproductive age	productive age	postproductive age
2008	54,067	7,238	33,865	12,964	13.39	62.64	23.98
2009	54,141	7,207	33,661	13,273	13.31	62.17	24.52
2010	54,286	7,234	33,368	13,684	13.33	61.47	25.21
2011	53,282	7,092	37,773	8,417	13.31	70.89	15.80
2012	53,382	7,119	37,609	8,654	13.34	70.45	16.21

Remote Area:

The change of the age structure of population in the remote area is evident from the following table.

Tab. III.5: The age structure of population of the remote area for the period of 2008 - 2012 (as of December 31)

Year	Population	Economic age groups					
		No. of persons [1]			structure [%]		
		preproductive age	productive age	postproductive age	preproductive age	productive age	postproductive age
2008	439,202	60,966	282,268	95,968	13.88	64.27	21.85
2009	440,108	60,312	281,397	98,399	13.70	63.94	22.36
2010	441,000	60,181	279,808	101,011	13.65	63.45	22.90
2011	436,552	59,876	316,532	60,144	13.72	72.51	13.78
2012	436,903	59,919	315,310	61,674	13.71	72.17	14.12

Total Area

The change of the age structure of population in the total area is evident from the following table.

Tab. III.6: The age structure of population of the total area for the period of 2008 - 2012 (as of December 31)

Year	Population	Economic age groups					
		No. of persons [1]			structure [%]		
		preproductive age	productive age	postproductive age	preproductive age	productive age	postproductive age
2008	493,269	68,204	316,133	108,932	13.83	64.09	22.08
2009	494,249	67,519	315,058	111,672	13.66	63.74	22.59
2010	495,286	67,415	313,176	114,695	13.61	63.23	23.16
2011	489,834	66,968	354,305	68,561	13.67	72.33	14.00
2012	490,285	67,038	352,919	70,328	13.67	71.98	14.34

III.4.1.2. The Health of Population

The health of the concerned area's population is assessed in the three above mentioned geographic areas (area concerned, remote area and total area) and it is compared with other (control) areas of the Slovak Republic and the self-governing regions (BASGR, TTSGR, TNSGR and NRSGR).

Selected health indicators, covering the most important diseases with regard to the cause of death[14], are used to determine the health of the population.

The mortality rate indicator without the differentiation of causes: This is the gross mortality rate of the population of area concerned. The gross mortality rate is expressed in the number of deaths per 1000 inhabitants per year.

The indicators of causes of death: The causes of death that are most frequent in the Slovak Republic are selected from the indicators of causes of death. The causes of death are defined in terms of the international classification of diseases ICD-10. The mortality rate according to causes is expressed in the number of deaths per 100,000 inhabitants per year. Selected health indicators are the following:

- Relative mortality rate of population caused by all types of tumours
- Relative mortality rate of population caused by leukaemia
- Relative mortality rate of population caused by circulatory system diseases
- Relative mortality rate of population caused by respiratory system diseases
- Relative mortality rate of population caused by digestive system diseases
- Relative mortality rate of population caused by environmental factors[15]

The mortality rate development according to undifferentiated causes (gross mortality rate) and according to indicators of causes of death (ICD-10) is evident from the following table:

Tab. III.7: Values of the gross mortality rate indicator in 2008 to 2012 (as of December 31)

Area	Relative mortality rate [deaths/1000 inhabitants]				
	2008	2009	2010	2011	2012
Total Area	10.01	9.99	10.01	9.97	10.20
Area Concerned	9.65	10.21	10.19	10.27	9.91
Remote Area:	10.06	9.96	9.99	9.93	10.24
the Slovak Republic	9.82	9.75	9.83	9.60	9.69
Bratislava Self-Governing Region	9.39	9.22	9.48	9.43	9.38
Trnava Self-Governing Region	9.77	9.81	9.96	9.92	9.78
Trenčín Self-Governing Region	9.80	10.02	9.74	9.68	9.73
Nitra Self-Governing Region	11.41	11.19	11.12	10.98	11.17

The total gross mortality rate in the area concerned was in 2008 to 2012 the same as values of this indicator for the whole Slovak Republic. In the monitored period of 2008 to 2012, a comparable development in the Slovak comparison was recorded in the area as in higher territorial units - Bratislava self-governing region, Trnava self-governing region, Trenčín self-governing region and Nitra self-governing region.

[14] The population's mortality rate is one of the basic health indicators of the public health. But the mortality rate is the indicator of impact of all living conditions mainly in relation to diseases with short duration and high mortality. It fails to capture treated diseases, diseases not threatening life and long-term diseases and therefore it is only a partial assessment of the health of population.

[15] The environmental factors of mortality rate and sickness rate are traffic accidents, falls, drownings, damage by smoke and fire, poisonings and nearly poisoning with harmful substances, intentional self-harm and attacks.

Tab. III.8: Relative mortality rate of population caused by all types of tumours (C00-D48) in 2008 to 2012 (as of December 31)

Area	Relative mortality rate [deaths/100,000 inhabitants]				
	2008	2009	2010	2011	2012
Total Area	248.55	245.42	241.07	253.76	256.38
Area Concerned	253.39	289.98	254.21	277.77	256.64
Remote Area:	247.95	239.94	239.46	250.83	256.35
Slovak Republic	221.57	220.57	224.18	223.36	225.42
Bratislava Self-Governing Region	233.06	233.66	232.07	240.38	228.83
Trnava Self-Governing Region	241.28	239.88	240.82	251.66	254.05
Trenčín Self-Governing Region	221.72	226.13	236.63	227.03	226.58
Nitra Self-Governing Region	265.16	257.77	252.00	258.71	265.83

Tab. III.9: Relative mortality rate of population caused by leukaemia (C91-C95) in 2008 to 2012 (as of December 31)

Area	Relative mortality rate [deaths/100,000 inhabitants]				
	2008	2009	2010	2011	2012
Total Area	6.89	7.08	5.86	7.55	4.28
Area Concerned	5.55	7.39	9.21	7.51	1.87
Remote Area:	7.06	7.04	5.44	7.56	4.58
the Slovak Republic	6.34	5.99	5.80	6.07	5.40
Bratislava Self-Governing Region	7.95	6.26	5.89	5.44	5.71
Trnava Self-Governing Region	6.25	5.88	6.57	8.28	5.75
Trenčín Self-Governing Region	6.17	7.34	5.18	6.23	4.55
Nitra Self-Governing Region	7.79	7.23	6.39	5.95	5.52

Tab. III.10: Relative mortality rate of population caused by circulatory system diseases (I00 - I99) in 2008 to 2012 (as of December 31)

Area	Relative mortality rate [deaths/100,000 inhabitants]				
	2008	2009	2010	2011	2012
Total Area	522.23	517.15	523.74	506.29	532.14
Area Concerned	519.73	524.56	519.47	533.01	532.01
Remote Area:	522.54	516.24	524.26	503.03	532.15
the Slovak Republic	526.62	521.02	525.11	505.26	513.28
Bratislava Self-Governing Region	467.09	454.63	471.46	453.23	468.43
Trnava Self-Governing Region	507.38	507.90	508.28	496.12	500.38
Trenčín Self-Governing Region	554.63	557.56	534.39	529.97	524.48
Nitra Self-Governing Region	610.87	589.23	592.55	571.81	589.77

Tab. III.11: Relative mortality rate of population caused by respiratory system diseases (J00 - J99) in 2008 to 2012 (as of December 31)

Area	Relative mortality rate [deaths/100,000 inhabitants]				
	2008	2009	2010	2011	2012
Total Area	59.20	58.88	67.84	57.37	64.04
Area Concerned	51.79	38.79	86.58	37.54	50.58
Remote Area:	60.11	61.35	65.53	59.79	65.69
the Slovak Republic	55.08	58.60	60.92	60.49	62.04
Bratislava Self-Governing Region	55.95	55.56	68.08	70.56	70.51
Trnava Self-Governing Region	56.26	57.70	71.04	55.62	56.78
Trenčín Self-Governing Region	46.51	52.90	47.43	49.82	58.16
Nitra Self-Governing Region	56.63	66.32	68.82	67.87	71.91

Tab. III.12: Relative mortality rate of population caused by digestive system diseases (K00 - K99) in 2008 to 2012 (as of December 31)

Area	Relative mortality rate [deaths/100,000 inhabitants]				
	2008	2009	2010	2011	2012
Total Area	56.56	59.69	56.33	58.59	53.23
Area Concerned	55.49	48.02	47.89	54.43	48.71
Remote Area:	56.69	61.12	57.37	59.10	53.79
the Slovak Republic	55.98	54.40	52.34	53.11	52.54
Bratislava Self-Governing Region	62.60	65.52	58.06	59.19	55.17
Trnava Self-Governing Region	54.47	54.49	56.12	62.29	51.39
Trenčín Self-Governing Region	50.18	51.07	45.09	50.15	47.20
Nitra Self-Governing Region	71.07	68.87	65.98	65.84	63.19

Tab. III.13: Relative mortality rate of population caused by environmental factors (V91-Y95) in 2008 to 2012 (as of December 31)

Area	Relative mortality rate [deaths/100,000 inhabitants]				
	2008	2009	2010	2011	2012
Total Area	60.01	54.63	49.26	57.98	52.83
Area Concerned	53.64	53.56	51.58	54.43	52.45
Remote Area:	60.79	54.76	48.98	58.41	52.87
the Slovak Republic	58.64	54.51	54.22	52.20	50.40
Bratislava Self-Governing Region	53.36	45.29	52.49	46.66	44.88
Trnava Self-Governing Region	61.26	58.06	54.52	57.06	54.80
Trenčín Self-Governing Region	58.01	55.57	51.10	53.01	52.94
Nitra Self-Governing Region	63.56	64.90	65.70	65.40	63.77

No substantial changes in the development of the health population of the total area occurred in the monitored period of 2008 to 2012. The most common cause of death are the circulatory system diseases, oncological disease, respiratory system diseases, digestive system diseases and diseases caused by environmental factors. These in total had a 96.74 % share in 2008 and a 94.90 % share in 2012 of all deaths in the area concerned. In the remote area, it was a 94.27% share in 2008 and a 93.83% share in 2012 on all deaths. The most significant cause of death from quantitative point of view in the NNPP's area concerned (same as in the remote area) are diseases of the circulatory system.

The percentage of deceased according to causes of deaths in terms of the International classification of diseases is clear from the following table:

Tab. III.14: Percentage of deceased in the area concerned according to causes of death [%]

Year	Circulatory system diseases	Tumours	Respiratory system diseases	Digestive system diseases	Environmental factors of mortality rate and sickness rate	Other causes of death
2008	53.83	26.25	5.36	5.75	5.56	3.25
2012	53.69	25.90	5.10	4.91	5.29	5.11

Tab. III.15: Percentage of deceased in the remote area according to causes of death [%]

Year	Circulatory system diseases	Tumours	Respiratory system diseases	Digestive system diseases	Environmental factors of mortality rate and sickness rate	Other causes of death
2008	51.96	24.65	5.98	5.64	6.04	5.73
2012	51.97	25.03	6.41	5.25	5.16	6.18

Tab. III.16: Percentage of deceased in the total area according to causes of death [%]

Year	Circulatory system diseases	Tumours	Respiratory system diseases	Digestive system diseases	Environmental factors of mortality rate and sickness rate	Other causes of death
2008	52.16	24.82	5.91	5.65	5.99	5.47
2012	52.15	25.11	6.28	5.22	5.18	6.06

III.4.1.3. Social and Economic Status of the Population

In the Slovak Republic in 2012, there were 2,706,500 economically active inhabitants from the total of 5,411,000 inhabitants. The economic activity rate in 2012 reached 59 % and the unemployment rate reached 14 %.

The Trnava region is one of the productive agricultural regions of the Slovak Republic and at the same time it is also characterised by a variety of industry. The automotive, electronics and power industries have a prominent role. Of the total of 556,577 inhabitants, 295,800 were economically active in 2012.

The economic activity of the population of the Slovak Republic, TTSGR, BASGR, TNSGR and NRSGR in 2012 is evident from the following table.

Tab. III.17: The economic activity of the population of the Slovak Republic, TTSGR, BASGR, TNSGR and NRSGR in 2012 (as of December 31)

Area	Economically active population [1]	Economic activity rate [%]	Unemployment rate [%]
the Slovak Republic	2,706,500	59.2	14.0
TTSGR	295,800	61.8	11.4
BASGR	337,900	64.8	5.6
TNSGR	292,700	56.9	9.0
NRSGR	346,100	58.0	13.3

The dependency ratio can be considered an indicator of the level of economic and social conditions. It states the burden of dependent persons on the economically active workforce and thus it represents a ratio between economically inactive[16] and economically active part of the population. It is expressed with the amount of children in preproductive age and elder people in postproductive age falling on 100 persons in productive age.

The development of dependency ratio is shown in the following table. It should be warned also in this case that during the selected period (i.e. between 2008 and 2012) the Statistical Office of the Slovak Republic changed the methodology of division of age groups of inhabitants into these indicators. While the productive age was in 2008 to 2010 defined as 15 to 59 years for men and 15 to 54 years for women, in 2011 is the productive age defined uniformly as 15 to 64 years. No change was made in the definition of the preproductive age (0 to 15 years), the above mentioned changes applies for the postproductive ages (it follows the productive age). Therefore, the step changes in the dependency ratio come from the change in methodological techniques between 2010 and 2011.

Tab. III.18: The dependency ratio of population for the period of 2008 - 2012 (as of December 31)

Area	DR				
	2008	2009	2010	2011	2012
Area concerned	59.65	60.84	62.69	41.06	41.94
Remote area:	55.60	56.40	57.61	37.92	38.56
Total area	56.03	56.88	58.15	38.25	38.92

It is clear that in the interannual comparison of 2008-2010 and 2011-2012, the burden on the economically active population increased.

[16] The economically inactive population includes children in preproductive age and elder inhabitants in postproductive age who are dependant on the productive part of the population.

This is due to the growth of the elderly postproduction population group with a low growth in the preproductive population group at the same time. This is part of a long-term trend, which is also seen nationwide . The same development of economic burden of the productive population group with dependant persons was observed in the Slovak Republic interannually. The DR grew interannually (2011/2012), whereas in 2011, there were 39 dependant persons on every 100 inhabitants of productive age and in 2012, there were 40 dependant persons on every 100 inhabitants of productive age.

The lower share of preproductive group of children and rising share of elder postproductive persons thus leads to the increase of dependency ratio of the active population and economic imbalance of expenditures and revenues. On the other side, the positive aspect of the ageing of population and the extension of life expectancy supports the assumption of suitable better living conditions, and social and health care in given region.

III.4.1.4. Public opinion on nuclear energy production

The data on population also includes public opinion data.

In 2010, the MARKANT agency conducted a public opinion survey on nuclear energy production and at the same time, the shift of opinion of the inhabitants of Jaslovské Bohunice region and the Slovak Republic compared to the results of public opinion survey conducted in 2008 was evaluated. The 2008 survey was conducted on a sample of 1035 respondents from the general population of the Slovak Republic over the age of 18. An additional 322 respondents were polled directly from the Jaslovské Bohunice region. The 2010 survey was conducted on a sample of 803 respondents from the general population of the Slovak Republic over the age of 18, with 250 respondents directly from the Jaslovské Bohunice region.

Based on the surveys conducted in 2008 and 2010, the Jaslovské Bohunice region inhabitants' support for nuclear energy gradually grew. In 2010, 59.8 % of Jaslovské Bohunice region inhabitants were in favour of the construction of a new nuclear power plant, which is by 12.7 % more than in 2008. In 2010, 62.4 % of Slovak Republic inhabitants were in favour of construction of NNPP, which is a rise by 13.1 % compared to 2008. Compared to 2008, also the share of people that consider nuclear energy safe grew. In case of respondents from Jaslovské Bohunice region, the increase was from 43 % to 49.8 %. In the general Slovak population, the increase was a bit smaller, from 35 % to 37.9 %. The share of Slovak inhabitants convinced that the nuclear energy does not pollute the environment did not change. It was 54 % in both 2008 and 2010. This percentage is lower by a bit in case of Jaslovské Bohunice region inhabitants. Their agreement with this statement fell to 51 % in 2010 from 55 % in 2008. The half of respondents coming from Jaslovské Bohunice region inhabitants agreed that the presence of nuclear power plant in the region brings benefits for its inhabitants. These benefits were mostly perceived in the form of the employment rate increase (58 %), development of specific municipality, where the nuclear power plant will be running (45 %), general development of region (37 %) and a positive impact on the standard of living.

The monitored development trend of public opinion on nuclear energy production was confirmed also by a survey conducted by the company NMS Market Research SR in December 2013. The questions were answered by the total of 470 randomly selected respondents over the age of 18. The answers of three population groups same in size were evaluated in the survey. The first group were respondents from municipalities up to 10 km from the EBO site, the second one were the inhabitants from municipalities from the wider area over 10 km from the EBO site and the third one were inhabitants from bigger cities. Almost two thirds of respondents (63 %) agreed with the construction of a new nuclear power plant in 2013. The inhabitants of municipalities within 10 km from the NNPP expressed their agreement more often (73 %) than others. In the case of the statement that the nuclear power plant is safe for the surroundings, approximately half of the respondents still agree with said statement (52 %), this share is even slightly higher in for of inhabitants living within 10 km from the NNPP. A slight prevalence of disagreement (54 %) was found in the case of the statement that the nuclear power plant does not pollute the environment, however, in the case of inhabitants living within 10 km from the NNPP, this disagreement amounts to 47 %. A significant positive shift can be shown in case of the opinion on benefits of the presence of a nuclear power plant in the region. According to the opinion of the majority of respondents, the construction of new nuclear power plant in Jaslovské Bohunice will certainly positively affect the employment rate (91 %), the total development in the region (76 %) and the development of municipalities in whose cadastral areas the nuclear power plant will be built (74 %). Approximately half of respondents are convinced that the new nuclear power plant would have a positive impact of on social services (51 %) and healthcare (47 %).

III.4.2. Air and Climate

III.4.2.1. Air Quality

The basic starting point for assessing the quality of air in the Slovak Republic are the results of measurements of pollutant concentration in the air performed by the Slovak Hydrometeorological Institute. (SHI) It has proposed, as the authorised organisation, 18 areas in total of air quality management for 2012. The air quality management area of the city of Trnava is near the assessed site. This site was chosen due to a history of exceeding the dust particles of 10 µm fraction concentration limits. In 2011, the 24 hour limit value for the human health protection from dust particles of 10 µm fraction was exceeded 59 times at the Trnava-Kollárova station. Other pollutants did not exceed limit or target values. The pollution monitoring results from Trnava region is shown in the following table.

Tab. III.19: Evaluation of air pollution according to limit values for human health protection in 2011 (SHI)

Pollutant	SO_2		NO_2		PM_{10}		$PM_{2,5}$+MT	CO	Benzene
Period of averaging	hour	24 hrs	hour	year	24 hrs	year	year	8 hrs	year
Limit value [µg.m^{-3}] (acceptable number of excesses)	350 (24)	125 (3)	200 (18)	40 -	50 (35)	40 -	28 -	10,000 -	5 -
Senica	0	0	-	-	(40)	30.8	23.8	-	-
Trnava	-	-	0	22.4	(59)	36.7	24.9	3061	0.9
Topoľníky	-	-	-	-	(41)	26.5	23.7	-	-

Mathematical modelling can be also used to evaluate the air quality, apart from pollution measurement. The results of this modelling (done by SHI) can be summarized as follows:

Fine particulate matter (PM_{10}): The limit value of average annual concentration was not exceeded in Trnava region in 2011. The most important problem in Slovakia (but also in the majority of European countries) present the maximum daily concentrations of dust particles of 10 µm fraction (PM_{10}). But exceeding the statutory limits was not present in the area concerned.

Sulphur dioxide (SO_2): The model calculation confirmed the limitation of the area of the excesses of short-term concentrations only to the Prievidza district area. In case of hourly percentiles in Trnava region, the values are under 20 % of the limit value.

Nitrogen dioxide (NO_2): In case of this pollutant the effect of mobile sources (road network) is significant . Lesser contributors to this pollutant include stationary sources and background levels. The Trnava region area did not exceed the pollution limits for NO_2.

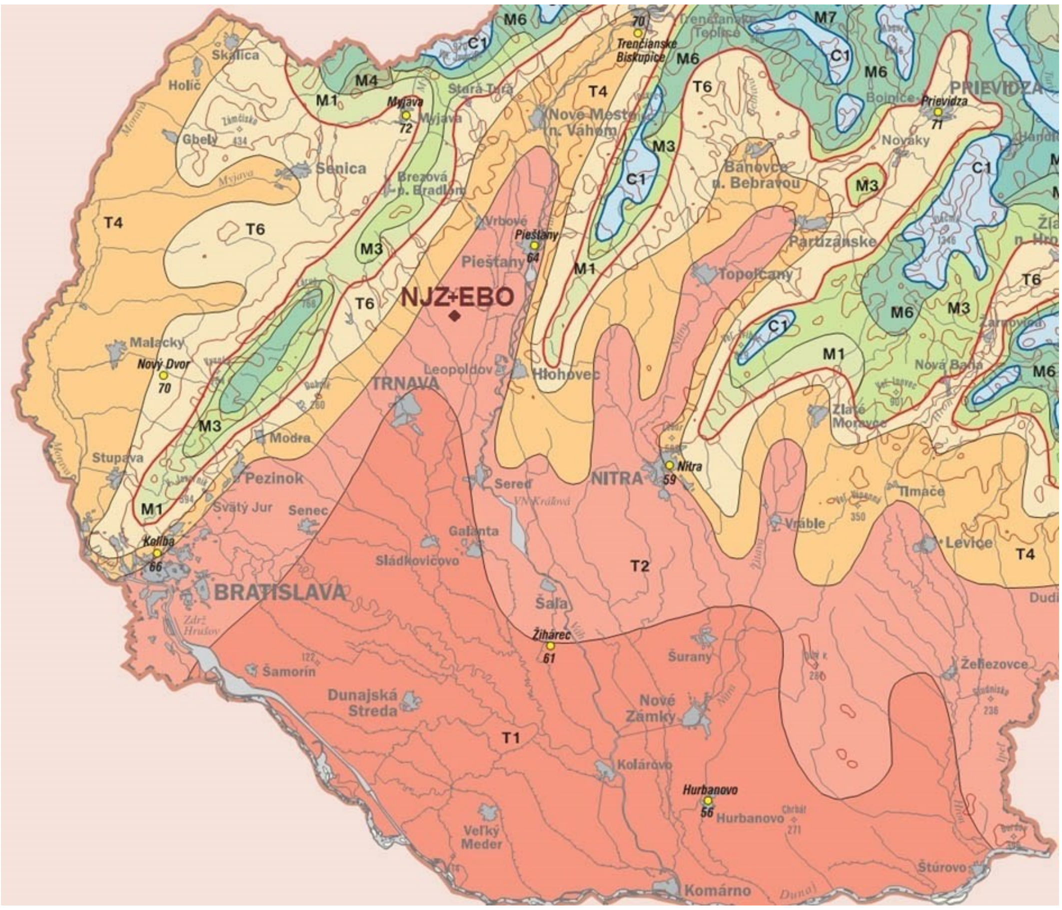
Carbon monoxide (CO): Traffic seems to be a dominant source of air pollution in the majority of the area. Based on the observed concentrations the effect of carbon monoxide does not seem to be an issue. Statutory limits were not exceeded in the subject area.

Benzene: According to model results the limit value for benzene was not exceeded in the whole Slovak Republic area. Traffic pollution seems to be the dominant source with regard to the areal distribution pollutant..

III.4.2.2. Climate Characteristics

In terms of global climate classification, the site is located in the temperate zone on the transition from the Atlantic-continental climate area to the European-continental climate area, in the transitional zone between maritime and continental climates. The area concerned is classified as a warm climate area. The site is further classified as primarily climate region T2 (warm, dry, with mild winter) and partially in the T4 region (warm, mildly dry, with mild winter).

Fig. III.1: Map of climatic areas



	T1	warm, very dry, with mild winter
	T2	warm, dry, with mild winter
	T4	warm, mildly dry, with mild winter
	T6	warm, mildly wet, with mild winter
	M1	mildly warm, mildly wet, with mild winter, hilly
	M3	mildly warm, mildly wet, with mild winter, hilly to uplands
	M4	mildly warm, mildly wet, with mild winter, hilly to plain
	M6	mildly warm, wet, hilly
	M7	mildly warm, very wet, hilly
	C1	mildly cold

The detailed statistical processing of climate features used data primarily from the Jaslovské Bohunice meteorological station for the period of 1981 to 2010.

Air temperature: The EBO site temperature conditions are characterised by typical inland annual and daily pattern course with a July maximum and January minimum. The average air temperature in Jaslovské Bohunice site in the period of 1981 to 2010 was 9.8 °C. The weather and also climate variability is complicated by another important phenomenon, which is the global warming. It affects the climate not only globally, but in last 30 years also in the Central European region.

Air humidity: The annual pattern of relative air humidity is approximately opposite to the trend of air temperature. In average, its maximum is in December and its minimum in April, with a secondary minimum is in July.

Precipitation: In the analysed area the annual pattern of precipitation amounts has a maximum in June and July, with a smaller amount of precipitation growth in November and December and a minimum in February. The precipitation in the warmer half of the year is primarily in the form of showers and heavy rains. The colder seasons have long-term precipitation with lower total amounts. The average annual precipitation sum was in Jaslovské Bohunice 553 mm in the period of 1981 to 2010.

Snow cover: The total snow cover per month (monthly sum in cm) has reached a maximum of more than 44 cm in the most severe months of the year (December to January). The average snow cover height (the ratio of the sum of total snow cover and the number of days with snow cover) reached 6.2 cm in the monitored 30-day period and the average snow height (the ratio of the total snow cover and the number of days between the first and the last day with snow cover) was 3.3 cm.

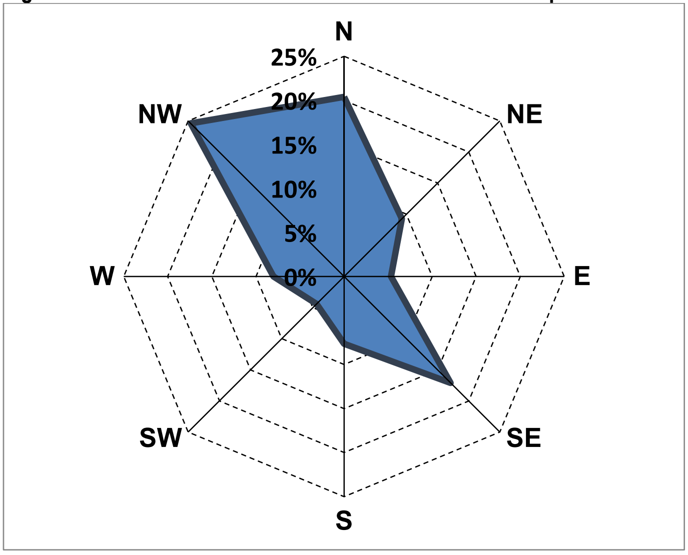
Air pressure: The variation of air pressure is considerably non-periodical, therefore neither yearly nor daily patterns are clearly defined as in other meteorological elements. The average annual air pressure was 995.1 hPa with a maximum in winter months and a minimum in spring months.

Wind: The frequency and directions of the winds (wind roses) were prepared for the period of 1987 to 2010. The data was obtained from a station located at the site at a height of 178 m above sea level with the anemometer 19 m above the terrain. These statistic characteristics are summarised in the following table and figure.

Tab. III.20: The relative frequency of occurrences of wind directions in the Jaslovské Bohunice site for the period of 1987 - 2010

	Calm	N	NE	E	SE	S	SW	W	NW	Total
Calm	0.0331	0	0	0	0	0	0	0	0	0.0331
0 - 2 m/s	0	0.0563	0.0380	0.0191	0.0302	0.0283	0.0226	0.0211	0.0342	0.2498
2 - 4 m/s	0	0.0678	0.0359	0.0168	0.0457	0.0275	0.0141	0.0228	0.0594	0.2900
4 - 6 m/s	0	0.0360	0.0124	0.0090	0.0435	0.0124	0.0048	0.0169	0.0652	0.2003
6 - 8 m/s	0	0.0252	0.0046	0.0055	0.0308	0.0053	0.0018	0.0117	0.0522	0.1371
> 8 m/s	0	0.0182	0.0019	0.0028	0.0205	0.0031	0.0007	0.0075	0.0350	0.0898
Total	0.0331	0.2040	0.0928	0.0533	0.1710	0.0764	0.0441	0.0801	0.2460	1

Fig. III.2: Wind rose of the Jaslovské Bohunice site for the period of 1987 – 2010



Based on the above data, the prevailing wind in the site is north-western (25 % frequency) to north (20 % frequency) wind with another prevailing direction to the south-east wind (17 %). The average annual wind speed reaches 4.1 $m.s^{-1}$.

Sunshine: Sunshine is the qualitative indicator of solar radiation input. Its amount is in a close correlative relation with global solar radiation. Its annual quantity is the combination of the astronomical predetermination of the amount of sunlight and the annual variation of cloud cover. The average annual sunshine duration reached 1,939.6 hours with a July maximum and December minimum.

Atmospheric phenomena: The site averaged 22.8 stormy days per year with the maximum of 36 cases per year. A storm can occur in almost any month of the year. Only November and December had no stormy days during the monitored period..

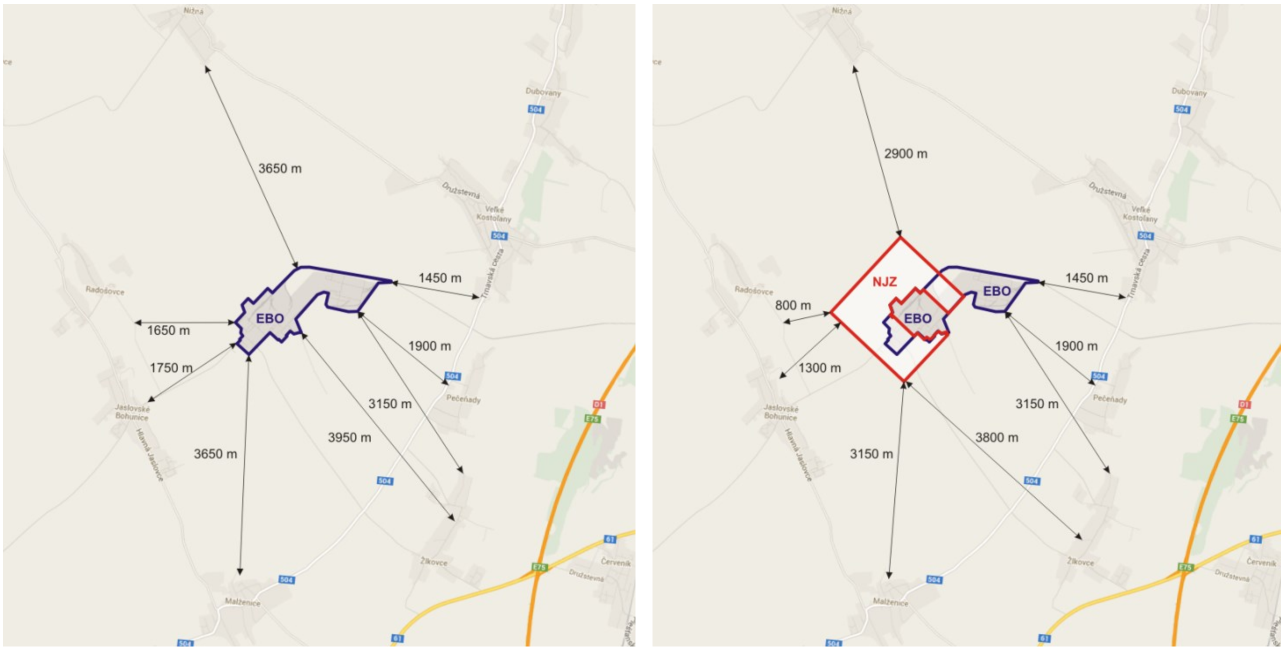
Other meteorological phenomena are also linked with storms. Hail occurs only sporadically and over limited areas. The occurrence of hail is concentrated mainly in the warm period of the year. The most days with hail during the year were recorded in 2004 - 4 cases. Frost cover occurs in the cold period of the year and its formation is linked with a combination of temperature, humidity and wind conditions. The most frequent occurrence of frost (8 days) was recorded in 2006. The occurrence of glaze ice and icing is primarily concentrated in the months of the cold half of the year, mostly from November to February. The highest amount of days with glaze ice and icing in a month was recorded in January 1999 (12 days). The year 1999, also the highest number in a year (20 days). The yearly average days with glaze ice and icing was approximately 7 days.

III.4.3. Noise

III.4.3.1. Noise Situation

In terms of noise the area concerned can be characterised as anthropogenised. The area's salient feature is the overlapping of noise from different activities (traffic, industry, agriculture) that more or less correspond with the nature of the country. The protected area is concentrated in the developed area of the surrounding municipalities. The following figure shows distances from settlements to the outer boundaries of the objects of noise protection in the neighbourhood of the assessed site.

Fig. III.3: Distance of the nearest protected areas in current situation and planned (without scale)



The road network, comprised of the network of class II and III roads, has a dominant influence on the noise environment in the area. Traffic intensity data show that the possibility of exceeding the acceptable noise levels from road traffic (60 dB for daytime and evening time, 50 dB for night time) exists mainly along the class II roads which pass through municipalities. The traffic on the delivery track leading to the EBO site is of secondary importance. This is because transportation over the track is connected to EBO site needs only and there is no other regular traffic on it.

Apart from traffic noise, the industrial operations in the EBO site (operation of NPP Bohunice 3,4, decommissioning of NPP Bohunice 1,2 and A1 Nuclear Power Plant Jaslovské Bohunice and other related activities) also contribute to noise levels.. No noise monitoring was conducted in the area concerned. But it is probable that the noise levels are acceptable in the closest protected area are met due to the distance from the EBO site. We do not expect exceedance of the statutory noise limits from this source.

Other noise sources are activities outside of the focal area and in the surrounding area, mainly agricultural activities. These activities are concentrated in a relatively short period (with a duration of several weeks at most). Agricultural activity has no crucial influence on the overall noise situation in the area.

The overall noise situation in the area concerned can be summarised as adequate considering the nature and functional structure of the area. The road traffic passing through the developed areas of settlements is the dominant source of noise.

III.4.4. Ionising Radiation

III.4.4.1. General Information on Sources of Population Irradiation

Ionising (radioactive) radiation is a natural part of the environment since the creation of life on Earth. The sources of ionising radiation, causing irradiation to human population, is divided into natural and artificial classes.

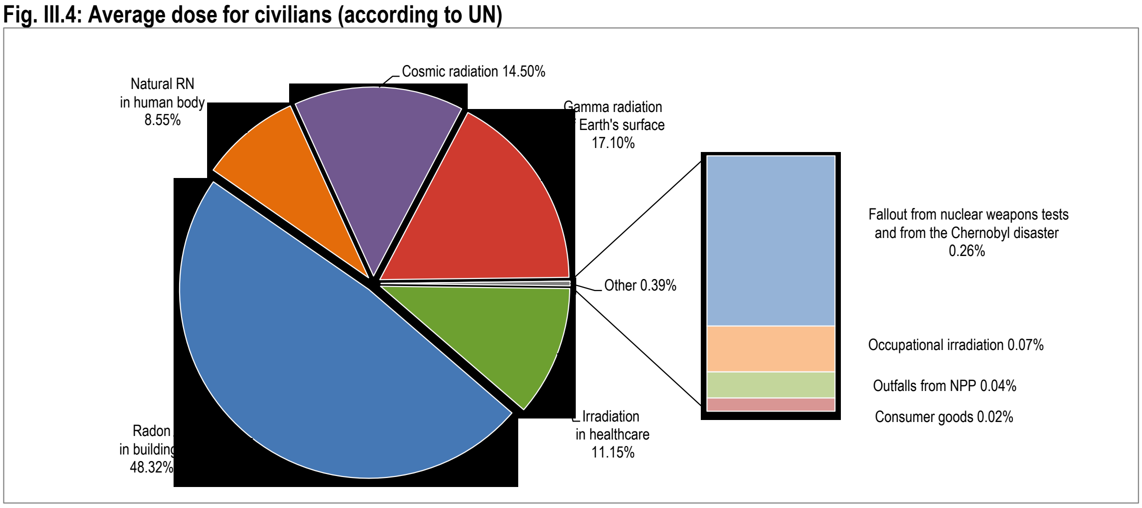
Natural sources: Natural sources provide the largest share of population radiation exposure. Natural sources include: cosmic and cosmogenic radiation, natural radiation of rocks, water and air, natural radioactivity of food and natural content of radioactive nuclides in human body.

The dominant radiation doses to population from natural radiation are caused by the inhalation of products of radon transformation in buildings, by doses from exterior gamma radiation from natural radioactive nuclides present in construction materials, in the geologic environment and in soil, from cosmic radiation and internal exposure (mainly from the ^{40}K isotope and other natural radioactive nuclides). According to the current state of knowledge, natural irradiation comprises almost 90 % of the average population exposure to radiation.

Artificial sources: The primary artificial source is medical exposure (X-rays, radiopharmaceuticals, etc.). Smaller exposures come from technogenic sources (use of radioactive nuclides in consumer and other goods including the amount of radioactive nuclides in construction materials), occupational irradiation and the so-called global fallout (remnants of nuclear weapons tests and nuclear reactors accidents). The radiation from nuclear plant outfalls counts here as well.

The average radiation doses for general population (according to the UN) is shown in Fig, III.4

Fig. III.4: Average dose for civilians (according to UN)

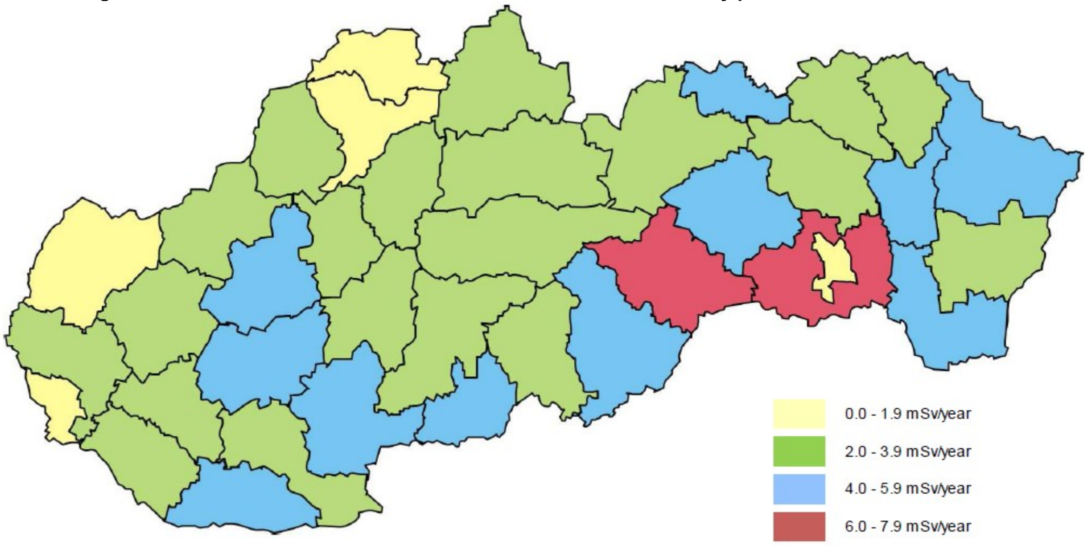


However the picture might be only illustrative (serving to acquire a perspective in the overall context), it is clear that the natural irradiation is the dominant, followed by irradiation in healthcare. Other contributions to population irradiation (including outfalls from nuclear power plants) are minor.

The radiation exposure in the Slovak Republic follows this pattern and represents a dose of approx. 2 to 3 mSv/year. The overall dose is affected, apart from altitude, mainly by conditions of gaseous radon releasing from the soil and subsoil into the surrounding air. The average value of annual effective dose for an inhabitant of the Slovak Republic reaches almost 2 mSv/year.

The radiation background can also be significantly higher inside residential areas due to radon accumulation. This is clear from the following figure.

Fig. III.5: Average annual effective dose from inhalation of radon and its subsidiary products in residential areas



III.4.4.2. Radiation Situation of the Area Concerned

III.4.4.2.1. Input Data

The basic information for evaluation of the area's radiation situation in relation to the existing nuclear facilities are the measurements at the source, i.e. results of monitoring of their gaseous and fluid outfalls. More precisely, results of check measurements of radioactive materials activity which allows for their release from the radiation source control. Irradiation - effective dose of representative people living in the vicinity of nuclear facilities is determined with model calculations based on recorded values. Monitoring measurements in the environment are also used in evaluation of the area radiation situation.

The following conclusions can be made based on the activities of the operators of individual NPPs in the area and other interested parties..

III.4.4.2.2. Emission Situation

All types of radioactive substances released into the air from the NPP in the EBO site from their start of operation until the present time were significantly below the set authorised limits. The release of tritium into surface waters did not exceed the set yearly limit. The outfalls of other corrosive and fissile products in waste waters were well below the set authorised limits.

The amount of authorised radioactive substances released into atmosphere and hydrosphere from nuclear facilities in the EBO site is set by annual limits.

The purpose of limit values is to ensure that the total emissions of radioactive substances into the environment from all sources in the area would be such, that due to the impact of radioactive emission an individual from the critical population group - a representative person will not exceed the effective dose of 0.25 mSv/year as a result of emissions into the atmosphere and hydrosphere (Government Regulation No. 345/2006 Coll., On basic safety requirements for the protection of health of workers and the population from ionising radiation) respectively the lower effective dose authorised by a reasoned decision of the Public Health Authority of the Slovak Republic.

But the nuclear facility operator's obligation is not only to avoid exceeding the set guiding values, but also to ensure that outfalls from the nuclear facility are kept at the a lowest level, as is reasonable achievable, when taking all social and economic aspects (ALARA principle) into account. The limit values of radioactive substances outfalls are set separately for atmospheric and hydrospheric discharges.

The NPP operators must ensure, according to valid legal regulations, that the effective dose of a representative person from the population caused by radioactive substances released into atmosphere and surface water from individual nuclear facilities in Bohunice site will not exceed the mentioned authorised values of effective dose for an inhabitant, which are at present set for individual operators in Bohunice site as follows[17]:

Tab. III.21: Guiding values of effective dose for the representative person form the population

Nuclear facility	Limit	Note
JAVYS NF	32 μSv/year	Including: 20 μSv/year for NPP Bohunice 1,2, 12 μSv/year pre other NF of the JAVYS company (NPP Bohunice A1, radioactive waste processing and treatment technologies (TSÚ RAO), Interim Spent Fuel Storage Facility (MSVP)) - jointly as VYZ.
SE NF	50 μSv/year	for NPP Bohunice 3,4

The sum of guiding values (82 μSv/year) is insignificant against the natural background (2000 to 3000 μSv/year) and thus does not pose a health risk.

The basis of the evaluation methodology of population irradiation effects is defining the so-called critical population group or a representative person from the critical population group. The critical group is define as a "model group of natural persons that represents such individuals from the population that are the most irradiated from given source and in given way". The population radiation exposure is evaluated by operators of individual NPP, including verification/validation of setting the critical population group - the representative person, This is submitted in annual reports to the respective supervisory bodies and the public. The critical population group can change for every year (e.g. due to current division of wind directions). The effective population doses in the surroundings of Jaslovské Bohunice nuclear facility, calculated on the basis of the overall activity of radioactive nuclides released into the atmosphere and hydrosphere from individual NF in the area for past 20 years are shown in the following table.

[17] SE-EBO (SE, j.s.c. - Jaslovské Bohunice NPP) (NPP Bohunice 3,4): The decision of the Public Health Authority of the Slovak Republic No. OOZPŽ/6774/2011 dated October 25, 2011, which permits the release of radioactive substances that originate in the operation of SE-EBO from under the administrative control through their release into the atmosphere, Váh river and Dudváh river

JAVYS (RAW and Decommissioning in Slovakia): for objects of NPP Bohunice A1 The decision of the Public Health Authority of the Slovak Republic No. OOZPŽ/7119/2011 dated October 21, 2011, which permits the release of radioactive substances from the NPP Bohunice A1 objects from under the administrative control through their release in exhalations trough ventilation chimneys in the A1 site into the atmosphere and in waste waters released into Váh river and Dudváh river

JAVYS: NPP Bohunice 1,2 The decision of the Public Health Authority of the Slovak Republic No. OOZPŽ/3760/2011 dated July 1, 2011, which permits the release of radioactive substances that originate in relation to activities related to the decommissioning of NPP Bohunice 1,2 from under the administrative control trough their release in exhalations trough ventilation chimneys in the A1 site into the atmosphere and in waste waters released into Váh river and Dudváh river

Tab. III.22: Annual effective doses of the representative person from nuclear facilities in Jaslovské Bohunice site for years 1993 to 2012

Year	Effective dose	Municipality (area)	Note
1993	$5.06.10^{-7}$ Sv/year	Žlkovce	
1994	$4.03.10^{-7}$ Sv/year	Žlkovce	
1995	$1.54.\ 10^{-7}$ Sv/year	Žlkovce	
1996	$4.63.\ 10^{-7}$ Sv/year	Žlkovce	
1997	$3.71.\ 10^{-7}$ Sv/year	Žlkovce	
1998	$1.64.\ 10^{-7}$ Sv/year	Žlkovce	
1999	$6.63.\ 10^{-8}$ Sv/year	Malženice	After the end of releasing the liquid waste technical waters into Dudváh effluent stream, the critical group became the inhabitants of municipalities depending on the prevailing wind direction.
2000	$1.50.\ 10^{-7}$ Sv/year	Malženice	
2001	$1.80.\ 10^{-7}$ Sv/year	Malženice	
2002	$1.96.\ 10^{-7}$ Sv/year	Malženice	
2003	$7.59.\ 10^{-8}$ Sv/year	Pečeňady	
2004	$1.32.\ 10^{-7}$ Sv/year	Pečeňady	
2005	$1.19.\ 10^{-7}$ Sv/year	Pečeňady	
2006	$1.01.\ 10^{-7}$ Sv/year	Bohunice	The individual NF that are source of irradiation have contributed on the maximum value of effective dose as follows: EBO (NPP Bohunice 3,4): 51.24%, JAVYS: 48.76% (of which NPP Bohunice 1,2: 48.71% and VYZ: 0.05%)
2007	$2.24.\ 10^{-7}$ Sv/year	Pečeňady	
2008	$2.16.\ 10^{-7}$ Sv/year	Pečeňady	
2009	$2.07.\ 10^{-7}$ Sv/year	Pečeňady	
2010	$1.56.\ 10^{-7}$ Sv/year	Pečeňady	
2011	SE: $1.72.\ 10^{-7}$ Sv/year JAVYS: $4.14.\ 10^{-8}$ Sv/year	Pečeňady Ratkovce, Žlkovce	Since 2011 the effective doses of the representative person from population are calculated separately for JAVYS and separately for SE (NPP Bohunice 3,4)
2012	SE: $1.85.\ 10^{-7}$ Sv/year JAVYS NPP Bohunice 1,2: $9.37.\ 10^{-9}$ Sv/year JAVYS VYZ: $1.50.\ 10^{-9}$ Sv/year	Pečeňady Ratkovce, Žlkovce Ratkovce, Žlkovce	VYZ includes the ventilation chimneys of radioactive waste processing and treatment technologies (TSÚ RAO) + NPP Bohunice A1 + Interim Spent Fuel Storage Facility (MSVP)

The results show that the real effective doses reach less than 1 % of the set limit of guiding value for effective dose for the representative person from the population (and thus are lower by the factor of 4 than doses from natural radiation background).

III.4.4.2.3. Pollution Situation

The following are monitored and analysed for the presence of radioactive substances in the surroundings of the NF in the EBO area:

Aerosols: Aerosols obtained from continuous 14-day sampling at 24 stations, 5of which are directly within EBO site. ^{137}Cs, ^{7}Be are measured with a gamma spectrometric method, ^{90}Sr, ^{239}Pu and ^{240}Pu are measured with a radiochemical method. The recorded values in the surroundings are usually below the minimum measurable (detectable) activity level. The situation is similar within the site itself.

Fallouts: Fallout radioactivity monitored at six selected stations of a teledosimetry system. ^{137}Cs is measured, ^{90}Sr, ^{239}Pu and ^{240}Pu are measured with radiochemical method. The recorded values are usually below the minimum measurable (detectable) activity,

Non-productive soils: The specific activity of grassy soils (^{40}K and ^{137}Cs at various depths, maximums are around 600 $Bq.kg^{-1}$ for natural ^{40}K and35 $Bq.kg^{-1}$ for ^{137}Cs).

Bodies of water: Radioactivity in effluent streams (the channel Manivier leading to the Dudváh and Váh). The activity of ^{3}H, ^{134}Cs, ^{137}Cs is measured. These are usually below the minimal measurable (detectable) activity. The activity of natural ^{40}K in surface waters is on the levels of tenths of $Bq.l^{-1}$ at most.

Other: Furthermore, the radioactivity of milk, rain water, ground water, agricultural products, water plants and sediments is monitored.

Dose rate: Dose rates are continuously monitored on 24 monitoring stations through a teledosimetry system, which monitors the EBO site. The values in the monitored years on these stations were between 60 and 100 nGy/hr, which are standard values in our area outside of the NF impact in the EBO site. For example, the data from dose rate measurement, recorded in 2010 with TLD in the whole territory of the Slovak Republic by the Radiation monitoring network show the average value of 92.9 ± 11.8 nGy/hr.

Geological environment: The monitoring of the radiation situation of groundwater is done in the site through the network of monitoring objects. The monitoring parameters for groundwater (in 2012) were: the volume activity of tritium (^{3}H), volume activity of strontium (^{90}Sr), volume activity of gamma nuclides (^{60}Co, ^{134}Cs, ^{137}Cs, ^{40}K and others), volume activity of alpha nuclides ($^{239,240}Pu$, ^{238}Pu, ^{241}Am), several selected physical and chemical characteristics (pH, overall hardness, conductibility), the level of ground water (in case of underground seepage waters the very presence of water).

From the results of monitoring of the radiation situation of groundwater and their summary evaluation for 2012 is as follows:

Tritium (^{3}H) occurs in the groundwater of saturated layer I. Its volume activity in the geological environment under the NPP Bohunice A1 site[18] is in the order of magnitude values of 10^2 to 10^4 Bq.dm^{-3}. According to the results of monitoring, conducted in the network of monitoring objects, the direction of tritium pollution spreading into the surroundings is practically identical with the direction of groundwater flow. The groundwater of saturated layer II can be considered as not contaminated according to the results of monitoring. Apart from tritium, the groundwater under the NPP Bohunice A1 site contains ^{60}Co in the volume up to 10^{-1} Bq.dm^{-3}. The activity of other artificial radioactive nuclides in groundwater was not detected outside the EBO site.

The groundwater in the remaining part of the monitored area is not radioactively contaminated (<10 Bq.dm^{-3}) with the following exceptions., Groundwater near Dudváh (the result of historical infiltration of discharged waters from Dudváh into groundwater, tritium activities in the TKS-1 drill hole up to 15 Bq.dm^{-3}, in the TKS-2 up to 12 Bq.dm^{-3}, the level of volume activities compared to historically measured results gradually subsides down to the level of natural background) and the area of close surroundings of Socoman, mainly close to its outlet opening into the Drahovský channel (tritium activity in the SK object (practically surface water) up to 390 Bq.dm^{-3}, in SK-6 drill hole (groundwater) up to 65 Bq.dm^{-3}).

The radiation situation in the area of Hlohovec water source and used water sources (wells) in the Leopold area is favourable. Tritium was found above the MDA level (< 4.4 Bq.dm^{-3}), in wells S-1, S-2 and S-3 of the Hlohovec water source: tritium volume activity up to 11.0 Bq.dm^{-3}. In 2012, the tritium volume activity in monitoring objects of the Hlohovec water source (drill holes marked with PxH) was up to 11.5 Bq.dm^{-3}. In this area, the infiltration of source waters from Drahovský channel into surrounding groundwater is occurring (the waste waters from Bohunice NF are released into this channel). The proof of this statement is the registered occurrence of tritium in wells of the Hlohovec water source since 2002.

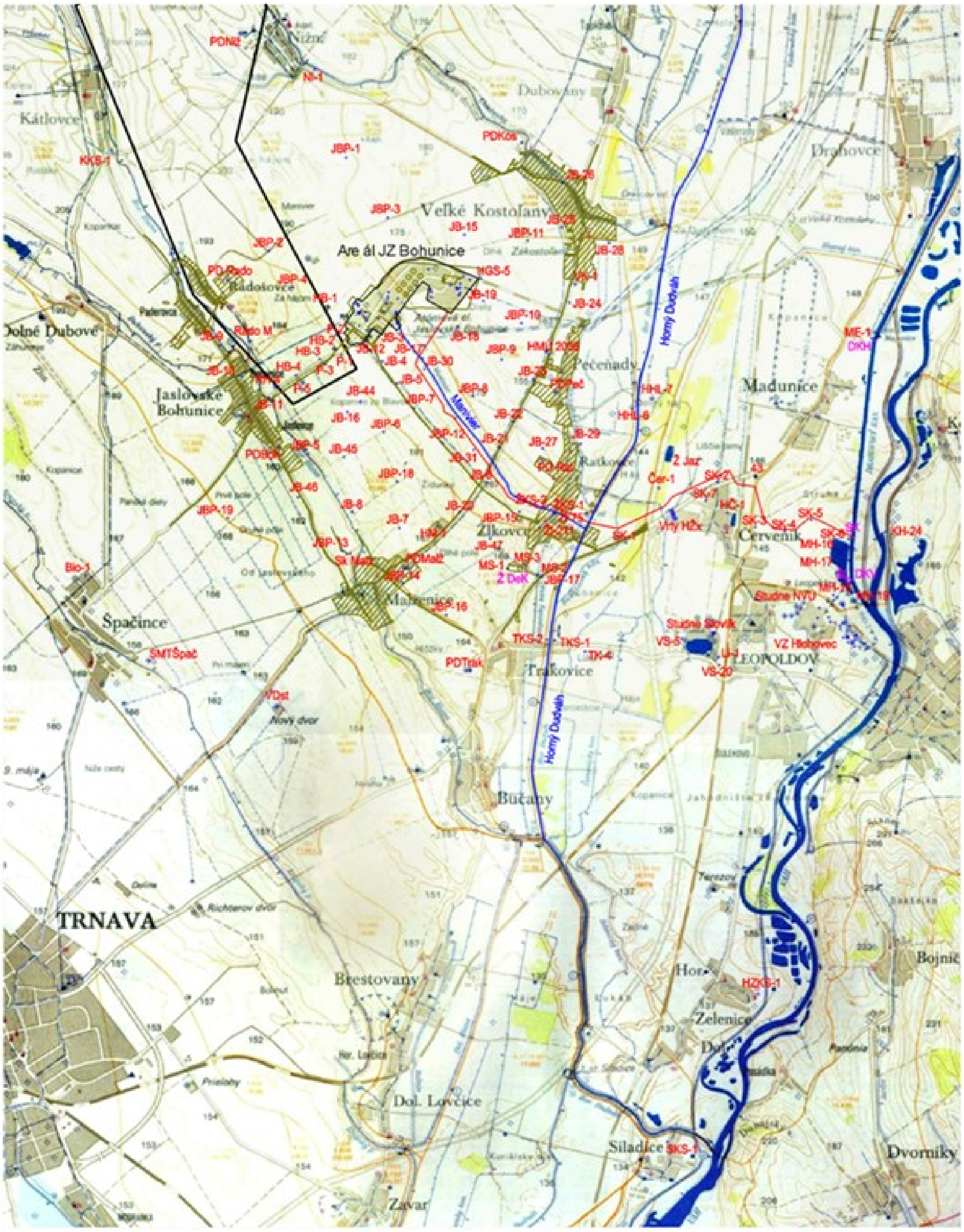
A significant improvement of the radiation situation can be seen in the trend of long-term time development of tritium volume activities in the surroundings of Bohunice NF.

[18] As the source of tritium in groundwater under the NPP Bohunice A1 site was identified primarily the underground storage reservoirs of radioactive waters and other underground storage premises of NPP Bohunice A1.1 The cause was the construction and operation of reservoirs and storehouses corresponding to obsolete safety approaches at the time of planning, construction and operation of NPP Bohunice A1.

The radiation situation in site's groundwater is effectively handled with implementation of remediation measures (remediation pumping) which removes the contaminated groundwater from the geological environment. The flow of residual pollution outside the site is being slowed down. The efficiency of the remediation pumping relative to the defined complex source in NPP Bohunice A1 site was above 86 % by the end of 2012.

The groundwater monitoring system can be clearly seen in the next figure.

Fig. III.6: Groundwater monitoring system



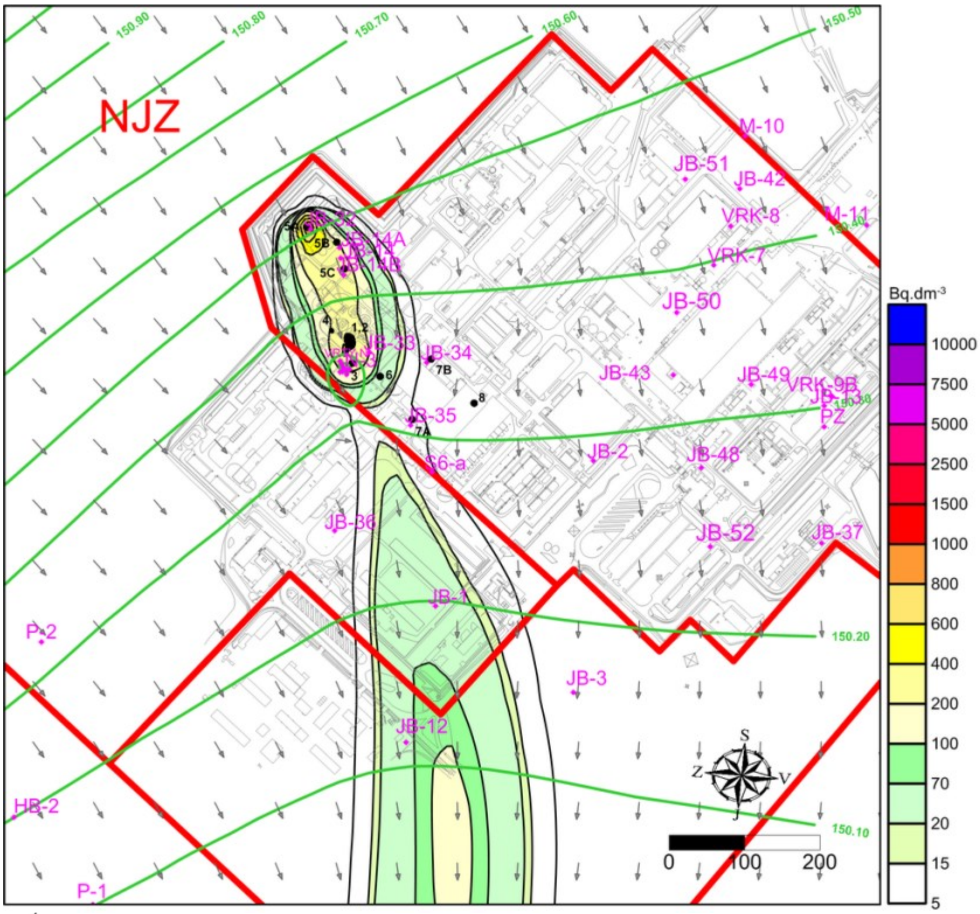
JB-3 Monitoring object - hydrogeological drill hole, well

Through the implementation of long-term redevelopment pumping of groundwater, in operation since 2000 in NPP Bohunice A1 site, the spread of tritium in groundwater outside the source site is restricted in the long term.

The existing radioactive pollution of groundwater in the area of EBO site and its surroundings cannot, even under the maximum conservative conditions (i.e. using groundwater for drinking, irrigation and feeding of animals by the population), cause damage to the health to anyone from the population.

With regard to the surface for locating the NNPP, from the prognosis follows that by 2021 (the year of expected start of construction) the ^{3}H volume activity from current sources of infiltration of contamination into groundwater at the edge of NNPP site will be around 100 $Bq.dm^{-3}$ (see the following figure).

Fig. III.7: Model of the tritium volume activity [$Bq.dm^{-3}$], year 2021, situation with permanent operation of the standard remediation pumping of groundwater from the N-3 monitoring hole



●1	Model contamination penetration
——	Model isoline of tritium contamination [$Bq.dm^{-3}$]
JB-3	Hydrogeological hole, well
⟶	Flow direction of groundwater level
150.20 ——	Model isoline of groundwater level [m amsl]

III.4.5. Further Physical and Biological Characteristics

III.4.5.1. Vibrations

No other significant sources of vibrations are present in the area of concern. No mining works with the use of explosives are executed in the area, the operation of existing facilities in the EBO site does not cause vibrations that would affect the surroundings.

III.4.5.2. Non-Ionising Radiation

It can be legitimately expected that the level of non-ionising radiation (i.e. magnetic or electric field in the vicinity of electric devices) in the publicly accessible space meets the required limits. The objects themselves and facilities for electric power production (generators, transformers, distribution boxes) are located in confined spaces, outside the publicly accessible space. The aerial electric lines conducting the output or reserve feed which run through the publicly accessible space are of standard build complying with the project and safety requirements for these types of devices. .

III.4.5.3. Other Physical and Biological Characteristics

No other significant physical or biological characteristics of the area concerned have been specified.

III.4.6. Surface and Groundwater

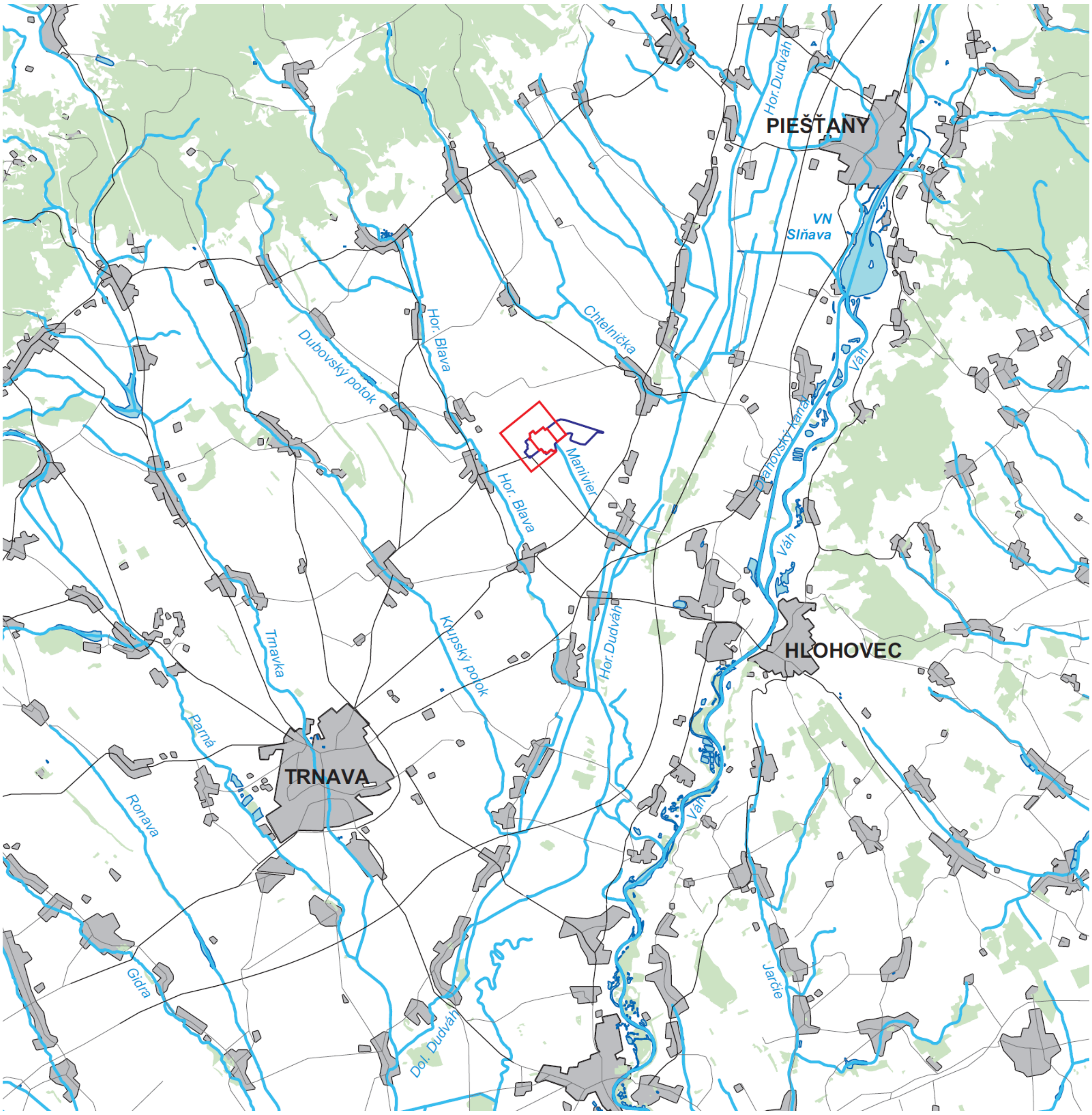
III.4.6.1. Surface water

The area concerned is part of the partial catchment of the Váh river that flows to the east from the area concerned and to the Čierna voda basic catchment. The main erosion base which drains the area with immediate relation to the NF site within the EBO site is the Dudváh river. Its regulated riverbed runs in parallel with the Váh river's bed. Both rivers maintain a north-east flow direction with the Dudváh draining the right-sided tributaries with the northwest-southeast flow direction. Short and steep streams, descending from the slopes of Považský Inovec with the east-west flow direction drain into the Váh. The right-sided tributaries, draining the area with local vicinity of the EBO site are streams rising in the Malé Karpaty, where they have their infiltration areas.

The Dolný Váh flows through a flat area to the mouth into the Danube. Whereas upstream of Žilina, the Váh has the features of a mountain river, downstream of Žilina its slope decreases from 1.3 to 0.7 ‰. Downstream of Nové Mesto nad Váhom, the river runs in a plain, its slope decreases even further down to 0.04 ‰. The lower part of the Váh does not suffer so much from erosion due to lower inclination. Due to insufficient capacity of its own riverbed it was necessary to erect levees on both banks (one meter above the 100-year flood).

The Dudváh is fed from the Malé Karpaty direction by the streams Holeška, Chtelnička, Blava, Krupský stream, Trnávka with tributary Pardá and Gidra and other, less abundant streams. The right-sided tributaries that drain the area concerned are the streams Chtelnička, Blava, Krupský stream and the artificial channel Manivier.

Fig. III.8: Water streams and water areas in the wider area of Jaslovské Bohunice



The most important water reservoir that also serves for the industrial water consumption of NF in the EBO site is the Sĺňava water reservoir. The water reservoir is located in a plain and consists of a dam and a system of right-sided and left-sided embankments on both banks of the Váh. The Sĺňava water reservoir has a surface area of 480 ha, length of 6.4 km, the maximum width of 2 km and can accommodate 12.12 million m^3 of water. Downstream, it is bounded by the Drahovce dam where the flow divides to the Váh's old riverbed and the Drahovský channel, where the Madunice hydroelectric power plant is built. Next to the aforementioned function of water supply for the NF in the EBO site, the Sĺňava water reservoir also serves as a water supply for irrigation, partial reduction of high water flows in Váh riverbed, provides protection to agricultural plots from flooding, protection to municipalities from floods and is used also for recreation, sports and fish farming. The water from water reservoir is pumped through the pumping station in Pečeňady and is used for the NF in the EBO site (and will be also used for the needs of NNPP) for the production of technical and demineralised water.

The following water reservoirs were constructed on some streams in the area: Biela skala (Častá), Blatné and Šenkvice (Šenkvice), Vištuk, Budmerice, Doľany, Suchá nad Parnou, Boleráz, Dolné Dubové, Horné Orešany, Ronava, Buková, Jablonica, Prietrž, Brezová (Brezová pod Bradlom), Chtelnica, Pustá Ves (Pustá Ves), Osuské, Čerenec (Prašník, Vrbové), Sĺňava (Drahovce, Piešťany, Ratnovce, Banka), Striebornica (Moravany n/V.), Slovlik (Leopoldov).

The following ponds are located in the broader area: Hornokrupský, Trnavské, Dechtické, Horná Streda, Lukáčovské, Zálužiansky, Alekšinské ponds.

The water quality in Váh catchment is affected mainly by pollution point sources (industrial and communal waste waters), because the Považie region is one of most developed industrial regions of the Slovak Republic. Also, the effect of regulation of the main river is significant, because it contains a system of power-producing dams and channels.

The quality of surface water in the Váh partial catchment was monitored in 2010 at 98 monitoring points, of which 12 monitoring points were located on the Váh, others on its tributaries and on irrigation and derivation channels. The most important tributary of the Váh, the Nitra river and its tributaries were monitored in 32 monitoring points.

The requirements for the quality of surface water according to Annex No. 1 of the Government Regulation No. 269/2010 Coll., were met for all monitored indicators in 11 monitoring points: Váh - Okoličné, Váh - Hubová, Blatnický stream - Píbovce, Turiec - Vrútky, Krpeliansky channel - Lipovec, Váh - Dubná Skala, Teplička - Omšenie, Váh - Piešťany, Tŕstie - above Stará Turá, Váh - Horné Zelenice, Váh - above Sereď. All cited monitoring points are located on the Váh or on Váh's tributaries, mainly in its upper part, where the impact of human activity is less substantial than in its middle and lower part. It can be stated in general that the quality of water in the Váh is satisfactory (with the exception of isolated $N\text{-}NO_2$ excedences). The smaller tributaries of the Váh are mainly problematic.

Of the Váh's tributaries, the worst state of quality with the highest amount of indicators failing to meet the requirements of Annex No. 1 of the Government Regulation No. 269/2010 Coll., was recorded on the small streams Trnávka (8 indicators failing to meet the requirements in the monitoring point downstream of the Trnava waste water treatment plant (WWTP)), Šárd (8), Jarčie (7), Šteruský stream (7), Salibský Dudváh (6), Cintorínsky stream (6), Bábsky stream (5), Krupský stream (4) and Dubová (3, downstream of Piešťany). The Trnávka monitoring point, downstream of Trnava WWTP, has been on a long-term basis the monitoring place with the worst quality of water. This is caused by a combination of negative factors - an effluent stream with low flow, flowing through an agricultural area and the presence of big urban concentration; moreover, Trnava is also an important industrial centre.

III.4.6.2. Groundwater

Multiple administrative districts in the broader area of interest are characterised by similar hydrogeological features such the type of permeability and the character of groundwater circulation. With regard to hydrogeological regionalisation, the examined area belongs to the following hydrogeological regions or subregions:

- The Váh quaternary in Danubian lowland north of the Šaľa - Galanta line (Q 048);
- The Trnavské hills quaternary (Q 050).

In terms of the Government Regulation No. 282/2010 Coll., establishing thresholds and list of aquifers the area concerned is classified as follows:

- In pre-quaternary formation of SK2001000P Intergranular groundwater of Danubian basin and its projections into the Váh catchment area;
- From the Váh's alluvium in the direction east in quaternary formation SK1000400P Intergranular groundwater of quaternary sediments of the Váh, the Nitra and their tributaries of the southern part of Váh catchment area.

The simplified geological profile of the NNPP site is as follows:

0.0 m - 15.0~29.0 m:	unsaturated zone - the horizon of loesses, loess-like clays, lime clays - without saturation,
15.0~29.0 m - 39.0~46.0 m:	saturated aquifer I - sandy gravels, sands, gravels,
39.0~46.0 m - 50.0 m:	Neogene plastic clays - confining unit,
50.0 m - depth not confirmed:	saturated aquifer II - sands, clay sands.

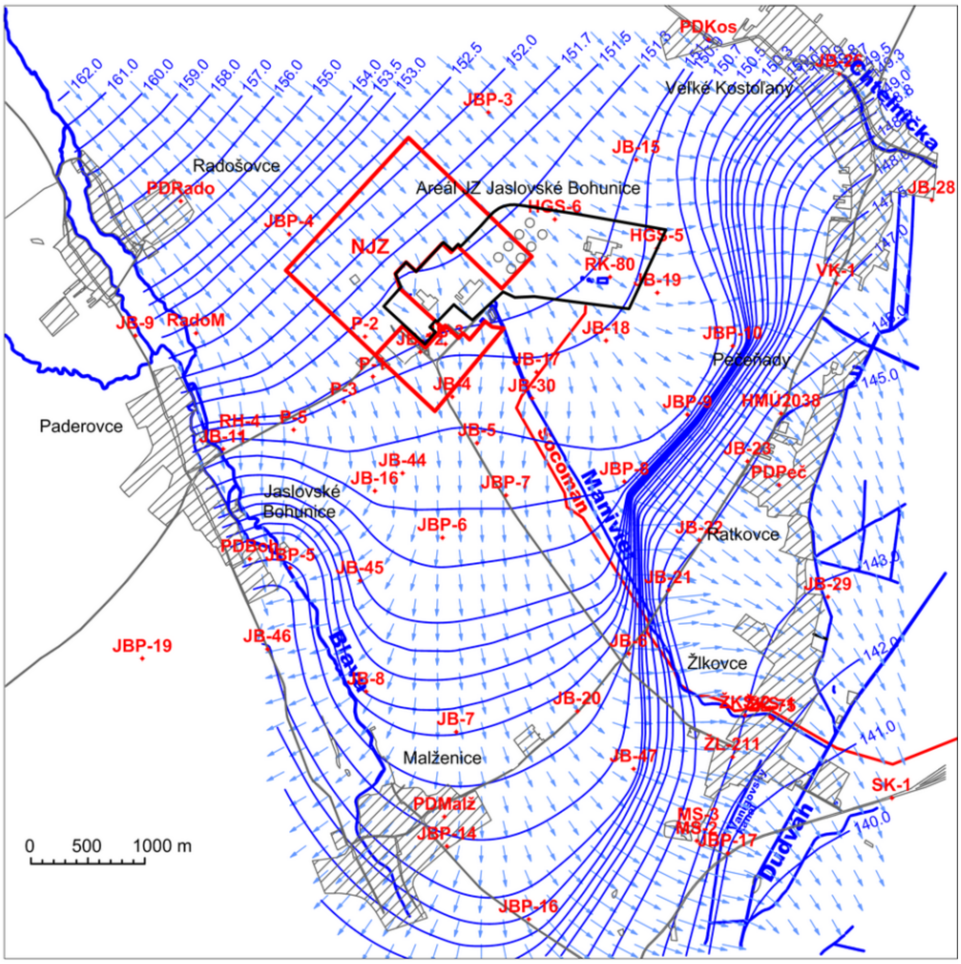
Groundwater in the examined area is located under loess complex in saturated aquifer I of fluvial sediments in lithological development of gravels, sandy gravels and sands. It is a common aquifer of groundwater that contains Váh sediments from upper pannon (or more precisely pont) to the lower part of pleistocene. The aquifer is laterally continuous , with varying thickness. The greatest thickness of the aquifer is in the vicinity of Bohunice NF site, around 26 m, the aquifer pinches out to the south-east and at the edge of alluvial plan it reaches thickness of only 2 m. The shape of the first saturated aquifer copies the morphology of underlying clays that present a hydrogeological insulator. The permeability of intergranular (porous) flow dominates, in the unconfined aquifer. A confined aquifer can be seen only locally, mainly in places where the aquifer is thin.. The supply of groundwater to the first saturated aquifer is probably from the further area at the border of Brezovské Karpaty with Trnava-Dubnica basin in the form of groundwater passing from hills' carbonate rocks to the basin's sedimentary filling. Partial infiltration from surface waters can be expected in places through the erosive base of streams cut into the basin. The areal infiltration from precipitation through loess sediments is negligible.

A monitoring system was built in the EBO site and its surroundings which provides the monitoring of the regime and the comprehensive monitoring of groundwater quality of the I. (and in some cases also the II.) saturated aquifer as well as monitoring the status of the engineering barrier in the whole industrial complex of the EBO site.

The groundwater level of the I. aquifer is located in various depths, depending on the morphology of the terrain's surface. In the area of ridges of the hills it is up to 40 m below the surface. In the area of right-sided tributaries of the Dudváh the level is within a depth range of approx. 2.7 m to 9.9 m below the surface and 0.8 m to 4.2 m below the surface in the area of Váh alluvial plan. The area of the EBO site is characterised by groundwater levels at the elevation of 150 to 152 m msl, which is 19 to 21 m below the surface. The flow of groundwater in the area of the NPP Bohunice A1 has been affected over the long term (since 2000) by remediation pumping of groundwater.

The flow of groundwater of the I. saturated aquifer is shown on the following figure.

Fig. III.9: Countours of groundwater level - of EBO site and its surroundings, as of the 15th August 2012



1.7E-014 0.03 Flow direction of groundwater and groundwater gradient level

152.00 Measured contours of groundwater level

JB-3 Monitoring object - hydrogeological drill hole, well

Selected physical and chemical characteristics (pH, overall hardness, conductibility) are monitored in groundwater according to approved monitoring programmes. The monitoring of certain secondary indicators (e.g. chemical oxygen consumption or concentration of non-polar extractable substances) in groundwater near certain objects that can negatively affect the water quality (i.e. oil management, fuel storage, etc.) is not conducted. Based on the results of monitoring of selected physical and chemical characteristics of groundwater in the monitoring holes of the concerned area for the period of 2006 to 2012 varied as follows: the pH values ranged from 6.32 to 7.98, the overall hardness values ranged from 1.59 to 6.15 mmol.dm^{-3} and conductibility values from 327 to 1,210 μS.cm^{-1}.

With regard to hydrochemical classification (Gazda's classification), the common groundwater in the area concerned can be characterised as basic, distinct calcium-(magnesium)-bicarbonate chemical groundwater type. Monitoring works documented increased indicators, such as iron and manganese of geogenous origin and increased content of nitrates, caused mainly by agrochemical treatment of the soil.

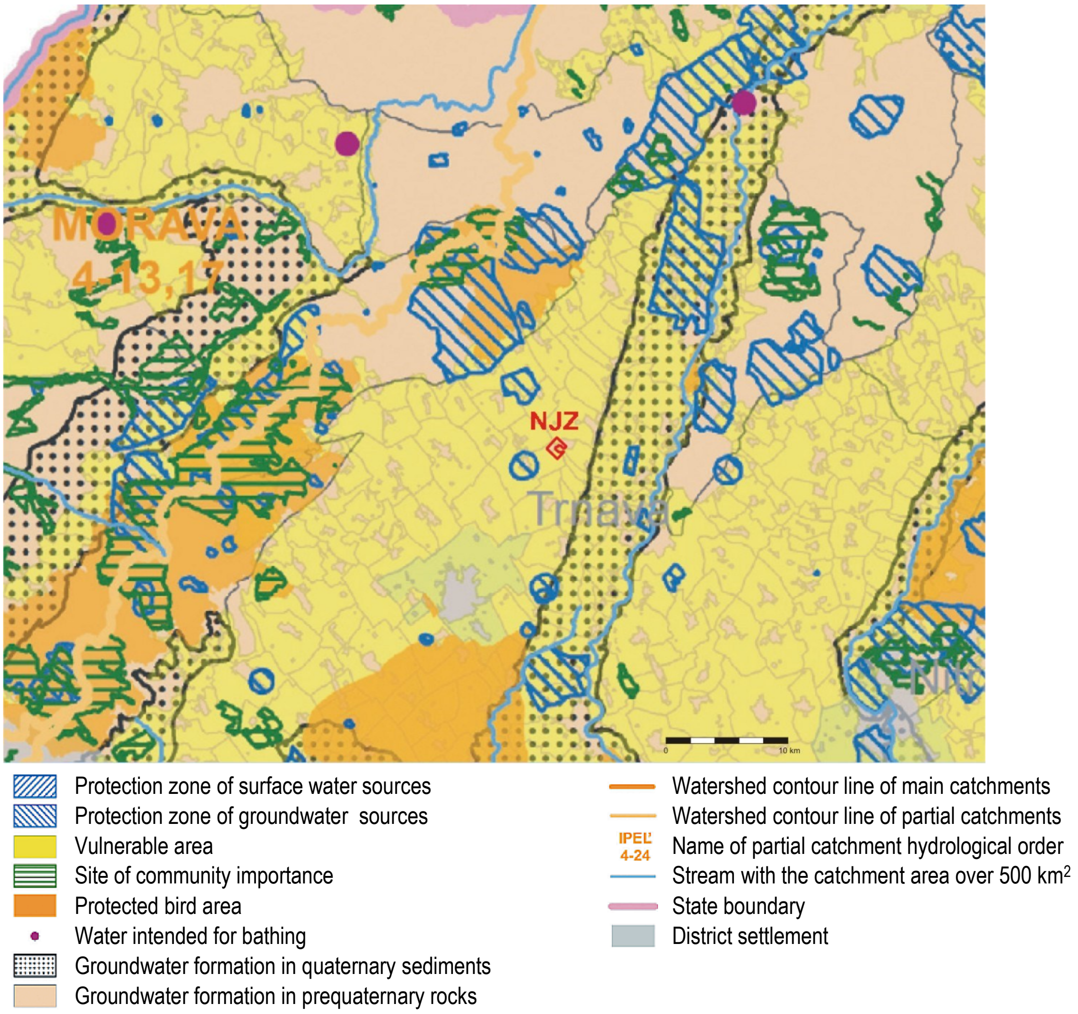
There are no sources of groundwater utilized in the area concerned. The EBO site is supplied with potable water from two branches of TaVoS Piešťany distribution line, these sources are located outside the evaluated area.

Four wells HB1 to HB4 are located in the space between the Jaslovské Bohunice municipality and the EBO sites. These were designated in the past to supply NPP Bohunice A1 with potable water but are not used today. Their protection is ensured with the protection zone of 1st. level.. The eventual protection of these HB wells will have to be solved based on results of the detailed site survey phase and based on the valid decisions of designated water rights authority.

Close to NNPP the wells of farm cooperatives (PD Veľké Kostoľany, PD Radošovce, PD Nižná, PD Pečeňady, PD Jaslovské Bohunice, PD Malženice, PD Ratkovce) are in use. These wells have protection zones established and are used in compliance of the respective permits issued by water rights authority., Wells for Slovenské liehovary a likérky, a.s. Leopoldov, ÚVTOS Leopoldov and mainly TaVoS Piešťany (Hlohovec water source) are also located in the remote area (10 - 15 km from NNPP) in relation to the future release of waste waters from the NNPP. These wells have protection zones established and are used in terms of the respective permits issued by water rights authority.

Protected water management areas (according to www.vuvh.sk) are shown in the following figure.

Fig. III.10: Protected water management areas and zones of hygienic protection of wider area concerned



III.4.7. Soil

III.4.7.1. Soil Characteristics

Most of the soil-forming substrates in the wider area of interest consist of pleistocene and holocene rocks. The soil-forming substrate in part of the area concerned, included in the Trnavská plain, consists of loesses, in the Malokarpatská hills of loess loams. The Dolnovážska alluvial plain is constructed by another soil-forming substrate - carbonaceous alluvial sediments. There can be found a wide range of soils in the area concerned, from black earth to illimerised soils and in the Váh's alluvial plan also a range of hydromorphic soils.

The *soil type* is the basic identification unit of morphogenetic and agronomics soil classification.

It includes the soil group characterised by the same stratigraphy of soil profile, i.e. certain combination of diagnostic horizons as the result of qualitatively specific type of soil-forming process that developed and is developing in the same hydrothermal conditions under approximately the same vegetation. Soil types in the remote area of interest are represented by various generic and often transitional forms. Brown earths are the most common prevailing types at the western edge. A substantial part of the Trnavská plain's area is covered by black earth. The right-sided bank of Váh (Dudváh alluvial plain) and stream valleys are filled by mollic fluvisols, which are the third most significantly represented type. The presence of fluvisol is typical for the narrow part of Váh alluvial plain. Rendzinas and pararendzinas are developed at the edges of Malé Karpaty and Považský Inovec mountain ranges,, mainly unsaturated cambisols and litosols. The humus content in soils in the vast majority of the area concerned is high (more than 2.3 %), soils with medium humus content (1.8 - 2.3 %) are less present. Another group are soils of urban areas (of municipalities, EBO site) where the soils are historicaly and intensively anthropogenically altered. The original soil types were modified, transformed, occasionally they have the characteristics of soils. Anthropogenic soils that are represented by soils intensively cultivated or long degraded or completely destroyed, were created through man's intervention into natural soil-forming processes.. With regard to soils, In the area concerned and its surroundings, the anthropogenic and anthropogenically affected soils are typically the anthrosol, in fills and in anthropogenically affected agricultural soils.

Soils are divided into so-called *soil classes* according to the percentage content of individual grain size fractions. With regard to the soil classes, mainly medium heavy loam soils are most common in the remote area of concern, occasionally sandy-loam or clay-loam soils can be found in the form of small islands, clay-loam soils are present in the narrow area of Váh alluvial plain.

The basic soil mapping and appraisal unit are *estimated soil-ecological units (ESEU).* They were created on the bases of a simplified special-purpose categorisation of climate, soil types, gradient, exposure to cardinal points, stoniness, soil depth, grain and soil-forming substrates. According to the Act No. 220/2004 Coll., on protection and use of farmland, the agricultural soils are classified into 9 quality groups according to ESEU. The highest quality soils belong into the group 1 and the poorest quality soils belong into the group 9. The following ESEU are present in the area for siting and construction of the NNPP: 0144202, 0147202, 0139002, 0139202, 0143002, 0143202. The predominant part of the area affected by construction includes ESEU in soil quality group 2 and 3, i.e. groups with high production capacity (high value), part of the soils represent ESEU in soil quality group 6, i.e. groups with medium production capacity.

The *soil gradient* is an important physical parameter that significantly affects the quality and way of using the soil in a particular area. With regard to soil gradient and exposure, the affected soils are classified in code 0 (plain without the manifestation of areal water erosion 0° - 1°) and code 2 (slight slope 3° - 7°).

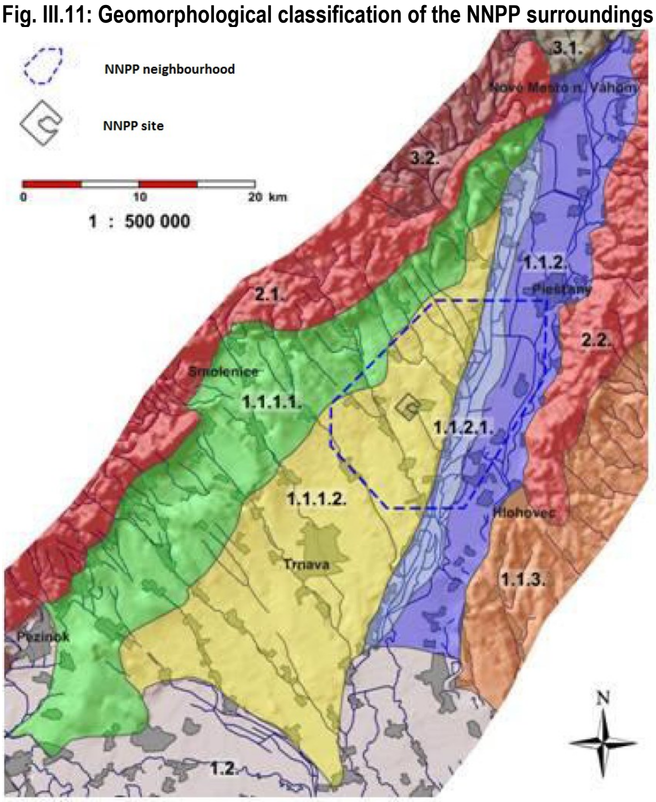
Despite that the affected area is characterised by high level of agricultural activity, with regard to *soil pollution* caused by agriculture, it is one of the least polluted areas in the Slovak Republic.

III.4.8. Rock Environment and Natural Resources

III.4.8.1. Geomorphologic Characteristics

The surroundings of the NNPP site reaches into geomorphologic units of Danubian hills and Danubian flatland, defined on the edges by morphostructures of Small Carpathians and Považský Inovec, in north it touches the Váh valley land. The area is part of the Danubian hills unit, Trnava hills and Lower Váh alluvial plain subunits. The Trnava hills further divides into parts of Trnava plain and Podmalokarpatské hills.

Fig. III.11: Geomorphological classification of the NNPP surroundings



Area	Unit	Sub-unit	Part
Danubian lowland (1.)	Danubian hills (1.1.)	Trnava hills (1.1.1.)	Podmalokarpatské hills (1.1.1.1.)
			Trnava plain (1.1.1.2.)
		Lower Váh alluvial plain (1.1.2.)	Dudváh water meadow (1.1.1.3.)
		Nitra hills (1.1.3.)	
	Danubian flatland (1.2.)		
Fatra-Tatra area (2.)	Small Carpathians (2.1.)		
	Považský Inovec (2.2.)		
Slovak-Moravian Carphathians (3.)	Váh valley land (3.1.)		
	Myjava hills (3.2.)		

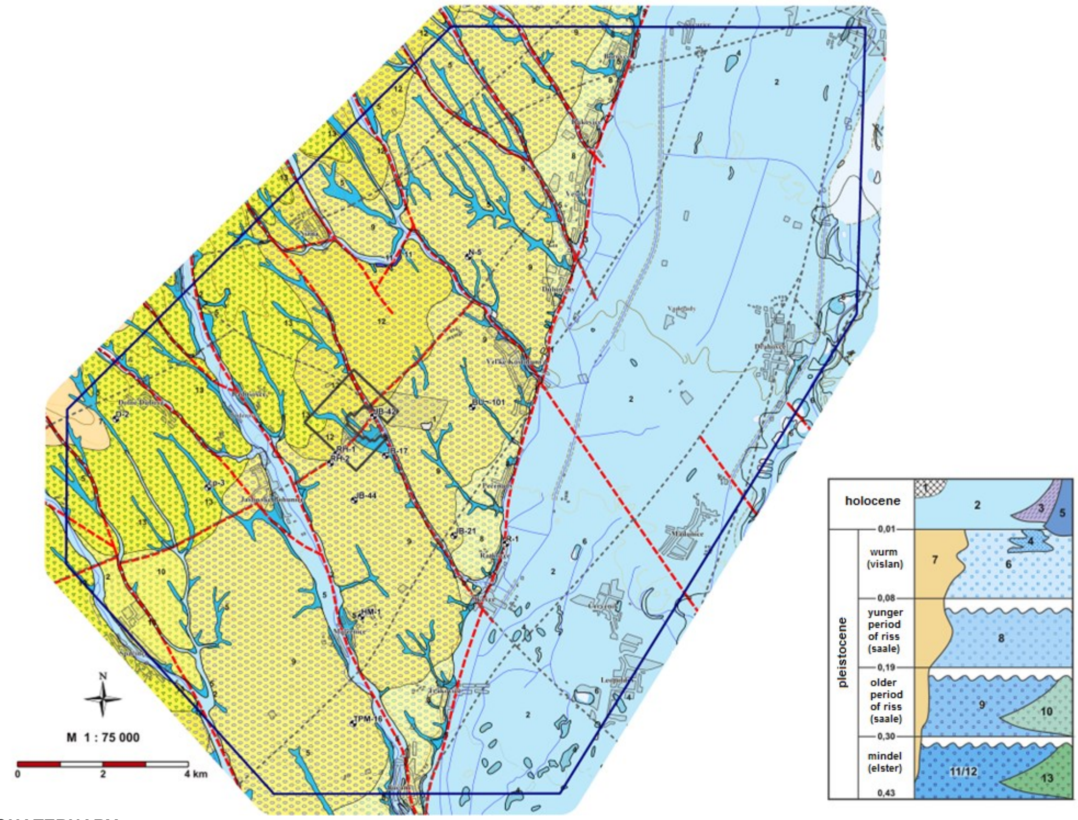
The altitude of the terrain in the wider area of the NNPP site ranges from 135 to 210 m above the sea level. The most distinct positive morphostructures in the area are the core mountains Malé Karpaty and Považský Inovec. The Trnava plain, comprising a significant part of the NNPP site's surroundings, is characterised by a less rugged topography. It has a flat, slightly undulated surface with slope inclination up to 2°. The eastern part of NNPP's surroundings comprises of the Lower Váh alluvial plain with fluvial plain relief with minimal segmentation.

Streams of Trnava hills are drained by Dudváh, belonging to the Váh catchment. The NNPP site's surroundings interferes in the area of Trnava hills the valleys of the streams of Krupský stream, Dubovský stream, Horná Blava, Manivier, Chtelnička, Lopašovský stream, Lančársky stream and Šteruský stream.

III.4.8.2. Geological Conditions

The NNPP site's surroundings is part of the Blatno depression, which is the northern projection of Danube basin as part of the Pannonian basin system. According to the regional geological classification, the Blatno low ground (depression) is the geological unit of the lowest order and is part of Trnava-Dubnica basin and Danube basin. The Blatno depression is a Neogene morphostructure with the most dynamic period of development in baden period. The basin's pre-tertiary substrate, its Neogene sedimentary filling and the areally extensive quaternary rock cover form in the geological structure of the basin.

Fig. III.12: Geological map of the NNPP surroundings



QUATERNARY

Holocene

1 Anthropogenic sediments: backfills, spoil banks, landfills

2 Fluvial sediments: unsegmented accumulations of valley alluvial plains and alluvial flats of streams, loams, sands, gravels

Pleistocene - Holocene

3 Proluvial sediments: mostly loams and sandy loams with fragments of rocks and gravels in sediment deposits of floodplain cones

4 Fluvial sediments: sands and sandy gravels of aggradation ramparts

5 Deluvial, deluvial-fluvial and deluvial-proluvial sediments: hillwash loams, rocky dejection , deluviums and detritus

Pleistocene (würm)

6 Fluvial sediments: gravels, sandy gravels and sands of basal accumulation in low terraces

7 Aeolian and aeolian-deluvial sediments: loesses, loess loams and loess-like soils

Pleistocene (early riss)

8 Fluvial sediments: gravels and sandy gravels of lower middle terraces with cover of loesses and undifferentiated clays

Pleistocene (late riss)

9 Fluvial sediments: sandy gravels and gravels of upper middle terraces with cover of loesses and undifferentiated clays

10 Proluvial sediments: loam and sandy loam gravels and with fragments of rocks of middle alluvial fans with cover of loesses and undifferentiated clays

Pleistocene (mindel)

11 Fluvial sediments: gravels, sandy gravels and residual gravels of undifferentiated accumulations of younger terraces

12 Fluvial sediments: gravels, sandy gravels and residual gravels of younger terraces' accumulations with cover of loesses and deluvial outwashes

13 Fluvial sediments: loam to sandy loam gravels and with fragments of rocks in middle alluvial cones with cover of loesses and deluvial outwashes

Assumed fault, active during Neogene

Assumed fault, active during Quaternary

BU-101 Drill hole

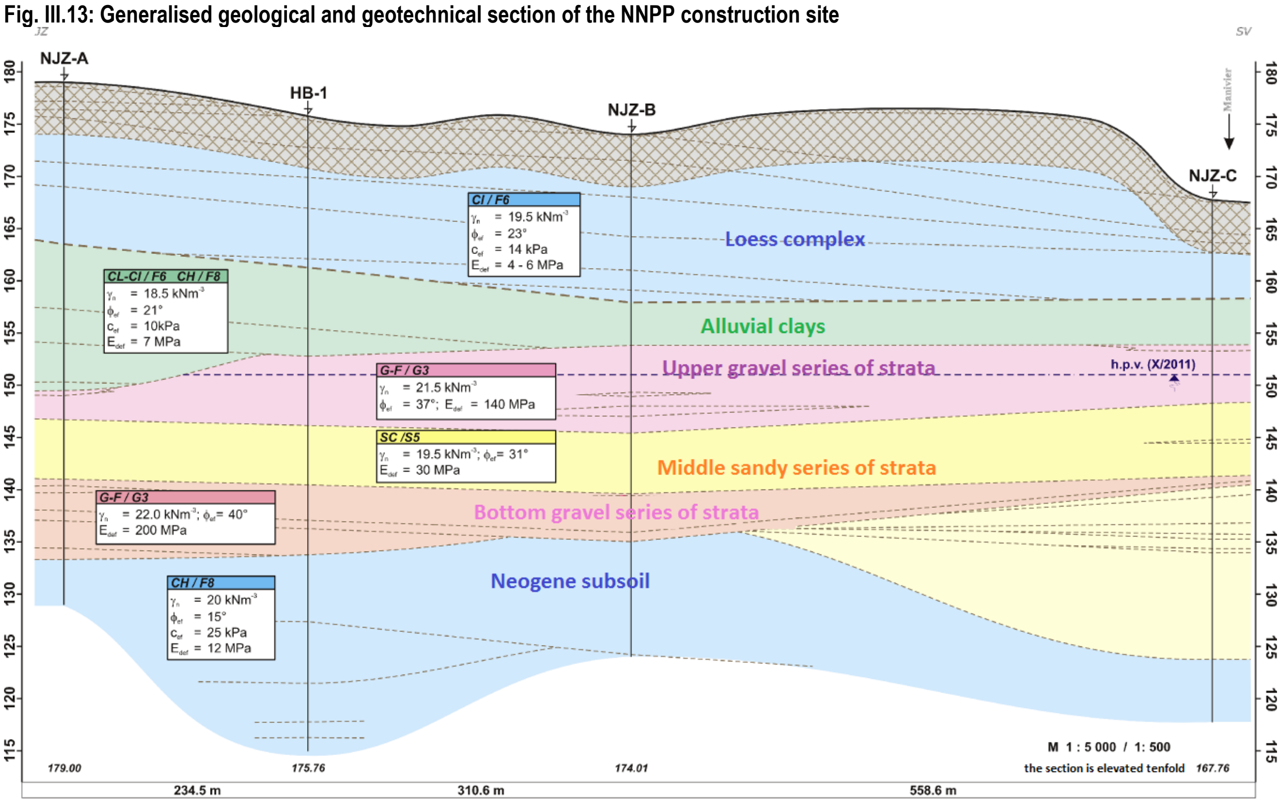
The pre-tertiary subsoil has no direct relation to the NNPP site itself. The tertiary basin filling rises on the terrain's surface in considerable distance from the area concerned (at the margin of the Brezovské Karpaty and in a few isolated cases on high points near Horné Dubové or on Šarkan near Boleráz). The lower to middle Miocene, upper Miocene to dak and the period ruman - pleistocene are substantial developmental phases of the basin.

The NNPP site's geological profile is characterised by the presence of the loess complex, underlain by the body of river sediments and Neogene subsoil. The profile was examined to the maximum depth affected by the ultimate assumed additional load of future NNPP objects, i.e. to approx. 50 m. It is basically divided into three sets:

- fine-grain soils above the gravel layeres: horizon of loesses and alluvial clays;
- grains and sands set: upper gravel, middle sandy and lower gravel formation;
- underlying set of Neogene sediments.

The basic geotechnical parameters of individual sets are shown in the following generalised section.

Fig. III.13: Generalised geological and geotechnical section of the NNPP construction site



Groundwater is accumulated in the aquifer comprised of gravels and sands. The fine-grain soils above the gravel layers and the Neogene subsoil are hydrogeological aquitards The free level of groundwater oscillates around 150 - 151 m above the sea level, or around 22 - 23 m below the surface. The level is slightly depressed under the level of gravels and superficial alluvial clay structures interface.

selected geodynamical phenomena, the presence of which can be theoretically predicted in given region are important to evaluate potential external risks in the NNPP site . A specific process that can be induced by seismic load is soil liquefaction. The occurrence of slope deformations or other manifestations of foundation ground instability and risks of flood phenomena are the main exogenously generated processes of concern. . Commentary on those phenomena:

Landslides:	Given the low energy of relief, the occurrence of slope movements in the area of Blatno depression is rather rare. Landslides are mainly located at the in edge of the depression adjacent to the core mountains not closer than 10 km to the NNPP site.
Erosion:	Current water and wind erosion is negligible within the Blatno depression .. The territory lies within the area with insignificant to no erosion.

Seismicity: The occurrence of earthquakes and their potential effect on the perspective construction site of NNPP is evaluated below, in a separate chapter.

Volume unstable soils (soil collapse rate): The presence of collapsible soils in the area is not ruled out. The term collapse means an abrupt reduction of volume due to water soaking or loading. Because possible soil collapse is a potential risk for construction objects with footing bottom in loesses, this characteristics was examined and will be taken into account during foundation construction.

Soil liquefaction: A specific type of instability in loose soils is the possibility of soil liquefaction during shock stress. No evidence of liquefaction potential was found for any soils from the foundation ground profile.

Exogenous processes: In the evaluated area, erosion, hillwash and aeolian processes and processes induced by the groundwater flow can be active. The effect of said processes is not relevant for the design of new objects of NNPP.

Tectonic faulting: According to the published map documentation, two fault lines, classified as quaternary in terms of age, meet southeast of the NNPP site. The younger fault has the northwest-southeast direction and its course corresponds with the Manivier channel's line and with the course of an older pre-quaternary covered fault. The older fault line has a northeast-southwest direction. The fault is disrupted by the passing fault and similarly it copies the older - prequaternary and at the same time covered fault division. The fault's activity in the quaternary period is not obvious from its course because it does not separate observed quaternary or pleistocene rock complexes in any way. The fault's activity cannot be deduced even from differences in the thickness of loess sediments and terrace sediments (or fluvial gravels and sands) interpreted on the basis of drilling works. Similar arguments can be applied also in case of the older quaternary fault line shown in the EBO site. This line neither separates rock layers of upper and middle terrace sediments (middle pleistocene in terms of the cited map), present in the NNPP site's subsoil, whereas on the contrary, the shown layer covers the fault line.

It can be noted from the geological surveys conducted that the fault lines running near the NNPP site could not be active in the period after the middle pleistocene, which is a period of approx. 780 thousand years. At the same time, no correlation could be found of said lines with fault that were indicated based on the interpretation of shallow and medium deep structural survey in the area. New results of geological surveys from given area support the above mentioned statement. The minimum age of the sediments of the alluvial complex (intact superficial gravel structure) is approx. 830 thousand years, while many data point to significantly higher ages up to the lower boundary of the pleistocene. These id data suggest tectonic inactivity in the surroundings of NNPP site at least from the period of 780 ~ 830 thousand years until the present.

III.4.8.3. Hydrogeological Conditions

Neogene structures: With regard to hydrogeological regions, the region N 049 Neogene of Trnavská hills has a total area of 453 km^2 and a total utilisable amount of groundwater of 151 l.s^{-1}. The hydrogeological complex of Neogene basin structures of the Blatno depression is characterised by sediment with variable porous permeability with low values of hydraulic gradients with varying more and less permeable environment. The most important unit with regard to permeability is the youngest Neogene hydrogeological unit - fluvial gravels and sands with position of clay sands and clays of Pliocene (or even upper-Pannonian) age, which is classified with Volkovské and Kolárovské strata.

Quaternary structures: With regard to hydrogeological regions, it is the region Q 050 Quaternary of Trnava hills with the total area of 480 km^2 and a total utilisable amount of groundwater of 661 l.s^{-1}. The layer of quaternary sediments is divided into genetic types with individual characteristics. The superficial formation of aeolian sediments is defined based on quite different properties.

Aeolian sediments: Loesses and sandy loesses of Pleistocene age are the dominant surface unit in Trnava hills.

Given its granular nature with a prevalence of silt with an addition of sand and clay, they are poorly permeable and create on the terrain's surface a regional hydrogeological aquitard with minimal saturation.

Proluvial sediments: Sandy gravels with fragments of rocks, creating alluvial cones and fans, are spread the most near the edge parts of mountains. Their presence within the NNPP site is unlikely.

Fluvial sediments: The hydrogeological unit of fluvial sediments consists of mainly loamy gravel sands covered by loesses or loess loams and Váh's alluvium. This unit was conventionally classified as multiple generation pleistocene river terraces. According to newer data it is part of Pliocene (except for the recent Váh's alluvium). The fluvial sediments unit was evaluated within the area of Trnava hills with a total of 148 hydrogeological drill holes. The mean value of flow rate coefficient(transmissibility) was determined to be T = $2.3.10^{-4}$ $m^2.s^{-1}$, the mean value of filtration coefficient ranges around $3.7.10^{-4}$ $m.s^{-1}$.

The upper pleistocene and Holocene gravel-sandy sediments of river alluviums in alluvial plains of local streams, predominately the effluent stream of the Váh, were the primary potable water supply in the past for supplying the population.. 386 hydrogeological drill holes and hydrodynamic tests were evaluated In the region,. The mean value of flow rate coefficient (transmissibility) was determined to be T = $3.5\ .10^{-2}$ $m^2.s^{-1}$, the mean value of filtration coefficient ranges very high, approximately $1.2.10^{-2}$ $m.s^{-1}$.

III.4.8.4. Seismicity

Analysis of the seismic risk for the EBO location was performed in 1996 - 1998 in compliance with the safety guideline IAEA 50-SG-S1 (Rev. 1). The analysis contained the probabilistic calculation of seismic threat for the location. The probabilistic calculation considered horizontal peak ground acceleration (PGA) and the horizontal component of the response spectrum in apparent acceleration (PSA) as the characteristics of seismic ground movements.

The calculation determined the values for PGA and PSA for return period of 475 years (corresponding to the level SL-1) and for the return period of 10,000 years (corresponding to the level SL-2). The basic output of the analysis of seismic threat for the EBO location were the values of horizontal and vertical accelerations for level SL-2 in values PGA_{RLE-H} = 0.344 g (for the horizontal component) and PGA_{RLE-V} = 0.215 g (for vertical component). These values are considered to be finally valid for the EBO site up to date and are accepted by ÚJD SR.

During the preparation stage of the NNPP project a new probabilistic calculation of seismic threat to the location was prepared using updated IAEA safety guidelines (particularly document SSG-9 Seismic Hazards in Site Evaluation for Nuclear Installations, 2010). It considers all the basic input sets, such as a new seismologic database and earthquake catalogue, geological database, seismotectonic model, selection of predictive equations of seismic movement, and a logical tree for probabilistic calculation of seismic threat is designed.

The seismologic database together with geological database creates a set of input data necessary for probabilistic calculation of the characteristics of the seismic threat to the NNPP site. The seismological database was compiled for the so-called NNPP region (a symmetric area with radius of 305 km from the NNPP site). This NNPP region includes parts of the territory of the Slovak Republic, Hungary, Austria, the Czech Republic and Poland and it reaches as far as Germany, Slovenia, Croatia and Serbia.

The compiled seismological database contains data about 9142 earthquakes which were macroseismically felt and/or seismometrically measured (by a device) in the NNPP Region between the years 350 to 2011. Earthquake in the database are characterized by data about its time, location, size and their uncertainty. The compiled seismological database was standardized to aunified variable determining the size of earthquake, the moment magnitude M_w. The standardized seismological database (earthquake catalogue) contains data on 2,652 earthquakes a minimum moment magnitude, $M_{w,}$ higher than or equal to 1.5. The map of earthquake epicentres included in the catalogue with moment magnitudes marked is shown in the following figures.

Fig. III.14: The map of earthquake epicentres in the NNPP region with moment magnitudes marked

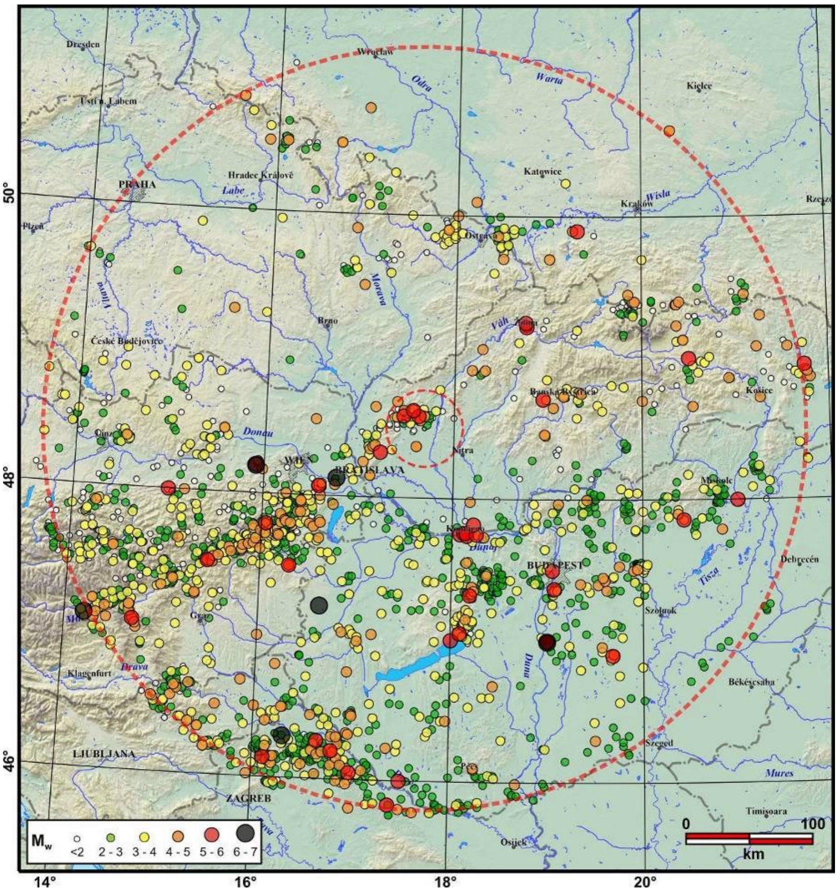
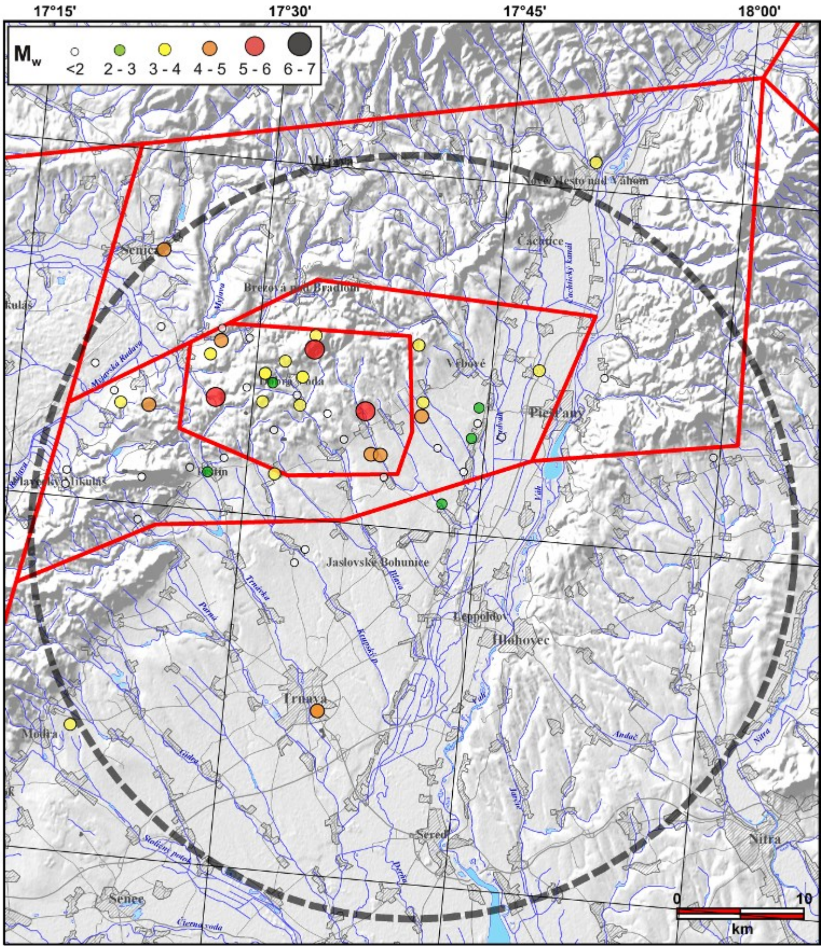


Fig. III.15: The map of earthquake epicentres and reservation of source zones in the vicinity of NNPP with moment magnitudes marked



The probabilistic calculation of seismic threat return for the NNPP will contain results for a return period of 475 years (SL-1), and a period of 10,000 years (SL-2). These values will be considered in the NNPP project design and related permit procedures.

III.4.8.5. Natural Resources

Energy raw materials: The Blatno depression was the subject of various phases of hydrocarbon deposit surveys In the period between 1950 and 1970. The result of surveying works was the identification of several deposits of flammable natural gas without real economic use. But a vast database of primarily drilling and geophysical data were used in tasks related to the EBO site and the NNPP site originates from the said phases of geological works. The deposits of natural gas and non-bituminous gases are localised on Baden age sediments. In general, they are non-commercial deposits without economical potential.

Geothermal waters: A specific type of raw energy material are geothermal waters whose presence can be linked to carbonate formations of Tatricum age and superficial covers (Fatricum and Hronicum), eventually on part of miocene sedimentary filling. Today, such water types are used in the remote area to minimum extent and there is no real expectation for their broader use in near future. No geothermal drill holes are in use in the vicinity of the NNPP site. The assumed unit yields of potential drill holes do not create economic conditions for their development.

Non-metallic raw materials: Deposits of non-metallic raw materials are located outside the surroundings of the NNPP site on the edges of Malé Karpaty and Považský Inovec.

They are part of pre-tertiary geological formations. No deposit is present on the NNPP site. In the wider area, 3 deposits of dolomite (Hrádok, Lúka and Hubina) and one deposit of decorative stone (Chtelnica - Malé Skalky) and feldspars (Hlohovec) are recorded.

Construction raw materials: Only the deposits of construction raw materials have economic importance, but also without presence with the NNPP site. Deposits in the remote area consist of gravel sands in Váh's alluvium (Nové Mesto nad Váhom, Hubina, Hrádok, Beckov - Prúdiky, Hlohovec - Svätý Peter, Madunice and Koplotovce), deposits of construction stone (Moravany, Lúka II. and Jalšové) and deposits of brickmaking raw materials (Boleráz and Hlohovec).

III.4.9. Fauna, Plant Life and Ecosystems

III.4.9.1. The Biogeographical Characteristics of the Area

Under the *zoogeographical classification - terrestrial biocycle* (Jedlička, Kalivodová in Atlas krajiny SR, 2002), the eastern part of the remote area can be classified in the Pannonian section (steppe province) and the western part of the area into the deciduous forest province (subcarpathian section). With regard to the limnic biocycle (Hensel, Krno in Atlas krajiny SR, 2002), the area falls into the Ponto-Caspian province, Danubian district and Western Slovakia part.

Under the *phytogeographical and vegetational classification* (Plesník in Atlas krajiny SR, 2002), the area is part of the oak zone, plain sub-zone, hills area, Trnava hills district, the western part of the wider area of interest is part of the Podmalokarpatské hills sub-district, and the eastern part is part of Trnava plain. In addition part of the Lower Váh plain and Dudváh water meadow sub-district and Váh alluvial plain sub-district reaches into the area.

The *geobotanical division of the area*, i.e. distribution of climax plant communities with the respective zoocoenoses and microbiocoenoses attached, expresses the primal structure of the land and depicts all original units of the ecosystem biodiversity (diversity at the level of ecosystems), is taken from the Geobotanical map of the Slovak Republic (Michalko et.al., 1986). This map presents a map display of reconstructed vegetation. The following units were reserved in the remote area concerned according to the geobotanical map:

Lowland bottomland forests: They contain hygrophilous and meso-hygrophilous forests growing on alluvial sediments along water streams, pertaining to the subaliance Ulmenion. The herbaceous undergrowth is relatively rich in species.

Submontane and montane bottomland forests: They are bound to alluviums of streams, underlain by flowing groundwater or often affected by floods. Hygrophilous and nitrophilous species prevail in the herbaceous floor.

Pannonian oak - hornbeam forests: The European oak absolutely dominates the natural vegetation of lowland oak forests. The most important mixed tree species is Turkey oak. The occurrence of hornbeam is low in most types, it is more frequent only on wetter places.

Oak and Turkey oak forests: The are mostly on areas of extreme relief, such as mountain ridges and crests, steep slopes with southern exposure and similarly on alkaline to neutral grounds. These oak forests reach deeper into Carpathian mountains on limestones and dolomites in the form of enclaves and reach up to the height of 500 m above the sea level. Together with rocky grassy communities they usually create one complex, mainly in the areas heavily affected by pasture and karst areas, where they are in the form of low dwarfed and thick overgrows with small islands of steppe and rocky grassy communities and bushes.

Willow - poplar bottomland forests: Closes to the river bed is the soft meadow, comprised of various types of willows (mainly white willow and crack willows), domestic types of poplars and European alder. Further from streams the soils are drier, the groundwater level is deeper and floods occur only sporadically. More often the water logging of soils with increased groundwater level occurs. These places would be quite dry without additional groundwater and common zoned forests would grow there, i.e. forest of the surrounding vegetation level (oak forests to beech oak forests).

But due to the influence of water stream, a firm meadow developed here, i.e. a forest comprised of English oak, ash (common ash and / or narrow-leafed ash), ulmus minor, and in lower elevation also with hornbeam, field maple, linden and other woods. The economic importance of these vegetations is significant and was maintained (perhaps even increased) after their transformation into poplar plantations - but the originally varied production of valuable varieties changed to quantitative production of poplar logs. The herbaceous cover of these forest is varied.

III.4.9.2. Protected Areas, Natura2000

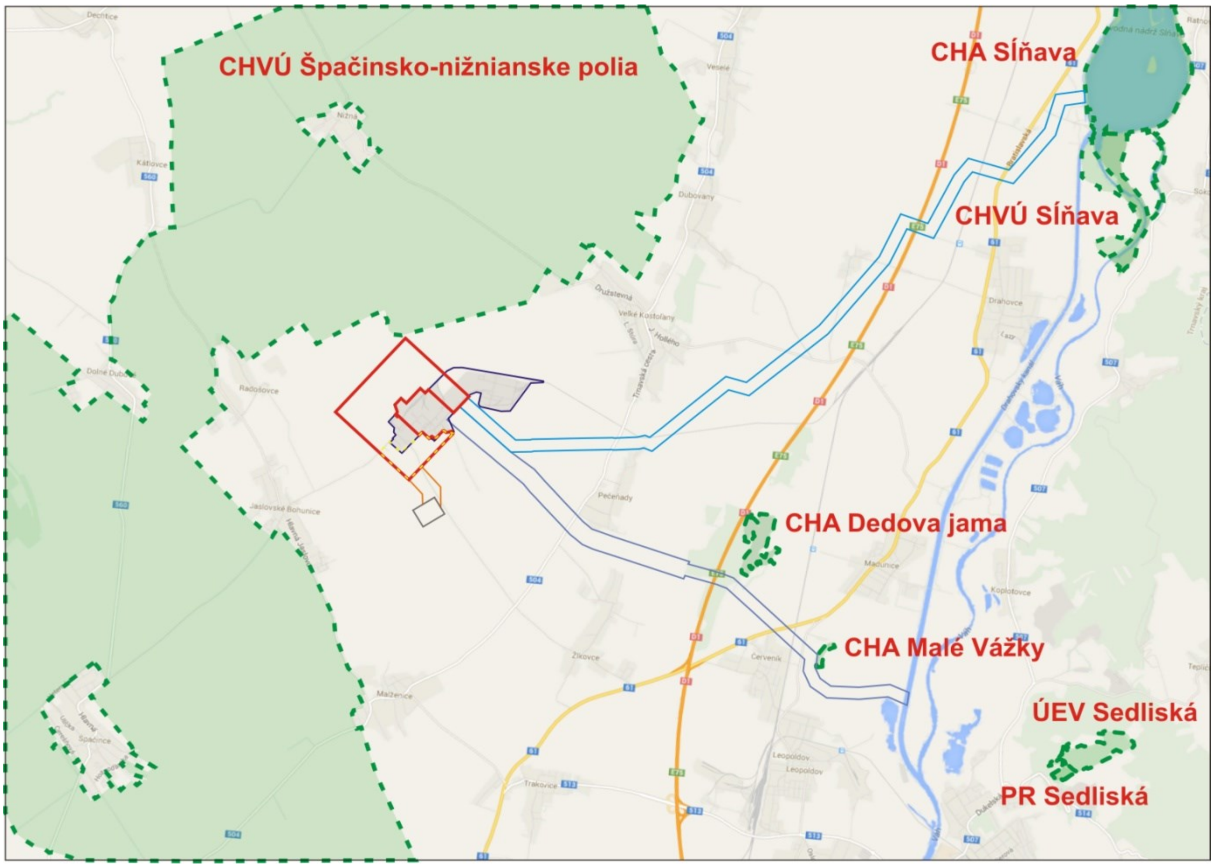
In terms of Act No. 543/2002 Coll., on the protection of nature and country, as amended, there were 3 protected sites (PS) and 1 natural reserve (NR) identified in the area concerned. The following table contains an overview of protected areas of the national system in the area concerned together with the level of protection defined.

Tab. III.23: Overview of protected areas in the area concerned

Name	District	Surface area	Level of protection	Subject of protection	Distance/direction from NNPP
PS Dedova jama	Hlohovec	29.57 ha	4	Protection of the remainder of indigenous alluvial forest that is important as refugium for animals, an important landscape element and site of unique presence of the population of summer snowflake and other protected plant species.	4.9 km/E (150 m from the pipeline corridor)
PS Malé Vážky	Hlohovec	3.48 ha	4	Protection of water biocoenoses significant from scientific, instructive, cultural and educational point of view.	6.9 km/E (in close proximity of the pipeline corridor)
NR Sedliská	Hlohovec	5.85 ha	4	Protection of xerothermic vegetation of steppe nature with rich presence of small pasque flower (Pulsatilla pratensis subsp. nigricans, P. vulgaris ssp. grandis) accompanied by other important thermophilic species of plants and animals, for scientific, cultural and educational purposes.	11.3 km/E
PS Sĺňava	Piešťany	399.00 ha	4 (OP 3)	Protection of water birds and water biocoenoses for scientific and research purposes.	11.4 km/NE ** (water intake structure at the water reservoir's edge)

The areal boundaries of these protected areas be clearly seen in the next figure:

Fig. III.16: Position of protected areas and sites of NATURA 2000



The basic part of the European policy of the protection of biodiversity and ecosystems is the implementation of the NATURA 2000 network, which represents a coherent European ecological network of special areas of conservations, which are in the specific interest of the European Union. In term of Section 28 of Act No. 542/2002 Coll., NATURA 2000 is defined as "Coherent European network of areas of conservation". It consists of two types of areas: protected bird areas (PBA) and special areas of conservation (SAC).

In the area concerned, the following bird areas were identified, which are classified in the national PBA list:

SKCHVU026 Síňava: Area important for nesting of water birds. It is a part of the highest concentration of peewits in the Slovak Republic. An important wintering grounds and migration corridor for many bird species in spring and autumn period. The area was declared as protected by Decree No. 32/2008 Coll.

SKCHVU054 Špačinsko-Nižnianske fields: One of the most important areas in the Slovak Republic for nesting of the saker falcon. The area was declared as protected by Decree No. 27/2011 Coll.

The proposed activity is located outside the direct interference with identified PBAs. The closest is SKCHVU054 Špačinsko-Nižnianske fields, approximately 100 m north of the outer boundary of the area for siting and construction of the NNPP (however, due to the layout of NNPP the real distance will be higher). The proposed raw water intake structure is located on the edge of Síňava water reservoir (SKCHVU026 Síňava).

In the area concerned, the following special areas of conservation were identified, which are classified in the national SAC list:

SKUEV0175 Sedliská: Biotopes that are subject to protection: 6210 Xerophilous grassland and bush vegetations on calciferous subsoils (important stands of Orchideaceae), 6240* Subpannonian grassland vegetations, 40A0* Xrothermic bushes, 91H0* Thermophilic Pannonian oak forests. Species that are subject to protection: greater pasque flower. The surface area of the area: 46.09 ha. The administrator of the area: CHKO Malé Karpaty.

The areal boundaries of these sites are clearly seen in the previous figure. The proposed activity is located outside the direct interference with the identified SACs. SKUEV0175 Sedliská is located approximately 11.2 km to southeast from the NNPP site and approximately 2.5 from the underground waste water pipeline corridor.

III.4.9.3. Territorial System of Ecological Stability

The territorial system of ecological stability (TSES) is a whole-areal structure of interconnected ecosystems, their elements and components ensuring the diversity of conditions and forms of life in the landscape. The basis of this system presents biocentres, biocorridors and interaction elements in multiple hierarchical levels.

In the wider area of interest, the agricultural landscape is predominately integrated into stretches of arable land of the area up to 500 ha.. They are areas with the lowest level of ecological stability. The vegetation in the developed area of municipalities contains considerably stable ecologically areas in the cultural landscape. The basic elements of the territorial system of ecological stability in the remote area comprise of the elements of the indigenous alluvial forests and vegetation on the banks of streams. But the fully functional TSES framework has to be completed in the area and add the missing biocentres, biocorridors and interaction elements.

All hierarchical levels of TSES elements - supra-regional, regional, local are represented in the remote area.

In the wider area of interest, the following elements from the Trnava district regional TSES documentation were identified:

- a biocentre of supra-regional importance: Dubník,
- a biocentre of regional importance: Sĺňava reservoir, Štrkoviská in Váh's alluvium, Orešany, Boleráz reservoir, Horná Krupá, Brestovianske groves, Vlčkovský grove,
- a biocorridor of supra-regional importance: the Váh river,
- a biocorridor of regional importance: Dudváh, Trnávka, Gidra, Parná, Blava, Krupský stream.

The majority of municipalities in question have no separate documentation of the local TSES. Thus, when determining ecologically valuable landscape elements, it should be taken from the prepared regional TSES for the Trnava district from 1993 (Jančurová et. al.).

The proposed activity interferes with the Sĺňava regional biocentre (raw water intake structure) and crosses the Dudváh regional biocorridor at two points (underground raw water and waste water pipeline). Based on the preliminary area survey it can be stated that other TSES elements are not affected by the implementation of the proposal and are located in sufficient distance from the proposed activity.

III.4.9.4. Other Elements of Environmental Protection

The proposed activity is not in contact with any protected tree, does not interfere with any protected landscape element, with any internationally significant meadow, with any nationally significant meadow or locally significant meadow, nor with any site of UN world cultural and natural heritage or with any UN biosphere reserve.

III.4.9.5. Fauna and Flora

Fauna

Given dominant position of agricultural landscape on the nature of the area conditions for territorially quality and varied structure of biota are not created. Animals are bound to small islands of bushy and full-grown vegetation, represented in the area by gardens of family houses, ruderal vegetation and remains of well-preserved vegetations of indigenous alluvial forests and vegetations on banks of streams. Higher species variety is also connected with bodies of water, flowing and stagnant as well as temporary. Other areas are used occasionally, mainly to obtain food.

Given the nature of area and its use, there is no assumption for the presence of protected species of fauna and flora in the area for siting and construction of the NNPP.

In the wider area of interest, the protected and important species of invertebrates include the predatory bush cricket (*Saga pedo pedo*), mantis *(Mantis religiosa)*, red cicada *(Tibicina haemabodes)* and stag beetle *(Lucanus cervus)*. Water invertebrates include burrowing mayfly *(Ephoron virgo)*. Several species of molluscs, amphibians and reptiles are connected with the environment of alluvial forests. The important ones in terms of zoogeography and fauna are, for example, the European green lizard *(Lacerta viridis)*, the dice snake *(Natrix tesselata)* and the Carpathian newt *(Triturus montandoni)*, these are also endangered species. The species composition of fishes in the streams flowing down from Little Carpathians is rather poor. The representation of fishes in Dudváh is affected by the adjacent section of the Váh. Of 47 species of fishes, 38 species occur regularly in it. The endangered species are crucian carp *(Carassius carassius)*, spirlin *(Alburnoides bipunctatus)*, sabre carp *(Pelecus cuttreatus)*. Of endemic species, pigo *(Rutilus pigus)* and striped ruffe *(Gymnocephalus schraetser)* are present. The construction of water reservoir in Kráľová has an negative impact on fish migration. Sĺňava is one of the three most important areas in the Slovak Republic for nesting of the species common tern *(Sterna hirundo)* and Mediterranean gull *(Larus melanocephalus)* and one of the five most important for nesting of common gull *(Larus canus)* species. The following other species were identified in the area: common kingfisher *(Alcedo atthis)*, Eurasian skylark *(Alauda arvensis)*, western marsh harrier *(Circus aeruginosus)*, red-backed shrike *(Lanius collurio)*, spotted flycatcher *(Muscicapa striata)*, African stonechat *(Saxicola torquata)*, European turtle dove *(Streptopelia turtur)*. The following species of fishes were identified in the Sĺňava water reservoir: common carp *(Cyprinus carpio)*, wels catfish *(Silurus glanis)*, northern pike *(Esox lucius)*, zander *(Stizostedion lucioperca)*, common bream *(Abramis brama)*, vimba bream *(Vimba vimba)*, European perch *(Perca fluviatilis)*, European chub *(Leuciscus cephalus)*, goldfish *(Carassius auratus)*.

The group of amphibians, tiny in the number of species, is represented in the remote area with 12 species. The most numerous representatives of vertebrates are birds, of which were found more than 250 species in the area so far, including about 110 species of nesting birds. No nesting of protected and important bird species were found in the area designated for siting and construction of the NNPP. But given the proximity of PBA, birds flying into the area concerned for food can be expected. Compared to birds, mammals have a poorer representation and especially small species are present. No protected and important species of mammals are present here, just like no endemic and relict species. Hunting game is represented by all important species - roebucks and deer, wild boars, European hares, pheasants, foxes.

Flora

The areas of agrocoenoses dominate the area for siting and construction of the NNPP, small areas or ruderal vegetation and bushes are present only sporadically, bordering the back roads. Given the nature of the area and its use, the presence of protected species of flora is not expected.

With regard to flora, the wider area of interest is characterised with transformation of natural vegetation to substitute natural vegetation (meadowlands, pastures), but mainly to agricultural vegetation (agrocoenoses). Willow - poplar alluvial forests within the catchment of streams are , are the most common forests, where they are present together with the vegetation of streams and swamps. These are present mainly in the area between the dams of the Váh.

The phytographically important species are represented by: corn mignonette *(Reseda phyterima L.)* and perennial honesty *(Lunaria rediviva L.)*. Of endangered species, the presence of green field-speedwell *(Veronica argestris L.)* in the Trnavské ponds site and Biskupický channel was not confirmed

The communities of soft alluvial forests (*Salicion albae*) that were present on the Holocene alluvial plain of the Váh river in permanent reach of the high level of groundwater can be considered part of the basic biotopes within the monitored area. Most of these areas is used today as agricultural land or they are areas in the flood area between dams.

The riverbank bushes of almond willows (*Salicion triandrae*) are present sporadically. North of Leopoldov, in the Malé Vážky site, which partially overlaps the examined area in its south-eastern edge, the remains of alluvial, willow - poplar vegetations and accompanying substitute communities are preserved.

Communities of ash-ulmus and oak-ulmus forests (*Ulmenion*) were prevalent on the broad alluvial plain of the Váh and the Dudváh, as well as on alluvial plains of bigger streams (Blava). They are connected with higher and relatively dryer places of alluvial river plains where surface floods occur regularly and for a short period. Today, only small remains are left in the agricultural landscape. They have been documented on the Dudváh alluvial plain.

The riverbank alder and ash-alder alluvial forests *(Alnenion glutinoso-incanae)* and riverbank communities of shrubby willows (riverbed willows) continue on the communities of willow-poplar alluvial forests on alluviums in narrow alluvial river plains in middle and upper reaches of rivers and streams. They are connected with the alluvial plains of streams waterlogged by flowing groundwater or affected by frequent surface floods, e.g. near Dolná Krupá, Jaslovské Bohunice, around Nižná, north of Rakovice.

The Pannonian oak - hornbeam forests are considered the driest forest type *(Ulmeto-Querceta).* It is present in the Dudváh catchment within the examined area. On border loess hills and island-like hills it transform into xerophilious communities *(Eu-Quercion pubescentis)*.

In the wider area the forest of the *Convallario-Quercetum roboris* community can be found. These communities are located in central and southern hilly part of the area in contact with lowland ask-ulmus-oak alluvial forests and Turkey oak or xerophilious pontic-Pannonian forests.

The Turkey oak forest are subxeriphilious to xerophilious forest connected mainly with illimerised brown earths on loesses or degraded black soils on loesses. Today they represent coppice vegetation, mainly with dominating black locust, with more demanding culture in vineyard, orchards and on field.

Bushes created a natural community on field and served as natural biocorridor and biobarriers. They were mostly removed with the transition to massive scale farming on agricultural land. Bushes on the banks of streams in the agricultural landscape are types of riverbank willows *(Calystegio-Salicetum triandrae)*. Bushes of anthropogenic nature *(Anthrisco-Lycetum halimifoliae)* are present in numerous sites, within small-area plots of lands, mainly near road and also directly in settlements.

No biotopes of national or European importance were identified in the area concerned on the basis of existing data sources and documents. A more detailed mapping will be possible in the next vegetative seasons and evaluated in the next assessment level.

III.4.10. Landscape

The landscape of the wider area of interest consists mainly of the elements of anthropogenic origin. It is an agricultural-settlement landscape, where developed area irregularly alternates vast agricultural surfaces. The dominant element of today's landscape culture is arable land in large blocks. Elements of infrastructure are also strongly represented, primarily high voltage lines. The most distinctive element of the landscape structure of the area concerned is the nuclear facilities site.

Other elements of anthropogenic origin include roads and transportation surfaces, built-up surfaces with a housing function and civil infrastructure and others. Forest covers and almost also non-forest wood vegetation are completely missing in the area. The most distinctive greenery elements are line vegetations along streams and tree-lined roads.

The low level of ecological stability is associated with the low to deficit representation of positive landscape elements (areas and lines of greenery, protected areas, TSES elements) in the area concerned. The low diversity of landscape elements also contributed to the low diversity of landscape view that is due to the easily observable low relief dissection, especially the objects of EBO site (mainly cooling towers) are well visible under good weather conditions.

The contemporary landscape structure of the wider area of interest presents a typical agricultural land of Trnavské hills. With regard to the classification of types and sub-types of landscape structure, it is a lowland arable land type of landscape. The landscape mosaic consists of big blocks of arable lands with various crops that are separated by paved or back, unpaved roads. The agricultural use of land is dominant. The second most representative element of the contemporary landscape structure in terms of surface area are the developed areas. They are the element of landscape structure serving the function of transportation (roads paved and unpaved, municipal roads within a settlement), housing (family houses, multi-storey apartment buildings), technical and civil infrastructure. The most distinctive landscape element of anthropogenic origin is the site of nuclear power plant. The Malženice CCGT plant asserts itself too within the landscape structure to a lesser extent. With regard to the tertiary landscape structure, the EBO site, together with linear elements of aerial electrical lines and heat pipes, are negative anthropogenic elements. The streams Blava and Dubovský stream, as well as the Manivier channel can be classified as natural elements located in the area concerned . All said streams are of lowland nature, present hydric corridors around which the vegetation in form of riverbed growths is concentrated. These vegetation elements are within the remote area among the most important because forest covers are almost completely missing in the area.

The non-forest wood vegetation is, apart from riverbed growths, represented also by tree-lined roads that are elderly in many cases and have no continuous canopy and by woods on fields. The vegetation surfaces is completed by settlement greenery (gardens at family houses, cemetery, park-treated surfaces, etc.).

The landscape view is the manifestation of visual perception of landscape's physiognomy. Depending on the perceptional capacity of the observer, the elements within the landscape, either of natural or anthropogenic origin, can be perceived very differently. Someone can regard technical objects of large proportions in the area as positive, as elements that diversify the landscape, another group of observers can perceive the same elements as very negative, disrupting the landscape view. Thus, when judging the landscape scenery, the subjective approach comes forward. When judging the landscape view, the determining factors are the relief and elements of contemporary landscape structure (landscape parameters such as exceptionality, variety and uniqueness are not preferred for the examined area, because these parameters do not pertain to the examined landscape). The siting of the NNPP is located in the strip of land between Malé Karpaty and Považský Inovec, in which objects higher than full-grown wood vegetation (approx. 20 - 30 m) are visible very well. Of course, visibility is affected by the current weather, under extremely good conditions, the visual range in the area of interest and its surroundings can range up to around 100 km. Given the poorly dissected relief, almost complete absence of forest covers and low representation of non-forest wood vegetation, it can be stated that the natural conditions strongly do not support the diversity of landscape view, so the landscape structure mosaic has a very low variability. The landscape view is comprised mainly of great blocs of fields that are here and there dissected by the elements of vegetation, the silhouettes of settlements and transportation lines. Pylons of high voltage lines and dense network of electric lines are disruptive technical elements. The most visible are the power plant objects in the EBO site, or more precisely, their cooling towers (approx. 125 m high), which are due to their dimensions visible quite well from all directions.

Fig. III.17: Technical elements as part of the landscape

The overall *ecological stability* of the area concerned is low to very low, ecostabilising elements are represented at a minimum rate. The landscape dominated by land used agriculturally in great blocs, with insufficient non-forest wood vegetation, with non-indigenous plant species and negative social and economic elements and phenomena, has a low ecological stability coefficient. The ecostabilising elements in the wider area of interest are represented by streams, permanent grassy covers and lines of non-forest wood vegetation. Parks and other settlement vegetation consisting of the vegetation of public spaces and house gardens in developed area of Jaslovské Bohunice can be included in the category of ecostabilising elements within the area concerned. The linear non-forest wood vegetation creates usually the edge of line elements of the landscape. That concerns mainly riverbank covers localised along streams and alleys (often with sparse canopy) along roads. These vegetation elements have in places lower quality but even despite that they present significant ecostabilising elements not only in the area concerned but also in the remote area.

III.4.11. Tangible Property and Cultural Monuments

III.4.11.1. Tangible Property

There is no tangible property of natural persons in the site for siting and construction of the NNPP.

A group of construction objects owned by the investor of the proposed activity (the JESS company and its major shareholder, the JAVYS company) is located in the site. They are objects of auxiliary nature for administrative, storage or operation purposes and cooling towers of the NPP Bohunice 1,2 in decommissioning. The site furthermore contains transportation and infrastructure utilities owned or administered by various legal entities.

For the purpose of the construction of NNPP, the possibility of using several objects as construction site equipment or for communication connection and supply with electricity, fire and potable water and gas is considered.

The property and legal relations to plots of land in question are being handled separately, outside the environmental impact assessment process.

III.4.11.2. Cultural and Historic Monuments

There are no cultural and historic monuments in the site for siting and construction of the NNPP. Numerous small solitary architectures (crosses, chapel, devotional pillars, statues, etc.) can be found in the wider area of interest.

The following can be considered as important archaeological sites in the area concerned:

- Jaslovské Bohunice - recorded finding of a settlement with fluted pottery or skeletal burial sites of Únětice culture of older bronze age. This area was settled already in Eneolithic period.
- Malženice - findings of a settlement of linear pottery culture and fluted potter of younger bronze age and La Tène age.

Also clay statues of women and animals were found in the wider area of interest, the most famous was named Venus of Bučany. A Celtic burial site, uncovered here, is dated in the 5th to the 3rd century BC.

The area concerned in not included in the monuments reservation list nor in reservation zones register. No paleontological or important geological site is located in the area concerned or in its surroundings.

III.4.12. Transportation and Other Infrastructure

III.4.12.1. Transportation Infrastructure

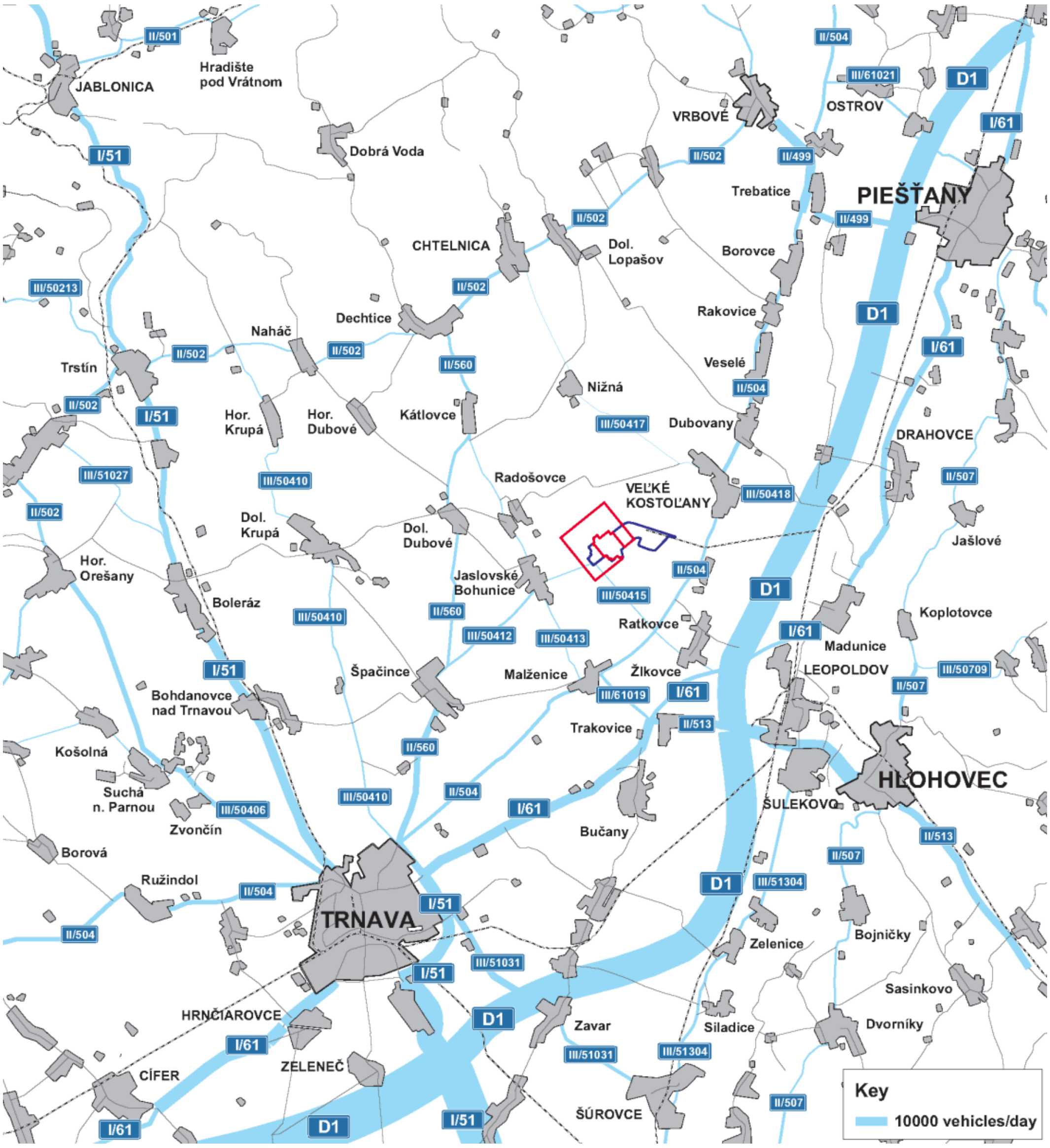
All basic types of transportation - road, railway, aerial and water are present in the area concerned and the wider area of interest.

Road transport: The basic road framework in the wider area of interest in districts of Trnava, Hlohovec and Piešťany is composed of state roads of local, regional and supra-regional importance (the D1 highway, class I roads No. I/51 and I/62, class II roads No. II/502, II/504, II/513 and II/560, completed with a network of class III roads). Within transportation relations of the site itself with the broader road network, the third class road No. III/50415 is important. This road enables road connection from two main directions (Jaslovské Bohunice direction or Žlkovce direction) and serves for personal transportation of employees as well as for trucks. An internal road network, providing access to individual objects, was built in the area of existing nuclear facilities within the site.

The average traffic intensity (according to traffic census done by the SSC in 2010) in the area concerned exceeds 3,000 vehicles in 24 hours on the class II roads (with the share of freight transport of 17 - 18 %) and reaches around 1,300 vehicles in 24 hours on the class III roads (with a 20 % share of freight transport) An exception is the section of III/50412 road between the municipalities of Špačince and Jaslovské Bohunice and the section of III/61019 road between the municipalities Malženice and Trakovice, where the intensity exceeds 2,000 vehicles in 24 hours.

The road network in the remote area of interest, including a traffic intensity cartogram, is shown on the next figure.

Fig. III.18: Road network in the remote area of interest including traffic intensities for 2010



Railway transport: Of the railway tracks in districts concerned, mainly the following tracks should be mentioned: Bratislava - Trnava - Žilina track, Leopoldov - Hlohovec - Nitra track, Trnava - Sereď track, Trnava - Jablonica - Kúty track and Leopoldov - Sereď track. The EBO site's connection to the railway network is done with an independent delivery track that was originally constructed for the needs of NPP Bohunice A1 and now serves for the whole nuclear power plant site. The 8.1 km delivery track is connected to the railway track No. 125 in the direction Piešťany - Trnava - Bratislava and ends in the Veľké Kostoľany railway station, where a siding was built for its operation.

Air transport: The airport in Piešťany, the Aero club's airport in Boleráz and an airport used for agricultural purposes in Trnava lie within 30 km from the EBO site. Airspace above the EBO site is regulated by the *LZP29 Jaslovské Bohunice prohibited airspace* (defined by a circle with 2 km radius from the centre of the EBO site, reaching 1,500 m above the ground) and the *LZR52 Jaslovské Bohunice restricted airspace* (a circle with 2 km radius with the same centre).

Water transport: The water transport is important mainly for transporting heavy and oversized components. It is executed on Danube from the Black Sea to the port in Bratislava (and further via road), another route that can be used today is on the Váh from the Danube to the site of Kráľová reservoir (and further via road).

III.4.12.2. Other Infrastructure

The entire usual technical infrastructure, i.e. the electricity transmission and distribution network, water networks of technological and potable waters, other pipelines and telecommunication networks are available in the area concerned.

Electric grid: Given its electrical power production nature the area concerned is characterised by a considerable number of transmission and distribution electric lines (including substations), intended to lead the output from the power producing facilities to the electricity network and to supply municipalities and cities with electricity.

Near the municipality Malženice there is a steam-gas power plant (operator E.ON, installed power of around 430 MW_e). At present it is shut down and moth balled.

Potable water: The municipalities of area concerned are connected to the Veľké Orvište group water main with other additional water sources. This water main also supplies potable water to the area of nuclear facilities in the EBO site.

Other water management systems: A water management system for operation of facilities in the Jaslovské Bohunice nuclear power plants (EBO) site is established in the area.

The raw water for existing facilities is withdrawn from Sĺňava reservoir into the Pečeňady pumping station where it is transported into the water treatment facility in the EBO site.

The collector of waste waters from the EBO site is the Socoman pipeline system, which the systems for collecting technological (industrial) waste waters and sewage waters from facilities in the EBO sites flow into. The pipeline length before the connection with Drahovský channel (river km 2.2) is approximately 10.8 km.

The final collector of rain waters from the EBO site is the Manivier open channel, in which the systems for collecting rain waters from the existing sites of nuclear facilities and their surroundings flow. The Manivier channel empties into the Dudváh river.

The agricultural plots can contain amelioration or irrigation systems.

Gas lines and pipelines: Several gas pipe lines and a oil pipeline run through the area concerned, their smallest distance from the area for siting and construction of the NNPP is around 3 km. The EBO site has a gas service pipe.

Other utilities: The area has a system to supply heat to the cities of Trnava, Hlohovec and Leopoldov and the Jaslovské Bohunice municipality with the heat produced by NPP Bohunice 3,4.

Furthermore, the wired and wireless telecommunication networks (including the transmission of radio and TV signals), systems for transmission of information from the EBO site' power plant emergency readiness system or other infrastructure are available.

III.4.13. Other Environmental Characteristics

No other environmental characteristics that could be affected by the proposed activity were specified.

IV. BASIC INFORMATION ABOUT THE EXPECTED ENVIRONMENTAL IMPACTS

IV. Basic information about the expected impacts of the proposed activity on the environment including health and on the options for mitigation measures

IV.1. Requirements for Inputs

1. Requirements for inputs (e.g. land occupation, water consumption, other raw material and energy sources, transportation and other infrastructure, workforce requirements, other requirements).

All requirements for inputs are shown conservatively, in their potential (envelope [19]) maximum.

IV.1.1. Land occupation

Land occupation: permanent land occupation: up to 70 ha

temporary land occupation: up to 42 ha

Due to the various special compositions of the individual NNPP components the surface area for siting and construction of the NNPP is limited by a conservative border which enables all considered orientations of NNPP objects with respect to the border contained in the draft land use plan of the Trnava Self-Governing Region. Such designated area includes the area for siting of the new nuclear power plant in a two-unit composition (approximately 64.5 ha, including 63.3 ha of arable land and approx. 1.2 ha of other surfaces), surface area of technical infrastructure (approx. 40 ha, including approx. 38 ha of arable land and approx. 2 ha of other surfaces) and the surface area of the construction site equipment (approx. 111.5 ha, including 78.2 ha of arable land and approx. 33.3 ha of other surface). The real permanent and temporary occupation area will be significantly lower than this conservatively defined area for siting and construction of NNPP.

The surface area of the existing EBO site is approx. 150 ha. Up to approx. 36.5 ha of this surface area can be used for the new nuclear power plant.

After the completion of the NNPP construction, the area of the construction site will be freed up.

The termination of the NNPP operation does not require any permanent or temporary occupation.

infrastructure utilities: of little significance

The routes of raw water supply main and waste water or rain water collection mains will be installed below the surface, without significant demands for permanent occupation. The aerial electric lines require occupation only for the foundations of the pylons.

IV.1.2. Water Intake

Water intake: technological water: up to approx. 1.995 m^3/s
up to approx. 63,000,000 m^3/year

The values shown present the maximum immediate and annual consumption (in case of a conservatively considered continuous operation), related to weather characteristics of the year 2025 (with the influence of the expected temperature increase due to climate changes it will be necessary to consider the increase of raw water consumption by 2085 to approx. 2.141 m^3/s). Of this amount, approx. 1.645 m^3/s will evaporate, the rest (approx. 0.350 m^3/s) will be discharged as waste water. The raw water intake will be independent of the existing intake systems. The raw water will be acquired from the Váh river (the Sĺňava reservoir) through a water intake structure near the existing intake structure for NPP Bohunice 3,4 and transported via force main from the Pečeňady pumping station into the technological water reservoir with the capacity for at least 30 days for the purpose of after-cooling in case of loss of raw water supply.

[19] Further commentary on the method of determination of conservative (envelope) parameters is shown in the Introduction chapter (page 7 of this Preliminary Study), or more precisely in its subchapter Methodological Processing of the Preliminary study.

The raw system supply system will be backed up with a spare intake system. For technological purposes the water will be treated in the treatment plant with a combination of mechanical and chemical procedures.

The immediate intake of raw water for nuclear facilities within the site is currently approx. 0.89 m^3/s. The overall intake (for the period of concurrent operations) will then be no more than approx. 2.885 m^3/s.

No demand for technological water intake rises during the construction of the NNPP. The water consumption for construction purposes will be handled by a branch line from the process water distribution system of the decommissioned NPP Bohunice 1,2 and A1. It is expected that the amount will not exceed approx. 200,000 m^3/year.

After the termination of NNPP operation the consumption technological water will be significantly lower than in the operation period and it will further decline in relation to the course of decommissioning activities.

potable water: up to approx. 46,000 m^3/year

The value shown follows from a conservatively determined number of 1,050 employees and the specific consumption of 120 l/person/day. The potable water will be acquired in a similar way as for the existing facilities within the site, i.e. from long-distance supply mains of Dobrá Voda, Dechtice and Veľké Orvište water sources based on contracts with their operator.

The potable water intake for existing facilities within the site range up to approx. 225,000 m^3/year (of which the NPP Bohunice 3,4 up to 50,000 m^3/year and the decommissioned NPP Bohunice A1 and 1,2 , including radioactive waste processing and treatment technologies and interim spent fuel storage facility up to approx. 175,000 m^3/year). The overall intake (for the period of concurrent operations) will then be around approx. 271,000 m^3/year.

The potable water consumption for the duration of construction will be not exceed approx. 206,000 m^3/year (approx. 4,700 workers at a specific consumption of 120 l/person/day). So at the level of potable water intake for other facilities of 225,000 m^3/year, the overall potable water intake level on the site for the period of NNPP construction will be up to 431,000 m^3/year. The current source of potable water has sufficient capacity to cover this consumption.

After the termination of operation, the potable water consumption will be significantly lower than in the operation period and it will further decline in relation to the course of decommissioning activities.

fire-fighting water: intake not specified

The fire-fighting water system (mainly the fire-fighting water reserve and supply) will comply with valid regulations and best practice in the fire protection area. The fire-fighting water system will be supplied from the recirculation of the cooling circuit that will be able to satisfy every demand for fire-fighting water supply with sufficient reserve.

The provision of fire-fighting water in the site is currently handled by independent fire-fighting water distribution systems, complying with valid regulations.

The raw or potable water can be used to provide fire-fighting water during the construction.

The provision of fire-fighting water after the termination of operation will at first be identical with the supply during power operation, i.e. from the coolant water system. Later, after the coolant water supply facilities are put out of operation, the fire-fighting water will be provided from the potable water supply system. The decommissioning of the fire-fighting and utility water itself will be executed as one of the last activities.

IV.1.3. Demands for other Raw Material and Energy Sources

Nuclear fuel: up to 42.0 t of UO_2/year[20]

This amount represents approx. 80 fuel units per year. The nuclear fuel will be purchased on the market. The fuel will be based on a UO_2 basis, the maximum fuel enrichment will be up to 5 % ^{235}U. The lengths of fuel cycles are assumed to be between 12 and 24 months, the fuel burn-up is assumed within the range of 60 to 70 MWd/kgU.

The current nuclear fuel consumption for the operation of nuclear power plant on the site is up to 20.0 t UO_2/year, the overall consumption (for the period of concurrence of operations) will thus not exceed approx. 62.0 t UO_2/year.

There is no demand for nuclear fuel consumption during the period of construction.

Electricity: up to 170 MW_e

The value shown represents the value of onsite consumption for operation. The consumption is covered by self generation activity and backup power supply of own consumption.

The onsite consumption input for NPP Bohunice 3,4 currently does not exceed 70 MW_e. and for JAVYS facilities it is approx. 3 MW_e. The overall input (for the period of concurrence of operations) will thus not exceed approx. 243 MW_e. The source for onsite consumption is the production of electricity itself and backup power supply from the distribution/transmission system.

[20] Apart from the first charge.

The electricity consumption during the construction is not specified in more detail, but it will be a normal demand.

The electricity consumption during the termination of operation is not specified in more detail, but it will be a normal demand.

Operating and other material: not specified

Operating materials mean chemicals for process water treatment, then lubricants, fuels and technical gases. The amount is not specified in detail, but it will be a usual demand (orders of approx. hundreds of t/year).

The existing nuclear facilities in the site have a similar consumption in operation

The consumption of construction and building materials during the construction will be in the range up to 1,000,000 m^3 of concrete, up to 150,000 t of concrete reinforcement and up to 50,000 t of steel structures.

No significant additional demand on consumption of operating materials, construction material or building material will arise during the termination of operation.

IV.1.4. Demands for Transport and other Infrastructure

Road traffic: target traffic intensity: approx. 600 vehicles/24 hours (including approx. 100 trucks)

The value shown represents a conservatively determined daily intensity average of the NNPP target traffic (i.e. number of arrivals). The NNPP source traffic (i.e. number of departures) will be identical. The overall intensity is given by summing up the target and source traffic. More detailed information on traffic information is as follows:

- Transportation of employees: The number of NNPP employees will be a maximum of 1,050 employees during operation, the ratio of individual car transport and public transport (buses) will be approx. 40 % : 60 %. Thus, the overall demands for the transport of employees will oscillate around approx. 400 to 500 cars and approx. 20 buses per day.
- Transportation of operating substances and materials: The number of vehicles providing transportation of operating substances and materials is expected to have a peak level of approx. 100 truck per day. The average daily intensity will be lower.
- Transportation of nuclear fuel: It can be a combination of transportation by train, vehicle, ship or air plane. The intensity is assumed in units of truck rides per years.
- Transportation of radioactive waste: The number of vehicles providing the transportation of radioactive waste is expected at the level of around tens of trucks per year.
- Transportation of non-radioactive waste: The number of vehicles providing the transportation of non-radioactive waste is expected at the level of hundreds of trucks per year.

The transportation route will use the III/50415 road, in the direction towards Žlkovce (approx. 50 %) and toward Jaslovské Bohunice (approx. 50 %).

The target traffic intensity, related to the activity of nuclear facilities in the EBO site today, averages approx. 1,000 vehicles/24 hours (including approx. 150 trucks). Therefore the overall traffic intensity of NNPP+EBO target traffic for the period of concurrence of operations will be approx. 1600 vehicles/24 hours (including approx. 250 trucks).

During NNPP construction, the overall traffic intensity of the NNPP construction traffic will be approx. 1700 vehicles/24 hours (including approx. 400 trucks) distributed as follows:

- Transportation of workers: It is assumed that approx. 4,7000 workers will be working on the site at the peak of construction. The ratio of individual car transportation to public transportation (buses) is expected to be 40 % : 60 %. Thus, the overall target traffic intensity will vary around approx. 1300 cars and approx. 100 buses per day. The naturally used routes are assumed with the following distribution to the III/50415 road: the Žlkovce direction (approx. 75 %) and Jaslovské Bohunice direction (approx. 25 %).
- Transportation of construction and building materials: The overall target traffic intensity will vary around approx. 300 truck per day, provided that part of materials (cement, quicklime) will be transported over rail. A pragmatic assumption of the distribution of the directions of transportation to the III/50415 road is as follows: the Žlkovce direction (approx. 50 %) and Jaslovské Bohunice direction (approx. 50 %).

The termination of NNPP operation does not require any additional road transportation demands as compared to the period of operation or construction, the same transportation system and gradual decrease of its intensities is expected.

Railway transportation: target traffic intensity: insignificant

The period of NNPP operation has no significant demands on the use of railway transportation.

The current railway transportation intensity, related to the activity of nuclear facilities in the EBO site, is insignificant and does not exceed single unit of vehicle trains per month.

During the NNPP construction period, the target railway transportation intensity can be expected at the level of 1 train/24 hours.

The termination of NNPP operation does not require any additional railway transportation demands as compared to the period of operation or construction. The same transportation system and gradual decrease of its intensities is expected.

Special transportation: of little significance

Transportation of heavy and oversized components: It means the transportation of pieces of units, mainly during construction. Thus, this transportation is insignificant with regard to intensity. With regard to spatial demands, only local adjustments of the existing infrastructure and temporary restrictions are anticipated.

Demands on other infrastructure: necessary adjustment/reinforcement

The connection of NNPP into the transmission system will require construction execution of a new substation (electric station) at Jaslovské Bohunice and its connection with the Križovany substation (these activities are not part of the proposed activity and will be executed by the operator, the SEPS company).

NNPP will be constructed independently from the existing water management systems of nuclear facilities in the EBO site. A new supply main will be constructed for the supply of raw water. New systems will also be constructed executed for collecting waste and rain water. Thus the existing infrastructure systems in the EBO site will not be affected.

The other infrastructure of the area concerned will not be affected.

IV.1.5. Demand for Workforce

Number of employees: up to 1,050

The conservative estimate of the overall number of employees of the power plant is a maximum of 1,050 persons.

The number of employees of the existing facilities in the site varies near the level of up to 2,650 persons (of which JAVYS has approx. 800 permanent employees and 450 employees of contractors, SE has approx. 1,300 permanent employees and 100 employees of contractors, these data are, however, variable and rather decline is expected), so the overall number of employees in the site (for the period of concurrence of operations) will not exceed approx. 3,700 persons.

The amount of workers during the construction of NNPP is conservatively estimated at approx. 4,700 persons.

The number of workers during the termination of operation is not specified in more detail, but it normally does not exceed the number of employees of the operation period and will be declining.

IV.1.6. Other Demands

No other demands not specified above arise.

IV.2. Data on Outputs

2. Data on outputs (e.g. sources of air pollution, waste waters, other wastes, sources of noise, vibration, radiation, heat, smell, other expected impacts, e.g. incurred investments).

All data on outputs is shown conservatively, in its potential (envelope[21]) maximum.

IV.2.1. Outputs into Air

Emissions into air: of little significance

The NNPP is not a combustion source, for this reason it will not be an important source of emissions into air. Only the backup technological facilities (backup diesel power generators and backup boiler house that will not be permanently operated sources) and cooling towers will be executed in relation to the NNPP. The emission of the primary pollutants PM, SO_2, NO_x and CO will be produced primarily during regular tests of devices in the order of tens of hours per year (this duration is required due to the functionality test of devices, maintenance, etc.). The amount of monitored pollutants will be trivial with regard to the frequency of operation of these devices and thus insignificant with regard to the impact on the environment. Another source of emissions will be vehicle traffic induced by the operation of NNPP. The amount of pollutant emissions will be of low importance and will depend mainly on the traffic intensity and the nature of specific emission factors of vehicles.

Similar conclusions can be made for the existing facilities in the EBO site.

[21] Further commentary on the method of determination of conservative (envelope) parameters is shown in the Introduction chapter (page 7 of this Preliminary Study), or more precisely in its subchapter Methodological processing of this proposal.

During the construction of NNPP, emissions from construction activity and related construction mechanisation and transportation (construction machinery, movement of this machinery around the construction site, car traffic) can be expected. With regard to the air protection, the most significant will be the activities during the demolition of objects needed to clear the space, mainly for the construction site equipment (significant dustiness of the process) and further the activity in the period of grading/groundwork (extensive movement of vehicles in the area). During these phases, the emissions of solid pollutants both from the operation of the construction machinery itself and from movement of this machinery around the construction site and also from the truck transportation, incurred by the need for removal of all the material are expected. The emissions of other pollutants are related to the use of machinery and balancing the fuel consumption. The emissions will be bound to the area of construction itself and its closest surrounding and furthermore, certain increase in air pollution can be expected along the transportation routes. The amount of these emissions will not exceed the common extent of works of similar nature. The partial increase of load will be time restricted to the construction period. Emissions will vary during the construction in relation to the schedule of individual construction activities.

In the period after the termination of operation, the operation-related point and line sources will vanish. The emission related to disassembly or demolishing works will not exceed the amount of emission in the preparation and execution period.

Waste heat:

	waste heat:	up to approx. 4,400 MW_t
	vaporization:	up to approx. 1.645 m^3/s

The waste heat will be neutralized in coolant towers through coolant water vaporisation.

The waste heat of the ex1isting operated facilities in the EBO site (i.e. the NPP Bohunice 2,3) is approximately 2,000 MW_t at the vaporization rate of approx. 0.75 m^3/s.

No significant waste heat will be produced in the period of construction or termination of operation.

IV.2.2. Waste Waters

Technological waste water:

overall:	up to approx. 0.350 m^3/s up to approx. 11,000,000 m^3/year
effluent stream:	the Váh river

The above values present the maximum immediate and annual amount of technological waste water (in case of a conservatively considered continuous operation). The amount of technological waste water will correspond to the amount of withdrawn technological water with the amount of evaporated water deducted. The quality of technological waste waters will comply with the limits set by Government Regulation No. 269/2010 or the valid water management permit. Technological waste water disposal will lie in their collection with a new drainage collector and discharge into the Váh effluent stream.

Today, the amount of the technological waste water from facilities in the site is up to 5,000,000 m^3/year (of which is the operation of NPP Bohunice 3, 4 up to 3,500,000 m^3/year, other facilities up to 1,500,000 m^3/year with a significant declining trend), the overall amount (for the period of concurrence of operations) will thus be up to 16,000,000 m^3/year.

No technological waste water will be produced during the construction.

During the termination of operation, a significant decline in the amount of technological waste water compared to the period of operation will occur.

Sewage water:

	the overall amount:	up to 31,000 m^3/year
	effluent stream:	the Váh river

The amount of sewage water will correspond to the amount of withdrawn potable water after deducting the consumption (the conservative estimate of approx. 66 % of the withdrawn potable water). The quality of sewage water will correspond to common waste waters from sanitary facilities. The resulting sewage water will be led through the sewerage system to the new waste water treatment plant and after treatment it will be led with the new collector (together with technological waste water) into the Váh effluent stream.

The amount of sewage water from facilities in the site varies up to 77,000 m^3/year (i.e. approx. 33 % of the withdrawn potable water); the overall amount (for the period of concurrence of operations) will thus not exceed approx. 108,000 m^3/year. The sewage water from existing facilities in the site after treatment is led through the Socoman collector (together with technological waste water) into the Váh effluent stream.

During the construction, the expected production of sewage water is up to 206,000 m^3/year (the amount of the withdrawn potable water, taking the consumption into account can significantly increase the amount). During the construction, the WWTP in the NPP Bohunice 1,2 site will be temporarily used for treatment of the sewage water from construction site's equipment, after treatment the waste water will led through the common Socoman collector into the Váh effluent stream.

The production of sewage water during the termination of operation is not specified, but it will be a common and declining amount, not exceeding the above mentioned outputs for the period of operation.

Rainfall water: the overall amount: up to 142,000 m3/year

effluent stream: the Dudváh river

The amount shown is estimated from the surface area of the NNPP itself (approx. 64.5 ha), the average precipitation rate of approx. 550 mm/year and the runoff coefficient of 0.4. Rainfall water comprises water from rain and other precipitation that does not infiltrate into the ground and is led into the effluent stream. Rainfall waters are not waste waters, the quality of rainfall waters will not be altered. Rainfall water disposal will lie in its collection with new drainage collector into the Dudváh effluent stream. Rainfall waters from the surrounding terrain will be caught into a protection trench and led by the Manivier channel into the Dudváh effluent stream.

The amount of rain water from the areas of facilities within the site is approx. 330,000 m^3/year (approx. 150 ha, average precipitation rate of 550 mm/year and the runoff coefficient of 0.4), the overall amount (for the period of concurrence of operations) will thus be approx. 472,000 m^3/year. Rainfall waters from the areas of existing facilities and from the surrounding terrain are carried by the Manivier channel into the Dudváh effluent stream.

During the construction, the amount of rain waste water will increase (together with growing occupation of areas, construction of objects and the sewerage system) until it reaches the amount stated for the operation period.

The decline in the amount of rain water compared to the operation period can be expected during the termination of operation and clearing of areas (if it occurs).

IV.2.3. Waste

Non-active waste: communal and other waste: up to 600 t/year
hazardous waste: up to 120 t/year

The amount and structure of resulting non-active waste will, in principle, correspond in quantity and quality to the structure of waste from the existing blocks (NPP Bohunice 3,4) in operation. They will be the common types of waste resulting from cleaning, maintenance, repairs, operation and change of non-active devices, construction waste from repairs, etc. The non-active sludge from waste water treatment will have a specific content. Because the non-active sludge from NPP Bohunice 3,4 were certified as a by-product (additive soil substance), it can be assumed that NNPP too will make an effort for similar use of these sludge. Similarly, also waste disposal will conform to the system in place, i.e. handing the waste over to authorized companies, focused on waste recovery and neutralisation. If the statutory requirements on waste management are complied with, no significant effect of waste disposal on the surroundings is expected.

Today, the waste production in the EBO site is approx. 1,900 t/year, including approx. 1,600 t/year of other waste and 300 t/year hazardous waste (data for 2012 cumulative for SE-EBO and JAVYS), the production is, however, variable between years depending on current activities.

During the construction, the production of approx. 360,000 t of construction waste can be expected, of which approx. 60,000 t is waste from the demolition of existing objects within the construction site. Waste will be separated, gathered and neutralised by an authorised organisation.

During the termination of operation, the amount of waste will decline compared to the period of operation. After the commencement of disassembly and demolition works, the amount of waste of construction nature will be gradually increasing up to approx. 1,000,000 t, including up to approx. 100,000 t of metals. Waste disposal will be governed by legal regulations on waste management valid at that time. But basically, a system similar to today's can be expected, i.e. recycling, reuse and the use of services of authorized organisations.

IV.2.4. Noise

Sources of noise:

cooling tower	$L_{Ap,1m}$ = 75 dB
backup power supplies	$L_{Ap,1m}$ = 85 dB *
transformers	$L_{Ap,1m}$ = 83 dB
substation switches	$L_{Ap,1m}$ = 90 dB *
engine rooms	$L_{Ap,1m}$ = 85 dB
compressor station	$L_{Ap,1m}$ = 85 dB
HVAC	$L_{Ap,1m}$ = 84 dB
safety valves of steam generators	$L_{Ap,1m}$ = 110 dB *

The above values present the expected acoustic pressure of NNPP's main sources, measured at a 1 m distance from the structures' outline at a stable level during the operation of sources (* marks non-standard sources of noise that occur only irregularly or exceptionally for short time periods).

The operation of power plant's main devices will be uninterrupted and identical for day and night time. The mobile source of noise will primarily be the road and railway traffic on public conveyances outside the NNPP site.

Analogous assumptions apply to the existing sources in the EBO site; their noise emissions are identical in quality and quantity.

The source of noise during the preparation and execution of the construction of NNPP will be construction and building activity on construction sites and traffic outside the construction site, in both cases using the usual construction and earthmoving machines and transportation means.

The sources of noise during the termination of operation will not exceed the performance parameters of devices during the standard operation or construction.

IV.2.5. Vibrations

Vibrations: without significant outputs

The proposed activity of NNPP is not a source of significant vibrations spreading into the surroundings.

The same conclusion can be made for the existing facilities in the EBO site.

No blasting works using explosives will be used in construction or after the termination of operation.

IV.2.6. Radioactive Outputs, Ionising Radiation

Radioactive discharges into the air:

noble gases:	up to 6.2E+13 Bq/year
tritium:	up to 6.7E+12 Bq/year
C-14:	up to 1.2E+12 Bq/year
iodines:	up to 2.5E+09 Bq/year
aerosols:	up to 1.9E+09 Bq/year
Ar-41:	up to 2.6E+12 Bq/year

The above values present the envelope (the maximum, for the configuration of 2 x 1,200 MW_e) annual discharge activities of individual groups of radioactive nuclides into the air during standard operation. They follow from published, publicly accessible data of reference type reactors suppliers. Based on the operating experience from the operation of NPP Bohunice 3,4, an older type of generation II reactor, it can be reasonably expected that the actual discharges into the air will be significantly lower than the values estimated by the project (see below).

The primary source of radioactive gases is the nuclear fuel itself in which the fission reaction is running and which produces active isotopes of gases. Gases permeate in limited amounts through micro-cracks in the fuel cover into the primary circuit coolant, which is in permanent contact with the fuel cover. The radioactive gases reach other nuclear power plant systems related to the primary circuit, through the primary circuit coolant. The biggest source of gaseous discharges containing radioactive nuclides is the deaeration of the primary circuit water degasser. Other sources are radioactive gases and aerosols from other technological systems and reservoirs that are continuously vented and collected into gas cleaning systems and to lesser extent the air collected from the reactor shaft's area. This is also reflected in the isotope content of discharges, in which the noble gases and radiologically important iodines prevail from among the fission products, and from the activation products, the radiological important are mainly the radioisotopes of carbon and argon. The discharges from NNPP will be released into the air in a controlled way through a vent chimney (after the application of a highly effective filtration and radiological check).

The discharges into the air from the existing nuclear facilities in the site are as follows:

noble gases (together with Ar-41):	up to 1.4E+13 Bq/year
tritium:	up to 7.5E+11 Bq/year
C-14:	up to 4.2E+11 Bq/year
iodines:	up to 4.6E+05 Bq/year
aerosols:	up to 1.8E+08 Bq/year

The above values present an envelope selection of the maximums of measured values of discharge activities of individual radioactive nuclides for the years 2003 to 2012 from the NPP Bohunice 3,4 in operation. These values contain the envelope values (selection from maximums) of the measured values of discharge activities of individual radioactive nuclides for the years 2009 to 2009 from other facilities in the site (the NPP Bohunice A1 and 1,2 in decommissioning, RAW treatment facilities and SNP storage facilities), but which have almost no impact on the overall situation, except for the aerosols. The discharges are released into the air in a controlled way through vent chimneys after the application of highly effective filtration and radiological check.

For illustration and comparison the project and limit permissible values of dominant radioactive nuclides discharges from the NPP Bohunice 3,4 into the air are shown.

They prove that the real maximums of discharges into the air are much lower (by up to several orders of magnitude) than the maximum projected values provided by the supplier and set permissible limits:

	project value	permissible limit	maximum measured
noble gases (together with Ar-41):	3.85E+15 Bq/year	2.0E+15 Bq/year	1.4E+13 Bq/year
tritium:	3.64E+13 Bq/year	-----	7.5E+11 Bq/year
iodines:	4.42E+11 Bq/year	6.5E+10 Bq/year	4.6E+05 Bq/year
aerosols:	3.09E+11 Bq/year	8.0E+10 Bq/year	9.0E+07 Bq/year

No radioactive discharges into the air from the NNPP will be produced during the construction.

During the termination of operation and decommissioning there will be gradual significant decline in discharges (by up to several orders) compared to the period of operation. The nuclide content of gaseous discharges will be different during the termination of operation and decommissioning than during the operation (a significantly lower share of noble gases and iodines).

Radioactive discharges into streams:

tritium:	up to 7.5E+13 Bq/year
corrosive and fission products:	up to 1.0E+10 Bq/year

The above values present the envelope (the maximum, for the configuration of 2 x 1,200 MW_e) annual discharge activities of individual groups of radioactive nuclides into streams during normal operation. They are derived from published, publicly accessible data of reference type reactors suppliers. Based on the operating experience it can be reasonably expected that the actual discharges into streams will be significantly lower than the values estimated by the project, which is also evident from the operation of NPP Bohunice 3,4 (see below).

The isotope content is dominated by tritium that originates in the primary circuit from the reaction with boric acid (included in low concentrations in the water coolant and serving as soluble neutron absorber for controlling the fission chain reaction) and that cannot be captured by cleaning systems. The discharges from the NNPP will be released into the effluent stream (the Váh river) after radiological check in a controlled way through the new final waste water collector (together with process and sewage waste water).

The discharges into streams from the existing nuclear facilities in the site are as follows:

tritium:	up to 1.2E+13 Bq/year
corrosive and fission products:	up to 4.0E+08 Bq/year

The above values present an envelope selection of the maximums of measured values of discharge activities of individual radioactive nuclides for the years 2003 to 2012 from the NPP Bohunice 3,4 in operation. These values contain the envelope values (selection from maximums) of the measured values of discharge activities of individual radioactive nuclides for the years 2009 to 2009 from other facilities in the site (the NPP Bohunice A1 and 1,2 in decommissioning, RAW treatment facilities and SNP storage facilities), which constitute only an insignificant portion of tritium discharges, but still the significant portion of discharges of other radioactive nuclides into streams from the EBO site. The discharges are released into the effluent stream (the Váh river, or in special cases the Dudváh river[22]) after radiological check in a controlled way through the Socoman final waste water collector (together with process and sewage waste water).

For illustration and comparison, also the project and limit permissible values of dominant radioactive nuclides discharges from the NPP Bohunice 3,4 into streams are shown. They prove that the real maximums of discharges into streams are much lower than the maximum projected value for corrosive and fission products provided by the supplier and the permissible limit and that the tritium discharges meet the project value and also the permissible limit.

	project value	permissible limit	maximum measured
tritium:	2.0E+13 Bq/year	2.0E+13 Bq/year	1.1E+13 Bq/year
corrosive and fission products:	1.3E+10 Bq/year	1.3E+10 Bq/year	4.0E+07 Bq/year

No radioactive discharges into streams from the NNPP will be produced during the construction.

During the termination of operation and decommissioning, gradual significant decline in discharges (by up to several orders) compared to the period of operation.

Ionising radiation field: insignificant

The ionising radiation field means the effect of electromagnetic (gamma) radiation or neutrons directly from the technological objects (without the contribution of discharges). This is already insignificant in close vicinity of the technological objects of both the NNPP and also the existing facilities, including their decommissioning.

22 There is an option for the NPP Bohunice A1 (in terms of valid permissions) to release the low-active discharges into the Dudváh effluent stream through the Manivier collector. This applies to well-founded cases during the repair or revision of the Socoman waste water collector and the supervisory body must issue a permit for the release.

No sources of ionising radiation that could have practical importance with regard to environmental protection will be used during the construction. The sources considered can be the closed emitters that are part of various devices (e.g. flaw detecting devices for the inspection of welds, etc.).

Radioactive waste: overall amount: up to 120 m^3/year

The values shown present the envelope (the maximum, for the configuration of 2 x 1,200 MW_e) production of RAW. It follows from the European Utilities Requirements for Light Water Nuclear Power Plants that established the reference value at 50 m^3/1,000 MW_e/year. The sources of waste are mainly the liquid RAW processing systems (concentrates from evaporating station, spent ion exchangers and sludge, later treated in JAVYS), the filters of active HVAC systems, used measurement probes and evidence sample cassettes, contaminated unserviceable parts, protective means or clothing, separated materials from the controlled zone, etc. With regard to the RAW classification in terms of statutory established classes, only very low level, low level and intermediate level waste will be produced.

The RAW production from the existing JAVYS facilities varies depending on the actual decommissioning activities on NPP Bohunice A1 and 1,2. Up to 25 m^3 of liquid RAW per year is produced within the NPP Bohunice 3,4 operation, consisting of up to 20 m^3 of radioactive concentrates, up to 5 m^3 of spent sorbents and of radioactive oil in negligent amount. Furthermore, the NPP Bohunice 3,4 operation produces up to 15 t of solid RAW. The RAW production in NPP Bohunice 3,4 has a long declining trend.

No radioactive waste will be produced during the construction of NNPP.

RAW in the orders of thousands m^3 will be produced during the termination of operation and decommissioning. It will comprise mainly of separated contaminated materials (contaminated technological systems or building structures) from the disassembly and demolition and materials used for decontamination.

Spent nuclear fuel: up to 42.0 t of UO_2/year

This amount represents approx. 80 fuel units per year. The amount of produced spent nuclear fuel corresponds to the amount of fresh fuel in the charge.

The same assumption applies also to the operation of the existing facilities (NPP Bohunice 3,4).

No spent nuclear fuel will be produced during the construction of NNPP.

No more spent nuclear fuel will be produced after the termination of operation and the removal of fuel from the reactor.

IV.2.7. Other Outputs

Non-ionising radiation: insignificant

The proposed activity is not a significant source of non-ionising radiation (magnetic or electric field). The electric lines (conducting the output or the backup power supply) located in the outer publicly accessible area will meet the required limits.

IV.3. Data on the Environmental Impacts

3. Data on expected direct and indirect environmental impacts.

IV.3.1. Impacts on Population and Public Health

IV.3.1.1. Health Impacts and Risks

IV.3.1.1.1. Radiation Impacts

With regard to the expected impacts of NNPP on population and public health, the impact of ionising radiation, i.e. the impact of radioactive discharges from the power plant into the environment (air, streams) can be assumed to be the most monitored. These discharges become part of the ecosystem and their radioactive elements are then received by the population via various propagation routes, mainly through breathing (inhalation) and/or consummation (ingestion). These impacts will have a co-operative effect of the new nuclear power plant together with the existing nuclear facilities in the site during their life cycle (operation, decommissioning).

No negative impacts on the population health, not even at the concurrent co-effect of other nuclear facilities in the site, are expected with regard to the considered discharges from the NNPP, to the impact of the existing nuclear facilities in the site so far and also the generally negligible share of the nuclear power production on the population irradiation (for more details see the chapter III.4.4 Ionising Radiation, page 83 of this Preliminary Study).

Despite this fact, the expected impacts on the population and public health will be evaluated in the Environmental Impact Assessment Report on the grounds of detailed calculations of the impact of radioactive discharges into the air and streams (for more detail on calculation see the chapter IV.3.4 Impacts of Ionising Radiation, page 126 of this Preliminary Study). The evaluation will be done partly through direct comparison of calculated irradiation dose with the statutory established limit doses, and partly (mainly) with the most advanced procedures of health risks assessment (for more details see the chapter IV.4. Health Risks Assessment, page 137 of this Preliminary Study).

IV.3.1.1.2. Non-Radiation Impacts

Naturally, apart from the radiation impacts, the impacts of non-radiation (conventional) factors, mainly the impacts of air pollution, noise and other factors will also be evaluated. Given the location of the activity outside residential areas, no significant negative impacts are expected even in this case (more significant can be only the impacts of the related transportation traffic using roads in contact with the residential area!.

The aforementioned impacts will also be evaluated in detail in the Environmental Impact Assessment Report, compared with respective limits and assessed with regard to health.

IV.3.1.2. Psychological Impacts

The proposed activity is located in the area in which numerous nuclear facilities have operated for a long period of time. It can be stated that the attitude of inhabitants of the area concerned towards nuclear energy production is long established consolidated by this fact and that the execution of proposed activity will probably not affect it significantly.

The conducted public opinion surveys (for more detail see the chapter III.4.1.4 Public Opinion on Nuclear Energy Production, page 78 of this Preliminary Study) show on one side the positive perception of the secure operation of nuclear facilities and social and economic benefits of nuclear facilities in the EBO site, and on the other side, part of the inhabitants of the region show certain concerns from unspecified adverse impacts on the environment. These opinions or their developmental trends will probably not change after the execution of proposed activity.

IV.3.1.3. Social and Economic Impacts

The proposed activity does not require any changes in the settlement structure of the area (demolition of housing objects, abolishing municipalities, etc.). Thus there are no social impacts incurred derived from the need to forcibly relocate the inhabitants. The activity is not a new (not pre-existing) activity in the area. Basically it means continuation of current activities. Therefore, significant change of the existing ownership structure of properties or their prices cannot be expected. Rather an increase in demand can be expected. Neither can the direct positive impact on the infrastructure of municipalities due to the sponsorship policy of the operators of nuclear facilities be ignored, which aims (among other things) to compensate for adverse impacts of the related traffic within the municipalities.

Economically speaking, the proposed activity will be a significant positive factor through creating a significant amount of new employment opportunities, both for highly-skilled professionals and for less-qualified professions.

IV.3.1.4. Impacts During the Construction and Termination of Operation

The radiation situation will not be affected during the construction of NNPP (no discharges of radioactive nuclides into the environment will be released) and therefore the population will not be affected. After the termination of the NNPP operation, the release of radioactive discharges into the environment will decline by several orders of magnitude, compared to the period of operation, and thus the impacts on population will decline as well.

Basically, the most important non-radiation impacts on the population and public health will thus remain the impacts of construction and building activities during the construction of NNPP and subsequently (after the period of operation, i.e. after more than 60 years) the decommissioning and demolition activities. For these activities, the operation of construction machinery on the construction site and traffic on transportation routes are typical. Their impacts, specified mainly by impacts on the air and the impacts of noise, will be analysed in detail in the Environmental Impact Assessment Report.

With regard to social and economic impacts during the construction, the increase of the employment rate but also of demands on corresponding infrastructure of the area concerned (housing, social requirements) is expected.

IV.3.2. Impacts on Air and Climate

IV.3.2.1. Impacts on Air

The new nuclear power plant, as any nuclear power plant, will not be a significant source of the emissions of air pollutants (SO_2, NO_x, CO, PM, etc.). These substances will be released only in very small quantities during the operation of auxiliary devices, such as diesel generator stations. The pollution of this type will possible be during the operation only during tests of backup power supply and during exceptional operation of this power supply. The impact of these sources on air pollution can be considered as not very significant.

No greenhouse gases are released into the air during the nuclear power plant operation, through which they contribute to a global decrease of CO_2 emissions by 800 million tonnes, approx. 15 million tonnes of CO_2 per year in the Slovak Republic. The nuclear energy production plays a irreplaceable role thus as a "non-carbon" source also from the perspective of the EU member countries' obligation to reduce the CO_2 emissions by 20 % of the 1990 level by 2020 and other long-term goals leading to almost complete elimination of CO_2 emissions.

Another contributor to air pollution will be the vehicle transport over transport routes, either transporting employees of materials and components needed for the operation of NNPP. The impact of these sources on air pollution can be considered as not very significant.

IV.3.2.2. Impacts on Climate

The emissions of heat and water from the NNPP operation could lead to the following climatic impacts:

- increased average air humidity and air temperature in the ground layer of atmosphere,
- increased amount of liquid and solid precipitation, increased occurrence of ground fog and frost,
- cloud formation from water vapours from coolant tower and therefore decreased duration of sunshine.

Based on processed data from the period 1981 to 2010 the increased dynamics of climatic system is typically due to anthropogenic influences, whose trend heads towards the climate warming. This trend can be seen not only globally, but also regionally. According to the 2007 Assessment Report of the Intergovernmental Panel on Climate Change, the occurrence of extreme weather phenomena is simultaneously rising. A similar trend in the climatic system development can be expected in the area in question in the following period.

Taking the current situation into account and taking the proposed scope of activity within the execution of the NNPP, we assume that this type of impact should be only of minimal and local importance, moreover not presenting a measurable change within the long-term monitoring of the site. In most cases it will concern changes less distinctive than climatic changes that will occur during more extreme years. These impacts will gradually decrease off with increasing distance from the NNPP.

These conclusions also apply to co-effect impacts with other facilities in the EBO site. In the period of 1985 to 2008, the NPP Bohunice 1,2 with the capacity 2 x 440 MW_e was running concurrently with the NPP Bohunice 3,4 and moreover, NPP Bohunice 3,4 will be decommissioned during the operation of the NNPP .

IV.3.2.3. Impacts During the Construction and Termination of Operation

During the construction, the air will be polluted by the car traffic on transportation routes of construction materials and technological part and further from other construction machinery driven by fuel consuming combustion engines. Moreover, the construction will cause dustiness, mainly during the execution of ground works and demolitions of structures needed to clear the area.

Based on the above mentioned facts, impact of construction with regard to air pollution will be limited to the area of the construction itself and its close surroundings. The impact of NNPP construction on the air pollution will be of standard nature, i.e. within the extent usual for construction and will be limited to the period of approx. 4 to 6 years. The mitigation of the impact on air quality must be primarily handled by a suitable design of the organisation of construction. The impacts of secondary dustiness can be decreased through the execution of suitable technical and organisational measures. Under general conditions for operation of sources emitting particulate matter, the transportation routes and handling areas will have to be regularly cleaned and sufficient dampness of surfaces will have to be maintained to prevent or limit dissipation. The measures will have to be implemented mainly during long periods of windy weather without any precipitation. In terms of significance it can be said that the air pollution during the construction will not mean a significant deterioration of air quality.

Given that the emissions from traffic and also accompanying activities in the site during the termination of operation will not surpass the emission during the construction, we expect similar insignificant impacts also during the termination of operation and decommissioning.

IV.3.3. Impacts of Noise

IV.3.3.1. Impacts of Noise

IV.3.3.1.1. Noise from the Operation of Technology

Noise impacts (of both existing and future sources) depend on the distance, the nature of acoustic parameters of technology's devices (their acoustic output), location of devices and time of their operation. The increase of noise level can be expected mainly on a local level (inside the nuclear power plant area or in its close surroundings).

No noise measurements in the outer environment of protected housing structures in the closest settlements are known for the existing operations. This due to the more than sufficient distance of the area's edge from the closest developed area (1,600 m). The main sources of noise are approx. 2 km away. The operating structures of NNPP will be located no closer than approx. 1,200 m from the closest or most affected developed area (Radošovce c.a.), i.e. in the distance over which the noise impacts can be reliably handled.

Operations with tonal noise emissions (e.g. substations and electric stations) can be more important in terms of noise effect. With regard to noise emissions, also non-standard activities, such as safety valves of steam generators, air discharge stations and safety valves of reduction stations. These sources, however, are not running during the power plant's standard operation (they are intended for transitory states and abnormal or emergency conditions, they are also put into operation for few seconds during their periodical inspections).

IV.3.3.1.2. Traffic Noise

The noise from car traffic depends mainly on the intensity and composition of traffic stream and from the characteristics of road's route. The assessed project will be connected to transportation from two directions - from the Jaslovské Bohunice municipality with the III/504012 road and from the Žlkovce municipality with the III/504015 road. In relation to the NNPP operation, we expect an increase of car traffic on these roads by approx. 40 %, for trucks the intensity in daily peaks can be increased by up to 70 %. It can be concluded from this traffic increase that a noise load increase by up to 1.5 dB can be expected near the most affected section. But given the current low load of this road, this increase will probably not exceed the statutory limits.

Data on traffic intensity on higher class road show a real projection of reaching the acceptable noise levels from road traffic.

Given the distribution of traffic into various directions and the much higher current load of these sections, the increase of noise levels in the affected settlements can be considered insignificant compared to the situation prior to the construction of NNPP.

IV.3.3.2. Impacts During the Construction and Termination of Operation

The construction phase will be pivotal in the area concerned in term of noise situation. It will be connected with intense construction activity in the NNPP site and transportation of construction materials, raw materials and workers.

Apart from the construction in the NNPP site and the proposed electrical station, the traffic for the execution of infrastructure utilities has to be taken into account.

The noise around running earthmoving machines is, naturally, temporary noise and it reaches quite high level in the construction site. But we expect the closest protected areas to meet the hygienic limits for noise from construction activity.

From the perspective of the impact on protected housing areas, the more dangerous is the transportation related to the construction activity. In the most exposed areas (III/504014 road between the NNPP and the Žlkovce municipality), we expect the increase of traffic-related noise load by approx. 3 dB against the expected basic traffic load in 2020. Similarly in case of the operation of NNPP, we expect a less significant impact on noise situation on connecting roads. But given the current traffic load of II. class roads there is a real expectation of exceeding the acceptable noise levels from road traffic (60 dB for daytime and evening time, 50 dB for night time). For these reasons it will be necessary to pay special attention to the issue of noise load from the induced car traffic.

The mitigation of the impact of the construction and meeting hygienic limits for traffic noise could be provided through organisational measures (the design of the organisation of traffic - time, route and mean of transport) and also with technical anti-noise measures, if needed.

During the termination of operation, lesser significance of noise impacts than during operation or construction can be expected.

IV.3.4. Impacts of Ionising Radiation

IV.3.4.1. Impact of Radioactive Discharges into the Air

The radioactive discharges from the NNPP will be released into the air in a controlled way through vent chimneys of production blocks and auxiliary operations. At the same time, the radioactive discharges of other nuclear facilities in the Jaslovské Bohunice sites (operated and later decommissioned NPP Bohunice 3,4, the NPP Bohunice A1 and 1,2 in decommissioning, RAW treatment facilities and SNP storage facilities) will be released in the air, depending on the schedule of their operation. The activity produced by the NNPP and other existing nuclear facilities in the site (i.e. source member) will not exceed values shown in the chapter IV.2.6. Radioactive Outputs, Ionising Radiation (page 120 of this Preliminary Study).

The calculation of the propagation of radioactive discharges through the environment (air and related exposure paths) and their radiological impacts under the standard operation conditions[23] will be done in the Environmental Impact Assessment Report both for the NNPP operation and for the operation of the NNPP together with other nuclear facilities in the site (co-operative effect). The calculation will be done by the RDEBO programme, approved by the Nuclear Regulatory Authority of the Slovak Republic. All relevant irradiation paths are considered in this programme:

- external irradiation from cloud and deposit,
- internal irradiation through inhalation and ingestion, i.e. the intake of radioactive nuclides through breathing and consuming (radioactive nuclide that enter the food chains via atmospheric fallout with taking the seasonality into account when calculating the doses from food chains).

[23] For data on the non-standard situation (emergencies and severe accidents) impact assessment methodology see the chapter IV.9. Further Possible Risks or its sub-chapter IV.9.1.4. Approach to the Assessment of Radiologic Impacts of Accidents within the EIA Process (page 145 of this Preliminary Study).

The critical (i.e. the possibly most affected) population group or a representative person from the critical group, the critical irradiation path and critical radioactive nuclides for individual irradiation paths will be determined. Furthermore, the effective doses or committed effective doses for both the representative person and also for individual population age groups and distance zones from the source (including potential cross-border impacts) will be determined.

The calculated doses will be compared to respective statutory limits[24] and at the same time they will become inputs for assessment of impacts on the population and public health (for more detail see chapter IV.3.1 Impacts on Population and Public Health, page 122 of this Preliminary Study and chapter IV.4. Health Risk Assessment, page 137 of this Preliminary Study).

It can be tentatively stated that given the choice of technology for the new nuclear power plant and the history of experience with the nuclear power plant operation in the Jaslovské Bohunice site, no significant negative impacts of radioactive discharges are expected into the air. But the above mentioned applies in every case, i.e. final conclusions will be made in the Environmental Impact Assessment Report on the grounds of detailed analyses of irradiation paths and health risk assessment.

IV.3.4.2. Impact of Radioactive Discharges into Streams

The radioactive discharges from the NNPP will be released into the stream (the Váh river) in a controlled way through the new waste water collector. At the same time, the radioactive discharges of other nuclear facilities in the Jaslovské Bohunice sites (operated NPP Bohunice 3,4, the NPP Bohunice A1 and 1,2 in decommissioning, RAW treatment facilities and SNP storage facilities) will be released in the same stream (but through the existing waste water collector), depending on the schedule of their operation. The activity produced by the NNPP and other existing nuclear facilities in the site (i.e. source member) will not exceed values shown in the chapter IV.2.6. Radioactive Outputs, Ionising Radiation (page 120 of this Preliminary Study).

The calculation of the propagation of radioactive discharges through the environment (water environment and related exposure paths) and their radiological impacts under the standard operation conditions[25] will be done in the Environmental Impact Assessment Report both for the NNPP operation and for the operation of the NNPP together with other nuclear facilities in the site (co-operative effect). The calculation of radiological consequences due to discharges into streams (hydrosphere) will be done by the RDEBO computing programme, which models also the propagation of radioactive substances and their subsidiary products in water environment and takes into the account the effects of ingestion of potable water, the ingestion of fish living in the water, the ingestion of meat and milk of animals fed the water, the ingestion of agricultural products irrigated by the water, bathing in the water, boating, presence on deposits (presence on the riverbank) and presence on the irrigated land.

The annual effective doses for all age groups will be assessed, from which the critical (i.e. potentially the most affected) population group (or the representative from the critical group) will be determined,. The results will be documented for the zone through which the Váh river runs with the maximum values of calculated effective doses or committed effective dose.

[24] The annual acceptable limits for the amount of radioactive substances released into atmosphere and hydrosphere from nuclear facilities in the EBO site is determined by the Public Health Authority (PHA) of the Slovak Republic. Their purpose is to ensure that the operation of nuclear facilities will not cause the statutory set effective dose of 250 μSv/year or the lower effective dose authorised by a reasoned decision of the PHA to be exceeded in the representative person from the population due to radioactive discharges. This dose is currently determined cumulatively at 82 μSv/year for the EBO site. From the data shown in chapter III.4.4.2. Radiation Situation of the Area Concerned (page 84 of this Preliminary Study) it clearly follows that the actual discharges from the existing facilities are well below the acceptable limits. Also the NNPP will be governed by the same principle, its contribution to the existing discharges cannot in any case cause the overall acceptable limits of individual radioactive substances, determined by the Public Health Authority, to be exceeded.

[25] For data on the non-standard situation (emergencies and severe accidents) impact assessment methodology see the chapter IV.9. Further Possible Risks or its sub-chapter IV.9.1.4. Approach to the Assessment of Radiologic Impacts of Accidents within the EIA Process (page 145 of this Preliminary Study).

The calculated doses will be compared to respective statutory limits[26] and at the same time they will become inputs for assessment of impacts on the population and public health (for more detail see chapter IV.3.1 Impacts on Population and Public Health, page 123 of this Preliminary Study, and chapter IV.4. Health Risk Assessment, page 137 of this Preliminary Study).

It can be tentatively stated that given the choice of technology for the new nuclear power plant and the history of experience with the nuclear power plant operation in the Jaslovské Bohunice site, no significant negative impacts of radioactive discharges into streams are expected. But the above mentioned applies in every case, i.e. final conclusions will be made in the Environmental Impact Assessment Report on the grounds of detailed analyses of irradiation paths and health risk assessment.

IV.3.4.3. Impact of Radioactive Discharges on Groundwater

No discharges from the power plant will be released into groundwater.

With regard to the effect on existing water sources, the area of the Hlohovec water source where the water shows higher (but reliably below the limit[27]) values of tritium at approx. 10 Bq/l, remains the area of increased interest. This tritium infiltrates from Drahovský channel where the waste waters from the EBO site released are and also where the waste waters from the NNPP will be released to. No significant effect on the existing situation is expected.

IV.3.4.4. Other Impacts of Ionising Radiation

Any other impacts of ionising radiation can be ruled out. The ionising radiation field (i.e. the effect of electromagnetic (gamma) radiation or neutrons directly from the technological objects, without the contribution of discharges) is already insignificant in close vicinity of the technological objects (of both the NNPP and also the existing facilities) and it does not concern the surrounding environment.

IV.3.4.5. Impacts during the Construction and Termination of Operation

No sources of ionising radiation that could have practical importance with regard to environmental protection will be used during the construction. The sources considered can be the closed emitters that are part of various devices (e.g. flaw detecting devices for the inspection of welds, etc.), without significant impact on the surrounding.

It is expected that the structures will be founded above the groundwater level and the saturated environment thus won't be affected. The foundation alternatives allow for leaving on the saturated aquifer part of alluvial clays that will serve as natural protection barrier of the saturated aquifer.

During the termination of operation and decommissioning, the radiation impacts will decline by several orders of magnitude compared to the period of operation. Also the respective doses for population will decline proportionately. Thus it can be expected that with satisfactory impacts of the operation, also the impacts of the termination of operation and decommissioning will be reliably satisfactory.

[26] The annual acceptable limits for the amount of radioactive substances released into atmosphere and hydrosphere from nuclear facilities in the EBO site is determined by the Public Health Authority (PHA) of the Slovak Republic. Their purpose is to ensure that the operation of nuclear facilities will not cause the statutory set effective dose of 250 μSv/year or the lower effective dose authorised by a reasoned decision of the PHA to be exceeded in the representative person from the population due to radioactive discharges. This dose is currently determined cumulatively at 82 μSv/year for the EBO site. From the data shown in chapter III.4.4.2. Radiation Situation of the Area Concerned (page 85 of this Preliminary Study) it clearly follows that the actual discharges from the existing facilities are well below the acceptable limits. Also the NNPP will be governed by the same principle, its contribution to the existing discharges cannot in any case cause the overall acceptable limits of individual radioactive substances, determined by the Public Health Authority, to be exceeded.

[27] According to the amended Government Regulation No. 354/2006 Coll., establishing indication values of the limits of the radiological indicators of drinking water quality, the limit for tritium (H-3) is 100 Bq/l and the limit of annual committed effective dose from the intake of radioactive nuclides is 0.10 mSv/year.

IV.3.5. Impacts on Other Physical and Biological Characteristics

IV.3.5.1. Impacts of Vibrations

Potential impacts of vibrations are ruled out.

IV.3.5.2. Impacts of Non-Ionising Radiation

Potential impacts of non-ionising radiation (i.e. magnetic or electric field in the vicinity of electric devices) will not be significant and will meet the required limits.

IV.3.5.3. Impacts of Other Physical and Biological Characteristics

The potential impacts of other physical and biological characteristics are ruled out.

IV.3.5.4. Impacts during the Construction and Termination of Operation

Potential impacts of vibrations, non-ionising radiation or other physical and biological agents during the construction or the termination of operations are ruled out.

IV.3.6. Impacts on Surface and Ground Water

IV.3.6.1. Impacts on Surface Water

The impact of the NNPP on surface water can be expected due to withdrawing raw water (the Váh river, the Sĺňava water reservoir) and release of waste waters (the Váh river) and rainfall water (the Dudváh river). This impact will act together with the co-operative effect of the current operation of other nuclear facilities in the Jaslovské Bohunice site, which use the same sources of water and the same effluent streams.

In terms of quantity, the water intake for nuclear facilities is provided for; the water loss (mainly due to evaporation) at approx. 1.645 m^3/s is not significant.

The qualitative characteristics of waste waters from the NNPP and other facilities in the site (NPP Bohunice 3,4, NPP Bohunice 1,2, NPP Bohunice A1, radioactive waste processing and treatment technologies (RAW PTT), interim spent fuel storage facility (ISSFSF)) are shown in the following tables:

Tab. IV.1: Estimated maximum emission mass indicators in waste waters from the NNPP (year 2025)

Indicator	Max. value [mg/l]	Max. daily flow [m^3/day]	Max. daily mass pollution [kg/day]
biological oxygen demand BSK_5	1,798	38,275.2	68.811
chemical oxygen demand by chromate - $CHSK_{cr}$	13.582	38,275.2	519.885
insoluble substances - IS	9.557	38,275.2	365.798
soluble substances - SS	668.155	38,275.2	25,573.791
ammonium nitrogen $N\text{-}NH_4^+$	0.504	38,275.2	19.313
nitrates NO_3^-	38.559	38,275.2	1,475.857
sulphates SO_4^{2-}	188.243	38,275.2	7,205.042
chlorides Cl^-	74.156	38,275.2	2,838.366
non-polar extractable substances (NES)	0.088	38,275.2	3.377
phosphorus total - P_{total}	0.179	38,275.2	6.860
iron - Fe	0.102	38,275.2	3.905
hydrazine hydrate N_2H_4	0.019	38,275.2	0.738
detergents - PES	0.105	38,275.2	4.010

Tab. IV.2: Estimated maximum emission mass indicators in waste waters from other facilities (year 2025)

Indicator	Max. pollution NPP Bohunice 1,2, A1 [kg/day]	Max. pollution NPP Bohunice 1,2 [kg/day]	Max. overall pollution [kg/day]
biological oxygen demand BSK_5	96.77	79.49	176.260
chemical oxygen demand by chromate - $CHSK_{cr}$	362.88	298.08	660.960
insoluble substances - IS	241.92	198.72	440.640
soluble substances - SS	12,096	11,923.2	24,019.200
ammonium nitrogen $N\text{-}NH_4^+$	48.38	39.74	88.1200
nitrates NO_3^-	604.8	794.88	1,399.680
sulphates SO_4^{2-}	1,814.4	3,477.6	5,292.000
chlorides Cl^-	1,209.6	1,788.48	2,998.080
non-polar extractable substances (NES)	4.23	3.48	7.7100
phosphorus total - P_{total}	24.19	14.9	39.090
iron - Fe	24.19	19.87	44.060
hydrazine hydrate N_2H_4	-	19.87	19.870
detergents - PES	6.04	4.97	11.010

The following table shows the theoretically possible pollution of Váh's waters resulting from releasing process waste waters at the Váh's decreased rate of flow to the sanitary rate of flow of 6.4 m^3/s and the comparison of calculated values with pollutant limits for surface waters under valid legal regulations.

Tab. IV.3: Comparison of estimated pollutant values of the Váh's waters pollution with current immission limits (year 2025)

Indicator	Max. pollution NNPP [kg/day]	Max. pollution NPP Bohunice 1,2, A1 and RAW PTT [kg/day]	Max. pollution NPP Bohunice 1,2 [kg/day]	Resulting concentration in water stream [mg/l]	Pollutant limit under GR 269/2010 [mg/l]
BSK_5	68.811	96.77	79.49	0.443	7
$CHSK_{cr}$	519.885	362.88	298.08	2.134	35
IS	365.798	241.92	198.72	1.458	-
SS	25,573.791	12,096	11,923.2	87.767	900
$N\text{-}NH_4^+$	19.313	48.38	39.74	0.194	1
NO_3^-	1,475.857	604.8	794.88	5.195	5
SO_4^{2-}	7,205.042	1,814.4	3,477.6	22.526	250
Cl^-	2,838.366	1,209.6	1,788.48	10.532	200
NES	3.377	4.23	3.48	0.020	0.1
P_{total}	6.860	24.19	14.9	0.083	0.4
Fe	3.905	24.19	19.87	0.087	2
N_2H_4	0.738	0	19.87	0.037	-
PES	4.010	6.04	4.97	0.004	-

Note: The resulting concentration of pollutants in water stream was calculated from the contribution of all polluters in the EBO site and the NNPP at the considered minimum rate of flow in the Váh of 6.4 m^3/s.

The maximum possible pollution from NPP Bohunice 3,4 (NPP Bohunice A1, NPP Bohunice 1,2) follows from annual limits for released waste waters.

It follows from the table shown that even under the least favourable conditions and concurrent decrease in Váh's flow of rate to minimum, a reasonable assumption of meeting the limits exists. Attention should be paid only to the NO_3^- indicator during exceptional situation of the Váh's minimum[28] rate of flow (6.4 m^3/s)..

The temperature in the Váh effluent stream under the discharge into the stream shall not exceed 28°C due to the release of waste waters (the decision No. KÚŽP1/2006/00273/Fr Trnava). In case of release of process waste waters from the existing facilities in the EBO site for the past period, the waste water temperatures were close to the limit (even exceeding the limit for a short period of time) in summer months. This waste water indicator is strongly affected by the air temperature in the surroundings of the NPP and occasional long-lasting warm weather can cause crossing this limit, while also the temperature in the Slňava reservoir, i.e. the raw water temperature, contributes unfavourably to it.

[28] To illustrate - the annual average rate of flow of the Váh at the Hlohovec profile is 140 m^3/s.

Following from the history of experience with the nuclear power plant operation in area concerned, no significant negative impact of the NNPP on the qualitative characteristics of surface waters is expected. The envelope (the least favourable) parameters of the NNPP comply with the requirements of pollutant limits under GR No. 269/2010 Coll. even with concurrent release of waste waters from other facilities of the Bohunice site.

IV.3.6.2. Impacts on Ground Water

Three nuclear power plants at various stages of the development of construction and operation technology were built in the Jaslovské Bohunice area in the past. Today, they are in various phases of life cycle - standard operation (NPP Bohunice 3,4) and decommissioning (NPP Bohunice A1, NPP Bohunice 1,2). No significant risk impacts on physical, chemical and biological quality of groundwater in the area manifested in any phase (construction, operation, decommissioning) of these facilities, what is also the result of geological structure of the subsoil. For this reason, we also expect an insignificant impact of the NNPP on physical, chemical and biological quality of groundwater. The potential risk factors (emergencies in operation of technologies and processing and collection of waste waters) will be eliminated with respective preventive measures.

The construction of the NNPP will not have any impact on water sources or protection zones of groundwater water sources. The NNPP does not interfere with any of the groundwater protected area. The eventual protection of wells will have to be solved on the grounds of the results of the phase of detailed site survey and according to valid decisions of respective water rights authority.

IV.3.6.3. Impacts during the Construction and Termination of Operation

The surface waters can be potentially polluted during ground works by increased leaks of operational liquids from construction machinery into the soil. But this impact will probably be not significant and will be eliminated with proper measures. Similarly, no significant negative impacts on groundwater can be expected during the construction. The potential risk factors (arising from the operation of trucks, construction machinery and increased amount of workers) will be eliminated with respective preventive measures.

The impacts will decline and gradually disappear during the termination of the NNPP operation. The removal of fuel from blocks will cause significant decline in raw water intake and related release of process waste waters, whose volume will be limited in last years of decommissioning only to the release of treated sewage waters and waters from last operated modified systems prior to their removal.

IV.3.7. Impacts on Soil

IV.3.7.1. Impacts on Soil

The most important impact of the proposed construction on the soil will be occupation, which is given by area demarcation for NNPP (New Nuclear Power Plant) siting. Permanent occupation for a new nuclear power plant siting (including areas for access road and railway spurs) will not exceed 70 ha. The rest of the areas of the total area for siting and construction of NNPP include areas for construction facilities or areas for dumping waste and soil, the siting of which can differ depending on final orientation of individual parts of NNPP. We expect temporary occupation on the level of up to 42 ha.

The occupation of the agricultural land represents the most important part of these areas. These are mostly the soils with a high production capability. The soil horizon will be removed during construction and used for a final finishing of the construction site, its reclamation and further use. None of the land lots affected is a part of forest-land resources (LPF).

Routes of the intake raw water pipe and exhaust waste water or rainfall water pipes will be built under the ground, without substantial demands on permanent occupation. Power lines above ground require occupation only for foundation bases of the utility poles. This soil occupation will have little significance.

Construction lies on a plain area, or slightly undulating area. The area affected is not threatened by landslides or by undermining. The execution of the proposed activity will not cause any change of a current status in this area.

We suppose that securing rainfall water runoff from the roofs and firming the areas of manipulation will not have a substantial impact on soil stability and erosion. The intended construction or operation will not reduce soil stability and there will be no erosion of the soils affected.

Current status of the soil quality in adjacent areas of the EBO area is subjected to regular inspections. The results we have gained so far show that it is not possible to prove the impact of the nuclear facilities in EBO locality on soil in the inspection points near the power plant. We do not expect the operation of the suggested activity to cause a substantial supply of hazardous substances to the soil environment and soil contamination. During the NNPP operation, regular monitoring of the individual parts of the environment and the soil inspection will continue.

IV.3.7.2. Impacts during the Construction Phase and Operation Termination

Potential soil contamination during the construction or during termination of operation is possible only in the case of accidental emergency situations of construction and transport mechanisms (as, for example, leakage of oil substances, hydraulic oils, etc.). Such emergency situations would be handled in accordance with the relevant emergency plan for water protection or following emergency transport rules. In case of free soil contamination by an oil substance, this soil will be disposed of as a hazardous waste (in line with the requirements of relevant legal regulations).

In relation to terminating the operation, we do not expect any further occupation of the soil fund.

IV.3.8. Impact on Rock Environment and Natural Resources

IV.3.8.1. Impact on Geologic Environment

Implementation of the project has a minimal impact on the geologic rock environment. The only direct influence is the excavation of subsoil layers in order to place the foundation constructions without further influence on its quality. The impact is restricted only to the area of the project. Integrity and quality of the rock environment will not be influenced during the operation.

There is no risk of slope deformations including subsurface creep in anthropogenic non-influenced environment of the NNPP locality surrounding.. Locally, there can be slight deformations within the reach of erosion of the local streams, without any impact on potential NNPP construction objects. There were discovered no soils that would be prone to liquidification. Stability and securing of engineered excavations (slope angles, lagging) will be determined individually according to the geotechnical calculation.

IV.3.8.2. Impact on Natural Resources

There are no economically important raw materials sources within the NNPP surroundings,. Registered or potential resources of raw materials will not be impacted.

IV.3.8.3. Impact on Geological and Paleontological Monuments

There is no potential impact on geological and paleontological monuments in the NNPP locality due to their absence.

IV.3.8.4. Impact during Construction and Decomissioning

The construction phase will demand certain amount of earthworks. The foundation variants with focus on calculated level of possible seismic load include improvement of the subsoil or its exchange to the level of gravel sediments (down to app. 20 m depth).

The implementation of the project will not influence soil stability or cause any higher degree of soil erosion. Construction will be carried out on levelled plane, which will be equipped with a system of storm water drainage. The unpaved areas of the location will be protected against erosion, either by paved communications or by the landscaping arrangements.

It is reasonable to expect that during the period after decommissioning, the foundation of the objects will be abandoned in the place, however, there are no expectations of any further influences on geological environment, natural resources, geological or paleontological monuments.

IV.3.9. Impact on Fauna, Flora and Eco Systems

IV.3.9.1. Impact on Protected Areas and Natura 2000

The area for siting and construction of NNPP does not directly impact any area of the national or European network of protected areas. According to Act No. 543/2002 Coll. on Nature and Landscape Protection, as amended, this area is under the level 1 protection.

The closest protected area is SKCHVU054 Špačinsko-Nižnianske fields with the nearest border in approximately 100 m from the outside border of the NNPP siting and construction area (however, the distance will be bigger in reality, due to the NNPP arrangement within the boundaries). The proposed intake of raw water is placed in the outskirts of water reservoir Síňava (SKCHVU026 Síňava). The waste water route leads 150 m south from protected area CHA Dedova jama and in near vicinity of south border of protected area CHA Malé Vážky.

We do not expect neither negative impact on the protected areas, protected zones or the area of Natura 2000 system during the NNPP operation nor any hazards caused to subjects of their protection.

IV.3.9.2. Impact on Other Elements of the Environment Protection

In the area of interest for NNPP construction and its immediate surroundings, there are no elements of territorial system of ecological stability (TSES). The existing road network will be used for transport routes, without any additional impact on TSES elements.

, Any direct impact on TSES elements during the NNPP operation is not expected. Indirect impact is related to impact on surface waters, which can be expected due to pumping and discharging of the water from the water recipients of Váh (reservoir Síňava–regional biological centre) and Dudváh (regional biological corridor). However, these influences do not represent threat to functionality of TSES elements.

IV.3.9.3. Impact on Fauna and Flora

Negative impact on flora, fauna and biotopes of a wider area of interest during the operation are not expected. Should there be any invasive species detected within the NNPP location, it will be necessary to take measures for their relocation, to prevent their spreading to the neighbouring areas.

During the operation, it is reasonable to expect impact connected with water intake, waste water discharge, temperature changes and chemical composition of discharged water and recipients. While maintaining all technical measures and limits, no impact or only minimal negative impact on quality and quantity of Dudváh and Váh waters is expected.

Considering the closeness of protected bird area, the power lines above the ground in NNPP to a new electric station represent (in certain conditions –fog occurrence, adverse weather, etc.) a certain risk that the flying birds could fly into the power lines. However, most probably the degree of such an impact will not be very significant. It involves quite a small area and in the case of monitoring and evaluating of any bird losses, it will be possible to additionally equip the power lines by signalling technical equipment.

IV.3.9.4. Impact during the Construction and Decomissioning

The permanent losses of the vegetation areas will be during the construction on paved areas. Except of these areas of permanent occupation, there will also be temporary occupations, such as waste fills, temporary soil waste fills, construction material storage, construction yards, the pipeline construction etc. It will be necessary to protect bushes and trees by shattering in those cases, where those will not be removed and the construction activities and construction machinery will be within their vicinity .The damaged areas will be landscaped or some areas could be put back into their original shape and usage after the construction.

Areas temporary disrupted by the construction machinery transport will be put into their original shape. A more accurate planning of temporary and permanent occupational areas will be possible in later phases of the project preparation.

Fauna and flora biotopes will be only slightly and temporary disturbed. That is why we can suppose that after finalising the construction, natural balance will be renewed in a short period of time and so the influence of the construction can be considered insignificant. Exact biotope identification and extent of their occupations will be possible in further phases of the approval process. In case there would be identified any negative impact on wet or wetland ecosystems, it is possible to transfer fauna and flora to more suitable locations and eventually find an alternative area. At the same time, it will be necessary to identify possible collisions of migrating species (for example amphibians or reptiles) and take the inevitable measures (barriers) and secure their transfer into more suitable locations.

Implementation of the project will most probably require cutting bushes and trees near field roads in some places due to construction and material transport., The already existing road network should be used during the construction as much as possible. In later stages of project documentation, we suggest making an inventory of bushes and wood species that will be prone to removal, including calculation of their social value and preparing a project of replanting, if necessary. The extent of the replanting would be determined based on eventually cut wood species agreed by relevant nature protection authority.

Fauna and flora of the wider area of interest are represented by common and typical representatives of agricultural landscape fauna and flora and their ecological functions and diversity of the species can be relatively successfully renewed after finalising the construction. During the earthworks, a spread of the invasive plant species can occur from construction surroundings, however, it is possible to eliminate or substantially decrease the impact of this phenomenon.

There will be an increased movement of the construction machinery in the area during the construction, which can lead to an increased air pollution, noise, dustiness and vibrations that can spread behind the construction area. It is necessary to thoroughly consider location of the construction yards and waste fills and guarantee that they will not be placed in the near vicinity of the protected areas.

It will be necessary to eliminate direct impact on the protected areas during the construction including the crossing of the construction machinery in near vicinity of these areas, location of the waste dumps in their near vicinity or by performing the construction works outside the nesting season. It will be necessary to pay attention to the technical solutions of the construction, so that the risk of water regime change within the protected areas is eliminated.

There are other activities connected to NNPP construction, for example, construction of the underground water piping. Raw water will be taken from the water reservoir Sĺňava, which is categorised as protected area CHA Sĺňava and SKCHVU026 Sĺňava. During construction works, there will be interventions into the water reservoir and these will have to take place outside the nesting season and there will have to be a strict control of the technical condition of machinery and equipment, in order to prevent possible leakage of oil substances.

By keeping the above mentioned measures, we do not expect any significant impact on protected areas.

Impact during the operation termination will not exceed the above mentioned influences during the construction stage.

IV.3.10. Impact on Landscape

IV.3.10.1. Impact on Landscape Character

Construction of NNPP, including the cooling towers, waste and raw water corridors and power overhead cables to the electrical station, will influence the *landscape* structure, because within the landscape the new anthropogenic objects will arise. As to the context of current and planned activities in the EBO locality and accumulation of expected influences on the landscape, it is necessary to emphasize, that in the near future, there will be a change of functional use of the land connected with the demolition of building objects, including the four cooling towers. It means that the anthropogenic landscape elements will be physically destroyed and the following adjustment of the area will also change its functional use. It is necessary to evaluate the impact of the newly built objects on a landscape in relation to the whole area of EBO, which is perceived within the landscape structure as a complex site. Considering also the accumulation of influences on the landscape, together with other activities on the EBO site, we do not expect them to be of high significance, in spite of the fact, that building one or two cooling towers will cause occupation of the land and a change in current functional use of the area.

Due to the NNPP construction including the cooling towers and power overhead cables to the electrical station, the *landscape* character will change. Cooling towers, operational objects of the power plant (especially the containment), but also overhead cables, are within the construction of NNPP the most visible objects. From the visual point of view, they represent dominant elements. By building the new cooling towers (respectively one tower) and destruction of four currently existing towers, the landscape character will change. This visual change will be more significant from certain observation points, because the new towers (respectively tower) will be placed to the west from current cooling towers. It means that the view which was dominated by the cooling towers of the nuclear plant and which the observers were used to seeing, will be changed. The height difference between the cooling towers that are considered in the construction (up to 180m or 164m in case of two towers) is not a key parameter in this case. In great observation distance it is obvious that from certain perspectives, the impact on the landscape character will be bigger in case of a tower with a bigger height. On the other hand, it is necessary to emphasize that observations from great distance are usually distorted by other influences, mostly related to weather conditions. On the contrary, a greater visual change of the landscape character will be visible from a smaller observation distance, because the horizon will be dominated by the objects differing in height (current height of the towers is 125 m, while the height of the towers planned is 180 m, other high objects will be the operational objects of the power plant and power lines above ground) and their arrangement will also be different (in comparison with the current status).

When we consider the impact on *stability* and *landscape protection*, there are no protected trees or protected areas pursuant to Act No. 543/2002 Coll., areas of NATURA 2000, biotopes of the national importance, nor any protected water management areas in line with Act No. 364/2004 Coll. in the area concerned, from this point of view, the considered activity will have neither positive nor negative influence on the types of areas mentioned. Similarly, we do not expect any impact on protected area CHKO Malé Karpaty and protected bird areas, or areas of European importance, located in broader surroundings of the area concerned. We do not expect that the considered activity will cause a significant change of ecological stability of the area concerned. Even the current status of the ecological stability in the evaluated area is on a low level and the ecological balance is kept by intentional human actions. The area concerned is currently in a condition of balance, so-called tertiary homeostasis, which means that the ecological balanced status is formed by concurrence of natural processes and anthropogenic activity, while the impact of human activity is much more apparent. We do not expect to identify any direct influences on TSES elements of local and regional significance in a wider area of interest.

IV.3.10.2. Impact during the Construction and Decomissioning

It is reasonable to expect the impact on the landscape structure, landscape character, stability and landscape protection during the construction of new objects in relation to construction works, construction material transport and the movement of construction machinery. These impacts are of a small significance and temporary nature.

The degree of impact of the new NNPP objects on landscape structure, landscape character, stability and landscape protection after the operation termination depends on a way, in which the operation will be terminated. If the objects are demolished, the landscape structure and landscape character will change. Currently, we can expect 60-year operation of NNPP. In case the expected finalising of the construction takes place in 2027, the NNPP will enter into the phase of operation termination and decommissioning after 2088. Before the decommissioning itself, plans will be prepared for its individual phases. After the decommissioning, the area will be released for further use, most probably further industrial use.

IV.3.11. Impact on Tangible Property and Cultural Monuments

IV.3.11.1. Impact on Tangible Property

In relation to the proposed construction, demolition of some construction objects is necessary, as well as replacement of the engineering networks. These are the operational objects, related to the electric energy production, while property relations of these objects are not solved. Third party tangible property is intact.

IV.3.11.2. Impact on Cultural and Historical Monuments

In the area of the NNPP siting and construction or its nearest surroundings, there are no monuments of cultural or historical value that would be at the centre of the interest of the inhabitants in near surroundings or visitors from the affected villages. There are no objects of small sacred architecture near the area for siting and construction of NNPP.

In a wider area of interest, there are some objects of cultural and historical value, however, due to the character and suggested location of the activities concerned, there will be no impact on them. In the area of the siting and construction of NNPP, there are no previously known archaeological sites that could be affected by the construction and there is no expectation of their possible occurrence. However, the possibility of the occurrence of an archaeological finding during the intended earth work construction is not explicitly eliminated. In the case that during the excavation or any other modification of the terrain, some archaeological structures are damaged it will be necessary to secure a safety archaeological examination, according to the provisions of Act No. 49/2002 Coll., on the Protection of Monuments and Historic Sights (amended and supplemented by Act No. 208/2009 Coll.) and proceed in accordance with the requirements of relevant legal regulations.

IV.3.11.3. Impact during Construction Phase and Operation Termination

The impact described above is relevant mainly to the construction phase. No additional influences will occur during the period of decommissioning

IV.3.12. Impacts on Traffic and Other Infrastructure

IV.3.12.1. Impacts on Traffic Infrastructure

Road No. III/50415 represents the only road connection of the site for passenger transport of employees as well as for the freight transport, (see diagram of the road network of the concerned area is stated in Chapter III.4.12. Transportation and Other Infrastructure, page 111 of this Preliminary Study). With regard to this fact, this road shall be the most affected from the aspect of increased traffic density. In connection with operation of New Nuclear Power Plant, we expect approximately a 40% increase of personal traffic on road No. III/50415. On the connecting road network, where traffic shall be distributed to both directions, we expect a increase on the nearby class III roads by road10%, on higher class road there shall be an increase by single digits of per cent.

The intensity of freight traffic that ensures delivery and disposal of material and devices needed for operation of the New Nuclear Power Plant may be increased on road No. III/50415 in daily rush hour phases by 70%. However on average we expect the increase to be much lower. Similar to passenger traffic, freight traffic will be distributed to the wider road network, while on roads of higher classes freight traffic shall gain significant values. These changes present conservative values, real increase may be expected to be lower.

In the case of railroad traffic, the impact of usage of the railroad traffic can be considered to be insignificant, railroad connection of the site has more than sufficient capacity reserve. Impact on other traffic infrastructure of concerned area (air, water, bicycle, or pedestrian traffic) is practically non-existing.

Stated evaluation of NNPP project implementation may be pertained also on the operation of other facilities in EBO site. Intensities of existing traffic, related to other facilities are already included in data about present (background) state. All roads, on which traffic operation shall take place, have sufficient capacity and are properly equipped for considered operation. Impact of overall traffic load after the increase of traffic intensities on most concerned roads may be from the traffic aspect considered to be during the operation stage little significant .

IV.3.12.2. Impact on Other Infrastructure

Apart from own utilities necessary for project operation (electrical power outlet, auxiliary power supply, water management intake), the implementation of the project shall have no other impact on the infrastructure within the area. Possible changes in the concerned infrastructure network shall be brought into the original state or to state required by its operators.

During the course of construction, supply of town and villages with electric energy and other media (water, natural gas, and other) shall be sustained.

IV.3.12.3. Impacts During the Construction and Decommissioning

The greatest percentage impact of the load on road network during the course of construction of the new nuclear power plant is expected in the vincinitz of the construction site, on the roads between the construction site, Trnava and D1 motorway. Overall traffic load shall not exceed, from the aspect of roads capacity, referential theoretical range of traffic intensities levels (hence traffic intensity corresponding with respective road classes).

The repairs are expected for securing segments of the roads that are currently in dissatisfactory quality and increase of the traffic would only worsen its condition. Exact extent of proposed repairs willl be set out before the construction of the NNPP on the basis of mapping of roads state, diagnostics, and survey of road structures.

In relation to oversized and heavy components transport, it shall be necessary to adjust attributes and parameters of concerned roads and paths. Transport of these components is a matter of several transportational units but with the usage of high number of operational measures (securing of them may be very difficult). So it is beneficial to fully utilize water way. Advantages of water way utilization are efficiency and simplicity of transport of heavy weights with low transport costs., Two alternate water traffic paths are considerable for the transport of heavy and oversized components (Danube to Bratislava port or Danube – Váh to location of Kráľová reservoir).

Considering expected volume of transported oversized components (in single units) and character of presumed adjustments on existing traffic infrastructure, the impact can be evaluated as non-significant.

For the raffic during the termination of operation stage, same system of traffic requirements as during course of operation or construction is anticipated. Expected impacts shall not exceed higher values as described within construction.

IV.3.13. Other Environmental Impacts

There are no other environmental impacts expected.

IV.4. Health Risks Assessment

4. Health Risks Assessment.

Evaluation of Health Hazards

To prevent and minimalize human health hazard originated from various sources, system of evaluation of health risks is implemented. It is based on procedures elaborated and further developed by the United States Environmental Protection Agency and within European Union. In the Slovak Republic, it is formally and objectively delimited by the Methodical Direction of Ministry of Environment of the Slovak Republic from October 22, 1998 No. 623/98-2 for procedure of evaluation and control of risks.

Methodology may be applied for evaluation of health and environmental risks resulting from effects of chemical, physical, and biological factors mainly as a basis for factual applications for evaluation of risks resulting from existing and planned constructions, actions, and products and evaluation of risks in extremely impacted areas.

Evaluation of health hazards presents a method, that sets threat rate for human health by chosen risk factor, while taking into account potential adverse effects on human population exposed (or having probability to be exposed) to these risk factors.

Estimation and evaluation of the risk is a qualitative and quantitative determination of probability and seriousness of harmful effects and situations that may originate at people respectively at environment due to their exposure to adverse factors. Risk is a function of probability and the seriousness of harmful effects, situations that may originate at people or in environment due to exposure to certain danger at defined conditions.

Evaluation of health risk consists of four consecutive steps:

- Hazard Identification,

- Dose – Response Assessment,
- Exposure Assessment,
- Risk Classification.

Hazard Identification: It is an initial qualitative familiarization with location, relevant harmful pollutants, and circumstances of their potential adverse effect on population. Basic output of this step is a list of health significant harmful pollutants and justification of the process by which those were choosen. List is appended by the descriptions of basic physical, chemical, and toxicological attributes of chosen harmful pollutants and their transport or relevant transformations in the environment, exposition paths, effects in human organism and possible effects on the health.

Dose – Response Assessment:It is a quantitative evaluation of relation between received dose of risk factor (exposure) and caused effect in organism (i.e. risk intensity).

From the aspect of health effects, chemical and physical pollutants are divided into two basic categories:

- harmful pollutants with threshold effect that are presumed to have no negative effect from the minimum dosages up to the certain level (threshold). Above this threshold seriousness of effect increases with the volume of exposure. Most of the toxic substances as well as so called deterministic effects of ionizing radiation (see below) belong into this category.
- harmful pollutants with non-threshold effect that are presumed to have certain adverse effect even at minimal dosages. Risk increases with the exposure from its zero level. Most of carcinogenic substances as well as so-called stochastic effects of ionizing radiation (see below) belong into this category.

Evaluation of risk from threshold and non-threshold harmful pollutants is principally different.

Concerning *substances with threshold effect,* on the basis of research with tests on animals and epidemiologic studies, a relevant threshold is set out for humans and is marked with the abbreviation NOAEL (No Observed Adverse Effect Level). This threshold is a measure of substance toxicity (lower the threshold, more toxic the substance is). RfD (Reference Dose) values or RfC (Reference Concentration) of usually lower (hence stricter) than NOAEL value are derived from the NOAEL value, by applying safety factor and uncertainty factor.. RfD and RfC values are defined as exposure estimation for human population (sensitive groups included) that during lifelong activity shall probably not cause health damage.

Concerning *substances with non-threshold effect,* the levels of exposure and concentration considered to be “acceptable” are determined on the basis of he scientific knowledge. They are marked by abbreviation RsD (Risk-specific Dose) or RsC (Risk-specific Concentration). The decision on what is “acceptable” is a controversial issue, which is being evaluated differently in different countries and institutions. Level $1x10^{-6}$(one case in a million) is used as the strictest criterion for acceptable risk of health damage, sometimes less strict levels are accepted (up to $1x10^{-4}$).

Exposure evaluation: It is determination of harmful pollutants levels (dosages or concentrations), to which various groups of population (subpopulation) are exposed to. Level of exposure depends not only on the spread and concentration of harmful pollutants in the environment but also on the location, activity and life habits of the people. Group of the people that is mostly affected by considered activity of pollutants is called critical group of population.

Risk classification: It is a determination of the risk; hence a forecast of health impact on exposed population on the basis on integration of knowledge about safety of particular substances and exposure data.

For the substances having the threshold value a ER (Exposure Ratio) is calculated, it is ratio of exposure to relevant exposure limit or advised referential level. If the ER is lower than 1 risk is irrelevant.

For the substances without the threshold value a risk for number of population is calculated. The strictest noted requirement is (as stated above) risk at margin 10^{-6}that means that after lifelong exposure 1 case of health damage in 1 million exposed citizens occurs.

Assessment of health risks resulting from the proposed activity shall be included in the Evaluation of Proposed Activity Report, which will utilize the procedures stated above . It is necessary to consider the nuclear source (apart from usual conventional harmful pollutants – air pollution, noise, etc.) as a most significant source of ionizing radiation, which impacts radioactive discharges on the atmosphere and water courses. This impact shall be assessed in in conjunction with the impact with operation of existing nuclear facilities in Jaslovské Bohunice area.

Adverse effects of ionizing radiation on human are divided into two groups:

Deterministic effects, they are characterized by direct tissue damage (e.g. skin inflammations, pupil cataract, acute radiation sickness, etc.). They occur after high radiation dosages. They have a threshold value, above which the seriousness of damage increases with dose, they do not manifest below threshold. They often (but not always) have an acute character and occur soon after radiation.

Stochastic effects, they are characteristic with malignant tumours and genetic damage. They may manifest not only at high dosage but also at low dosages. The generally accepted conservative opinion used of evaluate of radiation protection, deems them as a non-threshold and their effect to linearly increase with dosage. In this case the seriousness dosage of damage does not increase but the probability of its occurrence does.

In the assessment of potential impacts of New Nuclear Power Plant it is natural, considering very low dosages of potential radiation, to evaluate only stochastic effects. Deterministic effects do not occur.

For assessment of stochastic effects of ionizing radiation the best developed and scientifically reasoned procedures for risk estimation, developed by ICRP[29] and published in its report No. 103 (2007) shall be used. It defines, on the basis of the most modern scientific knowledge, coefficients for estimation of so-called health damage. They are stated in the following table.

Tab. IV.4: Nominal risk coefficients for assessment of health damage for stochastic effects of low radiation dosages (ICRP, 2007)

Exposed population	Risk coefficient [10^{-2} Sv^{-1}]		
	Neoplasms	Hereditary effects	Overall
Overall	5.5	0.2	5.7
Adult employees	4.1	0.1	4.2

Coefficients serve for the estimation of overall risk for representative population, as they summarily take into account the potential risk of mortal and curable malignant neoplasms, damage of offspring and effect of life shortening. ICRP here also includes genetic damage, passed to children (it was not tested on humans, but it is being applied due to preventive caution, since there are convincing evidence in test animals). The first line of the table is related to the overall population, the second one to the radiation employees.

The resulting risk is given by multiplying the lifelong radiation dosage by the relevant coefficient. In heanalyses that shall be carried out in Assessment of Proposed Activity Report, a conservative evaluation shall be consistently applied on overall population, hence by using $5.7.10^{-2}$ Sv^{-1} (0,057 Sv^{-1}) coefficient).

[29] ICRP (International Commission on Radiological Protection) is independent, non-governmental organization founded in 1928. It continously processes new scientific knowledge from the field of radiology and uses them for updating preventive recomendations for protection agains risks related to ionizing radiation (artifically produced and natural). It connects most significant world experts in this area and enjoys high internatiolan authority in this area. All international standards and national regulation activities in the field of radiation protection are based on ICRP recomendations.

IV.5. Impact on Protected Territories

5. Presumed impacts of proposed activity on protected territories [e.g. proposed protected bird territories, territories of European significance, coherent European network of protected territories (Natura 2000), national parks, protected landscape areas, protected water management areas].

Considering the above stated facts (see chapter IV.3.9. Impact on Fauna, Flora, and Ecosystems, page 133 of this Preliminary Study) protected territories shall not be impacted by the proposed activity.

IV.6. Impact Assessment from the Perspective of Their Significance and Time Course

6. Assessment of expected impacts from the perspective of their significance and time course during their activity

Proposed activity may be separated into three consecutive stages:

- construction stage,
- operation stage,
- termination stage (decommissioning).

The construction stage, the stage of carrying out building and construction works, is anticipated to last approximately 6 years with presumed start in 2021 and finish in 2027, when the start of test operation is planned. During this stage impacts of building and constructing works shall have effect. These impacts will have an exclusive non-radiation character and they may manifest themselves in the area of construction and in the wider surrounding of site (typically on traffic paths of building and construction material). Even though that these impacts shall be temporary, it is necessary to consider them to be significant and shall be analysed in detain in Assessment of Proposed Activity Report.

The operation stage is planned for the period of 60 years, with presumed start of test operation in 2027 and continued operation in 2029. Operation thus should end before 2090. During this whole stage operation impacts of proposed activity shall have effect. These impacts willl have a radiation as well as non-radiation character and may manifest in the area of the source site and its surrounding. Impacts willl be long term and from the aspect of potential impacts on environment they are considered to be the most significant. Thus they shall be analysed in detail at first place in Assessment of Proposed Activity Report.

The Decommissioning stage will commence after operation termination. The schedule of operation termination is not precisely specified currently. These impacts shall have radiation as well as non-radiation character. They should be temporary and most probably less significant than the above stated impacts of construction and operation (considering probable looser time schedule of demolition and dismantling, and significantly lower radioactive discharges to environment in the termination stage). In accordance with the act, subject of individual evaluation of impacts on environment (that shall be carried out within preparation for Decommissioning), they may be analysed only on the conception level in the Assessment of Proposed Activity Report.

The proposed activity will not further interfere with other activities (existing as well as presumed) locally and in the concerned area and with existing environmental background of the concerned area, or its development trends. The overview of other existing facilities and prepared intentions in the area, including presumed schedule of their activities, is stated in Chapter II.8 Brief Description of the Technical and Technological Solution (page 13 of this Preliminary Study and following pages). Basic information about existing environmental background and its development trends are stated in Chapter III. BASIC INFORMATION ABOUT CURRENT STATE OF ENVIRONMENT (page 69 of this Preliminary Study and following pages).

IV.7. Expected Cross-Border Impacts

7. Expected cross-border impacts

All legal and other requirements about environment protection and public health are related to the concerned area and groups of population that coexist with it in close contact to the proposed activity of new nuclear power plant.

Potentially the most concerned area and so-called critical groups of the population (groups of representative persons that are the most affected by the proposed activity and its radiation impacts) are in the immediate vicinity of proposed activity siting.

The distance to the closest populated areas of surrounding villages is in the range of a few kilometres. Even in this area all requirements for health and environment protection have to be met. Evaluation of these requirements shall be subject to analyses that shall be carried out in the Report on the Proposed Activity Environment Impact Assessment.

On the contrary the distance of the proposed activity from state borders of surrounding countries varies from tens to hundreds kilometres, as follows:

- Czech Republic 37 km
- Austria 54 km
- Hungary 61 km
- Poland 139 km
- Ukraine 330 km.

Thus in this context, after securing requirements of environment protection and public health protection in nearest area concerned, origination of significant over border impact is practically eliminated or is very improbable.

Irrespective of this fact, there shall be carried out analyses of radiation impacts on border areas of the nearest neighbour countries in Assessment of Proposed Activity Report , for normal operation of new power plant as well as for representative conservative case of a projected accident and a beyond-design-basis accident.

IV.8. Induced Circumstances

8. Induced circumstances that can cause impacts in relation to the current status of the environment in the area concerned (taking into consideration the type, form and extend of existing nature, natural resources, cultural monuments protection).

The proposed activity is being sited within an area in which the number of nuclear power and related facilities operating on the long-term basis, including necessary infrastructure are present. All components of the proposed activity (the power plant units and their electric and water connection) correspond in the characteristics with the ones already existing on the site. Thus there is no new activity being introduced into the area which would be in its nature significantly different from the activities already operating there or which would have significantly different requirements for the infrastructure in the area concerned. Nevertheless, some other activities related to the proposed activity will need to be implemented.

Primarily, it will be necessary to adjust the electric grid in the area concerned by building a new 400 kV electric station in Jaslovské Bohunice (see Appendix 1 to this Preliminary study for siting of this station). The electric power of the new nuclear power plant will be transmitted to this station and the stand-by power supply for the new nuclear power plant power consumption will also be provided from this station.

The operator of the Slovak Republic electric grid is Slovenská elektrizačná prenosová sústava, a.s. (SEPS, a.s.) which will be the owner of the electric station and which will also ensure its construction.[30]Thus it is not a subject of the proposed activity. The same applies to the potential construction and modification of other elements of the electric grid (power transmission lines) in the area concerned (e.g. connection of the new electric station Jaslovské Bohunice with the electric station Križovany). Thus these are not direct parts of the new nuclear unit but forms a part of development of the Slovak Republic transmission grid. Their assessment from the impacts on the environment point of view will be executed within the relevant legislation context during their project preparation process. However, all potential concurrent influences of the transmission grid will be commented and considered in the proposed activity assessment report.

Other related activities include systems of radioactive waste (RAW) and spent fuel (SF) disposal. These will become a part of the systems handled on the state level or state concepts level. Although the principals for RAO and SF disposal remain the same for NNPP as for the existing nuclear power plants, related state strategic and programme documents on RAW and SF disposal, do not currently take into the account a new nuclear power plant and those documents needs to be updated.

[30] From the financial perspective, the cosntruction will be financed by the designer via the connection fee.

.According to the relevant provision of Board Directive No. 2011/70/Euratom, which establishes the framework of the Community for responsible and safe disposal of spent fuel and radioactive waste, the Slovak Republic must inform the European Commission about the contents of its national programme including all items presented in Article 12 of the Directive by August 2015. In other words this is the final date for the update of RAW and SF status within the national programme therefore also for the analysis of the interconnections of NNPP with this strategy.

Spent nuclear fuel from the new power plant will be handed over to a legal entity authorized to dispose of the spent fuel (JAVYS). According to the strategy of the final section of nuclear power industry approved by the Government of the Slovak Republic in resolution No.26 of January 15, 2014, the storage of the SF from the Slovak nuclear power plants is expected to be in the temporary spent fuel repository in Jaslovské Bohunice, where its compacting will be finalized. However, building of another spent fuel repository is expected around 2020 due to capacity reasons. That repository will be implemented by the JAVYS Company as an separate investment. A part of the repository preparation will also be the assessment of the impacts on the environment, which is in terms of the Act No. 24/2006 Coll., on the assessment of the environmental impacts, an independent activity forming a subject to assessment (Annex 8, Sec.2, Insert 9 The repository facilities (planned for more than 10 years) for storing spent fuel or radioactive waste at different location than it was produced). Potential concurrent influences of such repository will be commented and considered in the proposed activity assessment report.

Further induced circumstances, which could cause impacts when considering the current status of the environment in the area concerned, are not known. Potentially, the matter for discussion could be the issue of the uranium raw material mining (or the nuclear fuel production) and also the issue of final radioactive waste disposal. These activities are not and will not be located within the area concerned. Moreover, they are not the direct consequence of the new power plant. They have broader connections with whole existing nuclear power industry branch (in European as well as in Slovak territory) and therefore they are solved within the relevant conceptual relations outside of the EIA process for new nuclear power plant.

IV.9. Other Potential Risks

9. Other potential risk related to the proposed activity implementation.

IV.9.1.Radiation Risks

IV.9.1.1. Safety Characteristics of the Generation III and III+ Reactors

Generally, the possibility of accident or incident occurrence during the nuclear power unit operation (as well as during the operation of any other industrial facility and human activity) cannot be completely eliminated. The specific feature of nuclear facilities is that they contain radioactive substances and their leakage into the environment could occur during an incident. Even when considering this risk, production of electric power in nuclear power plants is not more dangerous from the population health and life endangerment point of view than the production from other sources. This can be already demonstrated on the operated power plants, based on the international organizations statistics on the life endangerment risk ratio of individual types of sources for power production to the unit of produced power (see e.g. OECD/ NEA 2010 report Comparing Nuclear Accident Risks with Those from Other Energy Sources).

Generation III and III+ reactors are safer than the reactors of the previous generations. Their development was initiated by the effort to improve the operation and reliability indicators, and at the same time improve the safety characteristics. The basic safety characteristics of the reactors of generation III and III+ compared to the reactors of the previous generations are as follows:

- Introducing new systems for maximum hypothetical accidents management or improvement of existing systems (e.g. higher resistance of the protective enclosure, use of double container to ensure higher protection of the primary circuit equipment against external influences and increase of the protection level against the radioactive substances leakage into the surrounding environment, increase of resistance to accidents involving reactor outage failure, higher resistance to complete power supply outage - Station Blackout) lowered the probability of active zone melting as well as large leak by minimum one level compared to reactors of generation II.
- They withstand serious accidents including absorption and cooling or formed melting.
- They have lower probability of large radioactive leaks into the surrounding environment in case of serious accident.

- They withstand loss of all power supplies during longer period without operating personnel intervention.
- They use passive elements for the safety systems to higher extend (their functions use basic physical principles, are less dependent on power supply and other active systems).
- Generally they have better redundancy of the safety systems.
- They withstand more serious external emergency events better (e.g. plane crash, earthquake).
- Have better fire safety.
- Besides safety improvements they have higher instantaneous availability, efficiency and better operation economics.

IV.9.1.2. Potential Risks with Impact on Nuclear Safety and Radiation Protection

An incident or accident on the nuclear power facility or generally on any industrial equipment can occur due to failure of one or more elements resulting from internal or external cause. Internal cause can be given by a component or system malfunction due to design or construction error, failure of providing quality during production, assembly, operation, maintenance, inspections or tests, or component malfunction due to internal cause – fire, flood, human error, etc. External cause can be the occurrence of extreme weather conditions (extreme outside temperatures, extreme wind, tornado, extreme snowing, and external floods), seismic event or event caused by human activity. An event caused by human activity is gas leakage or explosion in the vicinity of the nuclear facility, leakage of toxic, explosive or in different way dangerous substances in the surrounding of nuclear facility e.g. during transport on the road or during storage of such substances within the site, pressure wave caused by an explosion in the surrounding area of the nuclear unit, plane crashing on the nuclear unit due to an accident, accident on another nuclear facility in the area involving radioactive or other dangerous substances leakage. A specific type of an event with external cause is sabotage and terrorist attack on the nuclear unit including intentional plane crash.

All types of possible incidents and accidents must be evaluated during the nuclear power plant licensing procedure and the impossibility of their occurrence or the acceptability of their consequences must be proven while the assessment of the radiation consequences has the highest priority. Proving the acceptability must be firstly based on deterministic basis when the result of an event is quantified and its acceptability for the nuclear power plant safety and negligible consequences for the surrounding area are proven. For extremely non-probable events (the frequency of occurrence 10^{-7}/year and less), their assessment and evaluation on probability basis is acceptable. Assessment of the protection level against terrorist attack and sabotage is part of the Plan of physical protection documentation which is approved by Nuclear Regulatory Authority of the Slovak Republic and it is a subject to a specific mode.

The systems, vital for the nuclear power plant safety, must be resistant to a simple failure or a failure with joint cause. Resistance is ensured by redundancy and diversity. Redundancy is ensured by multiple back-up of safety systems with the same function (2 to 3 times multiplied redundancy for nuclear power plants of generation II, for unit of generation III and III+ it is 4-times multiplied redundancy), physical separation of individual redundancy systems and their functional independence. Diversity is ensured so that the basic safety functions – reactor shutdown, heat removal from the fuel, containment of the radioactive substances leakage outside the container in case of primary circuit integrity violation, is ensured independently by two or more functionally different systems, each of which has multiple redundancy and is capable of providing the safety function execution.

IV.9.1.3. Characteristics of Non-standard States

The acceptability of the consequences of an incident or accident generally depends on the frequency with which the incident or accident can arise, while the consequences limit values defined by the legislative regulations and international requirements cannot be exceeded.

Following division applies to incidents and accidents in nuclear power plants:

- Abnormal conditions,
- Design-basis incidents (hereinafter design accidents in terms of the terminology given by the regulation of the Nuclear Regulatory Authority of the Slovak Republic No. 430/2011 Coll.),
- Beyond-design-basis accidents.

Abnormal conditions are failures and malfunctions or external events which are assumed to occur at specific nuclear unit less than once per 100 years. Therefore it can be expected that they occur at least once in the nuclear power plant operation period. Typical cases in this category include loss of external power supply, failures in reactivity management system, short-term opening of steam generators safety valve, pipeline rupture of small dimensions (auxiliary pipeline, measuring pipes and samples collection), etc. Such events cannot lead to malfunction of any of the barriers, safety systems and their impact on the surrounding environment must be minimal, defined by not exceeding the basic limit for citizens irradiation 1mSv/year per any citizen outside the power plant without considering any protective measures (Order of the Government of the Slovak Republic No.345/2006 and BNS I.11.1/2013).

Design-Basis Accidents are failures and malfunctions which should not occur during the period of operation, but occurrence of which cannot be excluded and the design counts with their occurrence. The probability of their occurrence is between once per 100 years and once per 1 000 000 years (10^{-2}/year - 10^{-6}/year) and for the external events of natural origin once per 10 000 years (10^{-4}/year). Typical initiating events of this category includes big pipeline rupture - main water supply, steam, primary circuit pipeline, steam generators pipeline/pipelines, independent combination of several abnormal conditions at the same time, mechanical failure in the reactor trim system, extreme weather conditions, seismic event up to SL-2 level (10^{-4}/year), etc. The safety systems must be able to provide barrier protection and eliminate the consequences of design-basis accidents in the surrounding area to an acceptable level with a sufficient reserves and reliability. The acceptable level means not reaching average effective dose for an individual in the closest surrounding area of the power plant - 10 mSv/year (BNS I.11.1/2013) or fulfilment of safety goals for design basis accidents defined by EUR. In EUR there are two safety goals defined for design basis accidents: 1st safety goal requires that no urgent safety measures including shelter, iodine prophylaxis and evacuation route are located within the 800-metre distance from the reactor, and 2nd safety goal requires that the economic impacts of an accident due to consequent protective measures including resettlement, management of use of by radionuclides contaminated food, water and animal fodder, were minimal with the restriction of at least few-kilometre distance (several square metres).

Note: The value of effective dose for an individual up to 1 mSv for events with the probability of occurrence higher than 10^{-4}/year and 5mSv/year for events with probability of occurrence up to 10^{-6}/year, represent the safety goals of EUR. In such way defined limits of acceptability are stricter than the doses limit for the design basis accidents (incidents) in most other countries operating nuclear power plants.

Beyond-Design-Basis accidents are in general accidents which have extremely low probability of occurrence, less than once per 1 000 000 years (less than 10^{-6}/year) and the power plant design takes into consideration such possibility only up to some extend without enforcing the requirement for full protection of all barriers. Beyond-design-basis accidents are divided into accidents during which no serious damage and/or nuclear fuel meltdown occur and serious accidents involving serious damage and/or fuel meltdown. While currently operated reactors were originally not designed for the conditions of beyond-design-basis accidents and their resistance was increased only by executed modernisations, generation III and III+ reactors contain in their designs also the ability to withstand or minimize the consequences of beyond design basis accidents. The main features include prolonged resistance to loss of all power supplies sources (Station Blackout), resistance to plane crash and the ability to withstand events involving fuel meltdown without compromising the containment. The same criteria of radiation consequences apply to beyond-design-basis accidents which do not include serious fuel meltdown, as it does for the design-basis accidents.

In case of serious accidents involving fuel meltdown, generation III and III+ reactors are required to preserve the containment functioning, which practically excludes the possibility of big and early leakages of radionuclides from the containment, excludes the necessity to implement measures such as going into hiding, iodine prophylaxis and evacuation behind the power plant protective area border and also restrictions of such economic impacts which would endanger free food trade an food consumption within large are for a long time. This does not means that it is necessary to exclude any measures in agricultural production within the area in closest surrounding of the power plant.

IV.9.1.4. Approach to the Assessment of Radiologic Impacts of Accidents within the EIA Process

Proving the acceptability of the potential incidents and accidents consequences will be the matter of following licensing procedure for the specifically selected NNPP project. Within the ongoing EIA procedure, the influence on the surrounding area and inhabitants will be demonstrated for the representative over pack cases of design basis accident and serious accidents involving fuel meltdown, in a conservative way from the source term point of view (the extent of leakage of radioactive substances into the surrounding area) and other conditions (e.g. unfavourable weather conditions), while preserving the safety function of the containment at serious accident as the basic design characteristic of generation III and III+ reactors.

In case of design-basis accidents (without any serious damage or fuel meltdown), the potential source of radionuclide leakage into the power plant surrounding area is their content in the primary circuit coolant as well as their content in the coolant under the fuel rods cladding in case that the part of the fuel rods cladding is compromised. The representative source term defining the size of the radionuclides leakage into the surrounding area for the radiologic consequences assessment will be defined in line with the EUR requirements. For the analysis of the representative design basis accident within the EIA procedure, the conservative envelope approach is required so that the source term defined in a way that the radiologic consequences corresponding with this source term will be with the sufficient reserve (considering the level of uncertainty) worse than the results of the later safety analysis (e.g. Preliminary safety report) within the licensing procedure for the whole variety of postulated accident events for the selected reactor type. The assessment of the radiologic consequences of the representative design basis accident for the EIA procedure will be executed by the conservative calculating programme RTARC (version 6.1), which is approved by the Nuclear Regulatory Authority of the Slovak Republic for the assessment of the radiologic consequences of design basis accidents.

In case of serious accidents (with the expectation of fuel meltdown), the potential source of radionuclide leakage into the surrounding area is their content in the fuel. Fuel meltdown is accompanied by radionuclide leakage from the fuel into the containment and then potential leakage into the surrounding area. In line with the EUR requirements, the safety systems must provide complete functioning of the containment and a serious accident will reach maximum level 4 from the impact on the environment point of view on the INES scale (accidents with local consequences – only within the nuclear power plant site and not behind its borders). The representative source term, which will be considered for the assessment of radiologic consequences, will be defined in regard to the EUR requirements for generation III reactors and considering the term sources for NNPP used in EIA in other EU states in the last years. The estimates of radiologic consequences for such source term will be calculated in realistic way (Best Estimate) using the European probability programme system - COSYMA, which is approved by the Nuclear Regulatory Authority of the Slovak Republic for the assessment of radiologic consequences of serious accident in the conditions of the Slovak Republic.

IV.9.1.5. Terrorist Attack Risk

The risk of terrorist attack on NNPP will be assessed and eliminated in the following phases of project preparation and implementation with standard measures and procedures of physical protection of nuclear power plants, so far used in practice in compliance with the requirements of international and national legal regulations.

The commitments of the Slovak Republic in the field of physical protection of nuclear materials follow from the accession to the Convention on the Physical Protection of Nuclear Material, which was signed in 1987 and the Appendix to this Convention, which was adopted by the Resolution of the Government of the Slovak Republic No. 394/2007 Coll.

The Appendix better reflects the current global security situation and is closely connected also to the International Convention for the Suppression of Acts of Nuclear Terrorism, ratified by the Slovak Republic in March 2006.

The requirements on physical protection of nuclear materials and nuclear facilities for the Slovak Republic are defined in the Nuclear Act and in the Decree of the Nuclear Regulatory Authority of the Slovak Republic No. 51/2006 Coll., establishing details of requirements for providing physical protection.

The supervisory activity of the state in this field is performed by the Nuclear Regulatory Authority (NRA) of the Slovak Republic, whereas it focuses on supervising physical protection on nuclear facilities in the Slovak Republic and carries out inspections focused on physical protection of nuclear facilities, nuclear materials and radioactive waste and during the transportation of nuclear materials.

An important part of the NRA activities in assessing measures providing for physical protection of nuclear material transportations is also approving the package assemblies for nuclear material transports. The NRA inspectors carry out inspections of all transportations of fresh and spent nuclear fuel and RAW. The information on transportation and physical protection of nuclear materials is governed by Act No. 215/2004 Coll., on the protection of classified information.

With regard to intentional air plane collapse, it can be stated that Act No. 321/2002 Coll., on armed forces of the Slovak Republic handles also the field of prevention and occurrence of emergency situation from an air attack and contains variety of preventive measures and active protective procedures up to the extreme situation - physical termination of the flight of civil carrier or violator.

All suppliers of the reference types of the generation III+ reactors for the NNPP have confirmed in technical information the resistance of their blocks to air plane collapse, including a big air freighter. In assessing the collapse of a big air freighter are applied the US NRC criteria, established in RIN 3150-A/19 Consideration of Aircraft Impacts for New Nuclear Power Reactors, that require that the active zone of the reactor remains cooled (or the containment integrity remains maintained) and the cooling of spent fuel remains maintained (or the integrity of spent fuel pool is provided for).

IV.9.1.6. Other Radiation Risks Related to the Operation of Nuclear Facilities

The safety requirements for the transport of nuclear materials and radioactive wastes are regulated by the Atomic Act (Act No. 541/2004 Coll.) and in Act No. 355/2007 Coll., on the protection, support and development of public health. Based on the authorisations included in these acts, the following implementing regulations, related to transportation of nuclear materials and radioactive wastes, were issued:

- the Decree of the Nuclear Regulation Authority No. 57/2006 Coll., establishing details on requirements for the transportation of radioactive materials;
- the Decree of the Nuclear Regulation Authority No. 48/2006 Coll., establishing details on the method of reporting operational events and events during transportation and details of identifying their causes and the Decree of the Nuclear Regulation Authority No. 32/2006 Coll., changing and amending the Decree of the Nuclear Regulation Authority No. 48/2006 Coll., establishing details on the method of reporting operational events and events during transportation and details of identifying their causes;
- the Decree of the Ministry of Health No. 545/2007 Coll., establishing details of the requirements on providing radiation protection during activities leading to irradiation and activities significant with regard to radiation protection;
- the Decree of the Nuclear Regulation Authority No. 51/2006 Coll., establishing details on requirements for provision of physical protection.

The basic transports of materials, related to the operation of nuclear source, are the transport of fresh fuel from the supplier to the NNPP, the transport of treated RAW from the NNPP to the RAW storage facility, the transport of spent fuel from the NNPP to storage (within the EBO site) and the transport of spent fuel from storage to the place of permanent deposit or recycling. The basis for risk management during the transport of nuclear materials and RAW are the following principles incorporated in the above mentioned legal documents:

- a permission or an approval of the permitting authorities under valid law must be issued for the transport;
- the transport must proceed in accordance with approved procedures and in compliance with related requirements of national legal regulations and international commitments and conventions;

- the transport procedures must take the possible risks into account and minimise the chance of an accident;
- the transported material must be stored in approved transport package assemblies (or transport and package assemblies) that provably ensure, that in case of an accident, no radioactive material leaks into the environment and in case of nuclear fission material, no additional decrease in sub-criticality under the approved limit occurs, not even in case of flooding with water;
- the dose rate in the surroundings of the transport assemblies and the surface activity must be minimised in compliance with the laws of the Slovak Republic - then in relation to irradiation of population in the surroundings of the transport mainly: the dose rate in the distance of 2 m from the surface of transport must not exceed 0.1 mSv/h.

For transportation of fresh nuclear fuel, 2 transports of fresh fuel in average per year to the EBO site can be expected, taking the existing blocks of the NPP Bohunice 3m4 and NNPP into account.

Depending on the market situation, it can be expedient for the operator to stock up for several years ahead. Because no nuclear fuel is produced in the Slovak Republic, it is certain that they will be supplied from abroad and it can be a combination of transportation by train, vehicle, ship or air plane.

Compared to transportation of other hazardous goods (other types of fuels from the energy production point of view), the transportation of radioactive materials is much less risky. First of all, there is no danger of explosion and fire, as is in case of transportation of classic fuels, where an accident leads to direct danger for live and has often tragic consequences for the people involved. In case of radioactive substances, the possibility of leaks into the environment is reduced to the lowest possible level. Procedures for reducing the radiation consequences of an accident so that the public health is not in danger are prepared for each transportation.

The transportation of spent nuclear fuel will be done only inside the sites within the area until the launch of deep repository and they bring no requirements on outer transportation infrastructure and thus no related risks of possible accidents.

Any accident of low-level RAW fixed in a solid matrix and stored in containers does not pose any significant threat during the transportation to the repository, including potential sabotage, for the environment or the population.

IV.9.2. Non-Radiation Risks

From the non-radiation point of view, the proposed activity basically presents a standard industrial operation without significant risk of emergency situations with negative impacts on the environment and/or the population. Emergency situations associated with the leak of polluted waste waters (by breaching the tightness of the sewer or damage to the functioning of the oil / water treatment plant), the leak of stored substances (chemical substances, fuels, lubricants and cooling mediums, detergents and similar) from storage tanks or pipe bridges or during the transport cannot be potentially ruled out in relation to the operation. Also catching on fire of mediums or other substances cannot be potentially ruled out.

The risks shown have a low level of probability and no special preventive or elimination measures apart from those, that are usual or prescribed by respective regulations (construction, safety, fire, transportation or other regulations), including the Act on prevention of major accidents.. The consequences of the type of events described are resolvable with commonly available means.

IV.10.Adverse Impacts Mitigating Measures

10. Measures to mitigate adverse impacts of individual scenarios of the proposed activity on the environment.

No potentially significant adverse impacts were identified within this Preliminary study that would need to be handled beyond the framework of generally binding legal regulations or other regulations. Thus no additional measures for mitigation or compensation of adverse impacts are proposed.

The basic project measures for prevention, exclusion, reduction and mitigation of adverse impacts lie in these areas:

- use of the best available technologies of III+ generation reactors,
- ensuring nuclear safety, radiation protection, physical protection and emergency readiness in compliance with the requirements of valid legal regulations, IAEA and WENRA standards or other industry standards,

- minimisation of radiation impacts on the population and employees in compliance with the ALARA principle,
- adaptation of monitoring programmes for monitoring individual potentially affected elements of the environment in relation to preparation and operation of the NNPP,
- minimisation of demands on the environmental sources and outputs into the environment,
- compliance with all legal regulations and standards in the field of the protection of the environment and public health.

As a result of the environmental impact assessment process can be additional series of well-justified measures, focused on further additional protection of individual elements of the environment and public health. These measures will become part of the conditions of the subsequent administrative proceedings and will be implemented during preparation, construction and operation of the proposed activity.

IV.11. Assessment of the Expected Area Development in case of Non-Performance of the Proposed Activity

11. Assessment of the expected area development in case of non-performance of the proposed activity.

Nuclear energy and related facilities that have all necessary infrastructure connections available are operated for a long period of time in the area concerned. It can be expected that this energy producing function of the area will remain even after the termination of the operation of existing energy producing sources, regardless of whether the proposed activity will or will not be implemented. The very accessibility of necessary areas and infrastructure and operational connections makes the site the primary location for new energy producing sources. Therefore from the environmental point of view, this is a rational and optimal solution consisting in expedient use of the prepared and equipped area.

A real and probable scenario in case of failure to implement the proposed activity will be to use the area for another energy producing source. With regard to the capacity possibilities of the area it would probably concern a comparable source (both in nature and in capacity) with the source that is subject of the proposed activity. In this scenario, no significant changes in the development of relevant area will occur both in case of implementation of the proposed activity and in failure to implement it.

The second extreme scenario in the case of failure to implement the proposed activity would be the complete abandonment of the use of the area for energy production. But even in this scenario, further pressure to use the area for other activities (which would, understandably, carry with them related impacts as well) cannot be ruled out. Complete abandonment of anthropogenic use of the area concerned (and its return into original state) is extremely improbable and would not be rational even from the environmental point of view.

IV.12. Assessment of Compliance with the Land Use Planning Documentation and the Strategic Documents

12. Assessment of proposed activity's compliance with valid land use planning documentation and other relevant strategic documents

The proposed activity is in compliance with key relevant documents of the Slovak Republic in the field of energy production and relevant land use planning documentation.

The energy policy of the Slovak Republic: The proposed activity respects the direction of the energy policy of the Slovak Republic as shown in strategic documents and declarations of the government of the Slovak Republic. The draft Energy policy of the Slovak Republic (September 2013) should after the adoption become a strategic that will determine basic goals and frameworks for development of the energy production in the Slovak Republic by 2035. The use of nuclear energy production as non-carbon source of electricity is included in main priorities of the energy policy of the Slovak Republic, because it contributes to sustainable development and decreases the dependency on the import of fossil fuels.

The construction of NNPP is according to this draft included in measures aimed at increasing energy security, but its implementation should contribute also to achieve the set goals of electric energy production, such as self-sufficiency and adequate pro-export capacity in electricity production; flexible, low-carbon and sustainable structure of resource base; and also adequate, available and competitive end prices of electricity.

The Energy policy includes also its assessment from the environmental impact point of view (Report on Strategic Document Review, so-called SEA). In conclusion it states that the impacts of strategic document are not such that would cause important impact on the environment and which would prevent its adoption.

Energy security strategy of the Slovak Republic: The construction of the NNPP is one of the strategic priorities of the energy security strategy of electricity supply in the period of 2013 to 2030, defined in the Energy security strategy of the Slovak Republic (ESS) of 2008. Within the ESS, the construction is included also in the Recommended programme of the construction of sources by 2030 with expected launch in 2024 -2025.

The Energy security strategy further contains, that the nuclear power plants will continue to be the base of energy producing mix of the Slovak Republic as an important element in providing the electricity supply security and sustainable development. The production of electricity from nuclear power plants is considered as long-term effective and economically advantageous method of ensuring the abundance of electricity and apart from high security with regard to fuel supplies, stability of electricity production prices and negligible effects on the health and the environment, they have positive impacts on the stability of electrical supply network.

The Slovak government's statement of policy: The intention to support the construction of new nuclear power plant in the Jaslovské Bohunice site is included also in the Statement of policy of the Slovak Republic for the period 2012 - 2016.

Trnava Self-Governing Region: The draft Land use plan (LUP) of the Trnava Self-Governing Region (2012) contains the intention of construction of NNPP and related structures in its text and graphic part.

The LUP of Jaslovské Bohunice municipality: The municipality has a land use plan, the text and graphic part contains only the current EBO site. The NNPP is considered in the ongoing update of the land use plan (in compliance with the LUP of Trnava Self-Governing Region).

The LUP of Radošovce municipality: The municipality has less than 2 thousand inhabitants and therefore is not yet obliged to prepare a land use plan.

The LUP of Veľké Kostoľany municipality: The municipality has a land use plan, the text and graphic part does not contain the current EBO site. In the documentation of broader relationships of the Veľké Kostoľany cadastral area the EBO site is plotted. The land use plan does not contain the intention to implement the NNPP.

The LUP of Pečeňady municipality: The municipality has less than 2 thousand inhabitants and therefore is not yet obliged to prepare a land use plan.

The LUP of Ratkovce municipality: The municipality has less than 2 thousand inhabitants and therefore is not yet obliged to prepare a land use plan.

IV.13. Further Steps of Impact Assessment

13. Further steps of impact assessment with the most severe sphere of problems.

This Preliminary study is the first document elaborated in the environmental impact assessment. Its purpose is not to present detailed information about the impacts of proposed activity, but to present the proposed activity, the area concerned, the state of the environment in the area concerned and to identify potential impacts of this activity on the environment and human health, including the cumulative and synergic impacts.

A comprehensive assessment of the proposed activity's impacts on all elements of the environment, including public health, will be carried out in the Environmental impact assessment report in compliance with Section 31 of the Act, which will be produced later.

The assessment will be done in compliance with the annex No. 11 to the Act and with requirement for the scope of assessment, set under Section 30 of the Act. The content and scope of the assessment will follow mainly from the characteristic impacts of the proposed activity (which is the nuclear power plant) and the specifics of the area concerned (i.e. taking the current state of the environment into account). For this reason, targeted studies, analysing in detail individual spheres of impacts on the environment, including the public health, will be done within the Environmental impact assessment report (above the scope of basic requirements of the annex No. 11 to the Act).

The estimated scope of studies is shown in the following overview:

- analysis of the health of inhabitants,
- assessment of health risks and public health impact,
- assessment of impacts on the air,
- assessment of impacts on the climate,
- assessment of impacts of noise,
- assessment of impacts of discharges of radioactive substances into the air,
- assessment of impacts of discharges of radioactive substances into streams,
- assessment of the state and development of the radiation situation in groundwater,
- assessment of radiological consequences of a representative project accident and severer accident,
- assessment of provision of water intakes,
- assessment of impact of released waste waters,
- assessment of groundwater flow in the area and impact on groundwater,
- biological survey and assessment,
- assessment of impacts on the landscape.

The above mentioned studies will take into account also the potential cross-border impacts, if relevant.

V. COMPARISON OF ALTERNATIVES

V. The comparison of alternatives of the proposed activity and the optimum alternative proposal (including the comparison with the zero alternative).

The proposed activity is not evaluated in multiple alternatives. This is explained in more detail in the chapter II.8.2 Overview of Considered Alternatives (page 14 of this Preliminary Study). It follows from the explanation that the proposed activity has no other real alternative solution than the one proposed, i.e. no other site or other technology. For this reason, the Ministry of Environment of the Slovak Republic upon the request of the proposer and based on assessment of facts stated therein has abandoned the requirement for scenario solution (via letter No. 8356/2013-3.4/hp of November 28, 2013, see Annex 2 of this Preliminary Study).

The proposed activity is thus submitted and assessed in only one implementation variant, presenting the construction of a new nuclear power plant in the Jaslovské Bohunice site, with technical and technological parameters described in the chapter II.8. Brief Description of Technical and Technological solution (page 13 of this Preliminary Study) and with environmental impacts described in the chapter IV. BASIC INFORMATION ABOUT THE EXPECTED ENVIRONMENTAL IMPACTS (page 114 of this Preliminary Study).

The so-called zero alternative stands in a specific position. The valid Act No. 24/2006 Coll., on the environmental impact assessment defines it as an "alternative of the state that would occur if the proposed activity was not implemented". In this case, the impacts of the proposed activity will not be introduced into the area concerned, i.e. the current state of the environment (or its development trend) would be maintained in the area concerned. This state is described in the chapter III. BASIC INFORMATION ABOUT THE CURRENT STATE OF THE ENVIRONMENT (page 69 of this Preliminary Study).

The implementation and zero alternatives are not directly compared; the zero alternative serves only for reference comparison of significance or tolerability of the implementation alternative's impacts.

V.1. Set of Criteria for the Selection of an Optimal Alternative

1. Creation of a criteria set and determining their importance for the selection of the optimal alternative.

The proposed activity is not evaluated in multiple alternatives.

V.2. Selection of an Optimal Alternative

2. The selection of the optimal alternative or determining the order of suitability for assessed alternatives.

The proposed activity is not evaluated in multiple alternatives.

V.3. Justification of the Optimal Alternative Proposal

3. Justification of the optimal alternative proposal.

The proposed activity is not evaluated in multiple alternatives.

VI. MAP AND OTHER IMAGE DOCUMENTATION

VI. Maps and other image documentation

The necessary related map documentation is provided in Annex 1 thereof. It contains the following information:

Cartographic data:

- orthophotomap of 1 : 50,000 scale

Existing facilities:

- the area of the existing site of Jaslovské Bohunice nuclear facilities

The proposed activity:

- the area for siting and construction of the proposed activity,
- the area for siting of technical infrastructure,
- the corridor for siting of the raw water supply main,
- the corridor for siting of waste and precipitation water main,
- corridor for conducting the output.

Other related items:

- the area for siting of the new Jaslovské Bohunice substation.

Administrative division of the territory:

- borders and names of districts,
- borders and names of municipalities,
- borders and names of cadastral areas.

VII. ADDITIONAL INFORMATION

VII. Additional information on the preliminary study

VII.1. List of Text and Graphic Documentation

1. The list of text and graphic documentation prepared for the preliminary study and the list of main used materials.

Other reports and documents:

- Permissions of SE EBO and JAVYS for raw water intake and waste water release.
- The decisions of PHA SR which for JAVYS and SE permits for the NP in the EBO site the release of radioactive substances into the environment.
- The final report from the quantitative survey of NMS Market Research SR (2013) Opinions on nuclear energy production.
- EIA reports on the assessment of facilities to be sited in the EBO site
- Stock-taking of RAO JAVYS a SE EBO 2012, 2013.
- Summary report of the Slovak Hydrometeorological Institute for the Jaslovské Bohunice site 2012.
- JAVYS reports on radiation protection for the year 2007 to 2012.
- JAVYS report on the environment for the year 2008 to 2012.
- SE EBO reports on radiation protection for the year 2008 to 2012.
- SE EBO report on the environment for the year 2008 to 2012.
- Reports of the Statistical office of the Slovak republic.

International documents:

- IAEA Safety Fundamentals
- IAEA Safety Requirements
- IAEA Safety Guides (SG) and Specific Safety Guides (SSG), related to the siting of NF and site assessment
- WENRA Updated Reference Levels for existing NPP, 11/2013
- WENRA Reactor Harmonization Working Group RHWG - Report on Safety of new NPP designs, 3/2013
- Recommendations of the International Commission on Radiological Protection (ICRP)

Concept and strategy papers:

- Concept and strategy papers of the Slovak Republic related to the use of nuclear energy production.
- Concept and strategy papers of the European Commission related to the use of nuclear energy production, energy production efficiency, energy sources, energy production effectiveness and economy.

Legal regulations:

- Acts, respective decrees and regulations in the field of nuclear energy production - mainly Act No. 541/2004 Coll., on the peaceful uses of nuclear energy (Atomic Act) and on the change and amendment of certain acts, as amended.
- Acts, respective decrees and regulations in the field of environmental impact assessment, mainly Act No. 24/2006 Coll., on environmental impact assessment and on the change and amendment of certain acts, as amended.
- Acts, respective decrees and regulations in the field of individual elements of the environment and public health.

Public sources and the Internet:

Public sources and web sites of self-governing units in questions, state and private organisations in the field of nuclear energy production, the environment and public health.

VII.2. List of Statements and Opinions

2. List of statements and opinions requested for the proposed activity prior to processing the preliminary study.

The following statements and opinions were requested and issued for the proposed activity:

- statement of the Ministry of Environment on the request to abandon the scenario solution.

The content of this statement is summarised as follows:

The new nuclear power plant in the Jaslovské Bohunice site - abandoning the requirement for scenario solution of the proposed activity, the Ministry of Environment of the Slovak Republic, letter No. 8356/2013-3.4/hp of November 28, 2013 (see Annex 2 hereof). Citation: *"After considering the arguments in your request, we inform you that pursuant to Section 22 (7) of the Act No. 24/2006 Coll., on environmental impact assessment and on the change and amendment of certain acts, as amended, we abandon the requirement for scenario solution of the proposed activity."*

VII.3. OTHER ADDITIONAL INFORMATION

3. Other additional information on the course of the proposed activity preparation and the assessment of its estimated impacts on the environment.

Not listed.

VIII. DATE AND PLACE OF THE PRELIMINARY STUDY ELABORATION

VIII. Date and place of the preliminary study elaboration

In Bratislava (Slovak Republic) and Brno (Czech Republic)   February 28, 2014

IX. CONFIRMATION OF DATA CORRECTNESS

IX. Confirmation of data correctness

IX.1. Preliminary Study Prepared by

1. The authors of the preliminary study

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IX.2. Confirmation of Data Correctness

2. The author of the Preliminary study and the Customer´s authorised representative will confirm the data correctness with their signature (stamp).

With my signature, I hereby confirm the correctness of data in this Preliminary study.
The author of the Preliminary study:

....

Ing. Petr Mynář, Preliminary Study Author
AMEC s.r.o.

....

Ing. Petr Vymazal, Company Executive
AMEC s.r.o.

Customer´s authorized representatives:

....

Ing. Štefan Šabík, Chairman of the Board of Directors
Jadrová energetická spoločnosť Slovenska, a. s.

....

Ing. Tomáš Vavruška, Member of the Board of Directors,
Head of the Safety and Quality Section
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List of Abbreviations and Terms

etc.	et cetera
a.s.	joint stock company
A1	A1 Nuclear Power Plant Jaslovské Bohunice
AES	commercial description of VVER reactor
ALARA	As Low As Reasonably Achievable
AMEC	a part of the trade name of the company AMEC s.r.o. (it is not an abbreviation)
angl.	English
APWR	Advanced Pressurized Water Reactor
AZ	active zone
BAT	Best Available Techniques
BIC(SWIFT):	Business Identification Code (Society for Worldwide Interbank Financial Telecommunication)
BL	bitumen line
BNS	safety guides and directives issued by ÚJD SR
BPEJ	estimated soil-ecological units
BSC RAO	Bohunice RAW Treatment Center
BSK	Bratislava Self-Governing Region
CČS	central pumping station
ČOV	waste water treatment plant
ČR	Czech Republic
ČS	pumping station
DIČ	Tax Identification Number
DPH	Value Added Tax
EBO	Jaslovské Bohunice Nuclear Power Plant
EC	European Commission
EIA	Environmental Impact Assessment
EMO 1,2	Mochovce Nuclear Power Plant Unit 1 and 2
EMO 3,4	Mochovce Nuclear Power Plant Unit 3 and 4
EN	European Standard
EPR	European Pressurized Reactor
ER	Exposure Ratio
EU	European Union
EUR	European Utilities Requirements for Light Water Nuclear Power Plants
HVB	Main Reactor Building
CHA	protected site
CHSK	chemical oxygen demand
CHÚV	Chemical Water Treatment Plant
CHVÚ	Protected Bird Areas
IAEA	International Atomic Energy Agency
IBAN	International Bank Account Number

ICRP	International Commission on Radiological Protection
IČ DPH	VAT Identification Number
IČ/IČO	Identification Number (of an organization)
IEC	International Electrotechnical Commission
IEEC	Industrial Energy Efficiency Coalition
IEZ	Economic Dependency Ratio
INES	International Nuclear and Radiological Event Scale
IS RAO	integral RAW storage facility
ISO	International Organization for Standardization
JAVYS	company name; RAW and Decommissioning in Slovakia
J	South
JE	Nuclear Power Plant (NPP)
JE A1	NPP Bohunice A1
JE V1	NPP Bohunice 1, 2
JE V2	NPP Bohunice 3, 4
JESS	company name: Nuclear Energy Company of the Slovak Republic
JV	South-East
JZ	*according to a context:* nuclear facility *or* South-West
k. ú.	cadastral area
KHNP	company name: Korea Hydro&Nuclear Power
KP	controlled zone
KRAO	liquid radioactive waste
KVET	combined heat and power production
KWU	Kraftwerk Union
LPF	forest-land resources
MDA	minimum detectable activity
MH SR	Ministry of Economy of the Slovak Republic
min.	minimum
MKCH	International Classification of Diseases
MMA	minimum measurable activity
MSVP	Interim Spent Fuel Storage Facility
MZd SR	Ministry of Health of the Slovak Republic
MŽP SR	Ministry of Environment of the Slovak Republic
n.m.	above sea level
NATURA 2000	European ecological network established by the Habitats Directive 92/43/EEC (It is not an abbreviation.)
NJZ	new nuclear power plant
n.l.	AD (Anno Domini)
NOAEL	No Observed Adverse Effect Level
NR	National Council of the Slovak Republic
NSK	Nitra Self-Governing Region
NV	Government Regulation
OSN	United Nations Organization

OZE	renewable energy sources
p.t.	under the ground
p.v.	ground water
PD	agricultural cooperative farm
PGA	Peak Ground Acceleration
PHM	driving propellants
PM_{10}	dust particles of 10 μm fraction
pod.	similar
PP	operating procedures
PR	nature reserve
PRAO	solid radioactive waste
PWR	Pressurized Water Reactor
RA	radioactive
RAL	radioactive substances
RAO	radioactive waste
resp.	or
RfC	Reference Concentration
RfD	Reference Dose
RIN	Rulemaking Issue Affirmation
RLE	Review Level Earthquake
RsC	Risk-specific Concentration
RsD	Risk-specific Dose
RÚ RAO	National Radioactive Waste Repository
S	North
SE	Slovenské elektrárne, a.s.
SEA	Strategic Environmental Assessment
SEB	Energy Security Strategy
SE-EBO	commercial name for SE, j.s.c. - Jaslovské Bohunice NPP
SEPS	Slovak Electricity Transmission System j.s.c.
SHMÚ	Slovak Hydrometeorological Institute
SKCHVU	identification code of Protected Bird Areas
SKÚEV	identification code of Special Areas of Conservation
SL	Seismic Level
SR	Slovak Republic
SV	North-East
SZ	North-West
SSG	Specific Safety Guides
ŠÚ SR	Statistical Office of the Slovak Republic
TLD	teledosimetry system
TSK	Trenčín Self-Governing Region
TSÚ RAO	radioactive waste processing and treatment technologies
TTSK	Trnava Self-Governing Region
TVD	essential service water

TVN	non-essential service water
TZL	solid pollutants
tzv.	So-called
ÚEV	Special Areas of Conservation
UHS	Uniform Hazard Spectrum
ÚCHV	cooling water treatment plant
ÚJD SR	Nuclear Regulatory Authority of the Slovak Republic
UNESCO	United Nations Educational, Scientific and Cultural Organization
ÚP	land use plan
ÚPD VÚC	zoning and planning documentation of the self-governing region
US EPA	United States Environmental Protection Agency
US NRC	United States Nuclear Regulatory Commission
ÚSES	territorial system of ecological stability
ÚVZ SR	Public Health Authority of the Slovak Republic
V	East
V1	NPP Bohunice 1,2
V2	NPP Bohunice 3,4
VJP	spent nuclear fuel
VN	water reservoir
VT	high-pressure
VVER	Pressurized Water Reactor PWR; Russian Vodo-Vodjanoj Energetičeskij Reaktor,
VYZ	summary term for other (except for V1) JAVYS Nuclear Facilities - JE A1, TSÚ RAO, MSVP
VZ	water source
VZT	HVAC - Heating, Ventilating, Air Conditioning
WENRA	Western European Nuclear Regulators Association
WHO	World Health Organization
Z	West
Z. z.	Collection of Legal Acts of the Slovak Republic
ŽP	environment

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