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INTERIM STORAGE OF SPENT NUCLEAR FUEL IN MOCHOVCE

Intention pursuant to Act No. 24/2006 Coll. on Environmental Impact Assessment and amending other laws

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Contents

List of abbreviation

ALARA	–	(As Low As Reasonably Achievable) – to keep doses as low as it is reasonably achievable, with consideration of technical, economic and social views (principle from the area of radiation protection)
AKOBOJE	–	Automated Complex of Nuclear Power Plant Security and Protection
Areva Transnuclear Inc.	–	Division of company Areva dealing with complex systems and solutions of management with radioactive waste and spent nuclear fuel
AZ	–	Active Zone
Bq	–	Becquerel
CA	–	Controlled Area
CC 48	–	Compact Cask 48
CCO	–	Chemical Consumption of Oxygen
ČEZ Dukovany	–	České energetické závody Dukovany
DSC	–	Dry Shielded Canister
DGS	–	Diesel Generation Station
EBO	–	Bohunice Nuclear Power Plant
EIA	–	Environmental Impact Assessment, – (evaluation of influences on environment)
EUROATOM	–	The European Atomic Energy Community
EMO	–	Mochovce Nuclear Power Plant
ES	–	Energy Solution
FA	–	Fuel Assembly
FS KRAO	–	Final Treatment of Liquid Radioactive Waste in Mochovce
HC	–	Hermetic Case
HVAC	–	Heating, Ventilation and Air-Conditioning
IAEA	–	International Atomic Energy Agency
IDE	–	Individual Daily Exposition

IE	–	Inspectorate of the Environment
JAVYS, a.s.	–	Jadrová a vyraďovacia spoločnosť, a.s.
LRCE	–	Laboratory of the Radiation Control of the Environment
MGU	–	Main Generation Unit
MSVP	–	Interim Spent Fuel Storage (Jaslovské Bohunice)
MPC	–	Multi-Purpose Canister
NAQMN	–	National Air Quality Monitoring Network
NDF	–	National Disposal Facility of Radioactive Waste
NEIS	–	National Emission Information System
NI	–	Nuclar Installation
NNR	–	National Nature Reserve
NPP	–	Nuclear Power Plant
NRA	–	National Regulatory Authority of the Slovak Republic
PHM	–	Fuel
PLA	–	Protected Landscape Area
PSR	–	Preoperational Safety Report
rkm	–	River Kilometer
RAM	–	Radioactive Materials
RAW	–	Radioactive Waste
RG SR	–	Regulation of the Government of the Slovak Republic
RO	–	Regional Office
SAS	–	Slovak Academy of Sciences
SE, a.s.	–	Slovenské elektrárne, a.s., člen skupiny ENEL
SFP	–	Spent Fuel Pool
SFSF	–	Spent Fuel Storage Facility
SG	–	Security Guard
SIE	–	Slovak Inspectorate of the Environment
SHMI	–	The Slovak Hydrometeorological Institute
SNF	–	Spent Nuclear Fuel
SP	–	Solid Pollutants

ST	–	Sewage Tank
STN	–	Slovak Technical Standard
T12	–	Storage Cask for 30 Fuel Assemblies
T13	–	Hermetic Case for Non-Sealing Fuel Assemblies
TC C-30	–	Transport Container C-30
TEC DOC	–	Technical Documentation
TRAM	–	Trapped Radioactive Materials
TSC	–	Transportable Storage Canister
TSES	–	Territorial System of Ecological Stability
TOC	–	Total Organic Carbon
$t.km^{-2}$	–	Tonne per Square Kilometre
VVER	–	Water-Water Power Reactor
V-213Č.	–	Model of Units of VVER 440 Type
ÚVZ SR	–	Public Health Authority of the Slovak Republic
VCC	–	Vertical Concrete Cask

Terms and Definitions

ALARA – As Low As Reasonably Achievable – optimization principle, according to which radiation protection is aimed at reducing the exposures of nuclear instalation personnel or population to a level as low as reasonably achievable, taking into account social and economic factors, while it is nevertheless allowed to perform inevitable activities that can lead to exposure.

Activity leading to radiation exposure – Any human activity that can increase the exposure of individuals from existing sources of ionizing radiation except of exposure in the case of a radiation accident or radiological emergency; must be justified and a risk of exposure must be balanced against the expected benefits to individuals or to society.

Ionising radiation – Radiation transferring energy in the form of particles or electromagnetic waves with a wavelength up to 100 nm or a frequency of over 3.10^{15} Hz, which has the capability of directly or indirectly generating ions.

Deep geological repository – A facility for radioactive waste disposal located underground (usually several hundred metres or more below the surface) in a stable geological formation to provide long term isolation of radionuclides from the biosphere.

Controlled area – Area of workplace with ionising radiation sources, where specific protective measures for permanent control of exposures for persons working with ionising radiation sources are required as well as control of contamination by radioactive substances including controlled entry.

Critical population group – Group of persons, which is in relation with a certain source of ionising radiation, rather homogenous and representative of the population that is most exposed from this source of ionising radiation.

Wet storage – Spent fuel is stored in water in so-called wet spent fuel storage facilities. Spent fuel is located in casks and they are stored in water pools. Water in the pool ensures heat removal and radiation shielding and the casks define geometric arrangement and thus the fuel sub-criticality

Monitoring – Repeated measurement of quantities serving for monitoring, follow-up and evaluation of population exposure and measurement of radioactive contamination of workers or a workplace with IR sources

Spent fuel management – Spent fuel management means the storage, reprocessing, handling, on-site transportation and disposal of spent fuel in a spent fuel repository (deep geological repository).

Proponent – The juridical or physical entity intending to perform the activity that is to be assessed according to Act on environmental impact assessment of activities (EIA).

Normal operation - Operation of spent fuel storage facility in accordance with specified operational limits and conditions, including fuel handling, storage and monitoring of fuel, maintenance and control.

Radiation protection optimisation – Procedure for achieving and maintaining the radiation protection at such a level that the risk of threat to life, health and the environment is as low as reasonably possible when taking into account economic and social factors (ALARA principle).

Limits and conditions – Limits and conditions of safe operation or safe decommissioning mean the document approved by the state regulatory authority regulating the nuclear safety of nuclear installations, which contains admissible values for the parameters of nuclear installation equipment (spent fuel storage facility) and defines its operational modes or decommissioning modes.

Natural ionising radiation – Ionising radiation with an origin in natural earth or space.

Radiation protection – The protection of people and environment from the effects of exposure to ionizing radiation, and the means for achieving this.

Radioactive substance – Substance that contains one or more radionuclides the activity or mass activity or activity concentration is in terms of radiation protection is negligible.

Radioactive waste – waste that contains, or is contaminated with, radionuclides at concentrations or activities greater than clearance levels as established by the regulatory body.

Storage container – Massive container, which may or may not be transportable (in this case we are talking about dual-purpose containers). Provides chemical, mechanical, thermal and radiological protection, ensures heat dissipation arising radioactive change during handling, transport and storage and its construction ensures subcriticality. Shielding and isolation of spent fuel from environment is provided by physical barriers formed by metal or concrete tank, welded or sealed internal shell, canister and lid. Heat removal from the stored spent fuel into the environment takes place by radiation and conduction and natural convection or forced air. Containers may be placed in open areas or buildings.

Spent fuel storage (interim storage) – The removal of spent fuel to a facility enabling its isolation, environment protection and control (e.g. monitoring) with the intention of retrieval for re-processing or final storage in future

Dry storage – Storage in a gaseous environment, such as air or an inert gas. Dry storage facilities include facilities for the storage of spent fuel in casks, silos or vaults.

Spent fuel disposal – Emplacement of spent fuel in an appropriate facility (deep geological repository) without the intention of retrieval.

Spent fuel – Spent fuel is irradiated nuclear fuel which has been permanently retrieved from the reactor.

Discharge – Planned and controlled release of (usually gaseous or liquid) radioactive material to the environment.

Source of ionising radiation – Radioactive emitter; an equipment which contains radioactive emitter, generator of ionising radiation or an equipment, activity of which leads to formation of radionuclides.

I Basic Information about the Proponent

I.1 Name

Slovenské elektrárne, a.s., Bratislava

I.2 Company Registration Number (IČO)

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I.3 Company Address

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II Basic Information about the Proposed Activity

II.1 Title

Interim Storage of Spent Nuclear Fuel in Mochovce

II.2 Aim

The aim is to store spent nuclear fuel from reactors SE-EMO (JE EMO 1, 2 and EMO 3, 4) and SE-EBO (JE V2) for the period of 60 years with the possibility of extension to 100 years. The storage facility will be erected within the area of Slovenské elektrárne in Mochovce. The storage capacity will be 21,200 spent fuel assemblies.

The aim of the assessed acitivity is to design, erect, put into operation and operation of the facility for interim storage of spent nuclear fuel in the storage of spent nuclear fuel which shall be located in the area of SE EMO and operated by Slovenské elektrárne, a.s.

The fuel will be stored in waste packages certified according to the Slovak regulations valid at the time of realisation.

II.3 User

Slovenské elektrárne, a.s., Mlynské nivy 47, Bratislava 821 09.

II.4 Character of the Proposed Activity

The proposed activity Storage Facility of Spent Nuclear Fuel in Mochovce is a new activity. According to the attachment no. 8 of Act No. 24/2006 Coll. on Environmental Impact Assessment and amending other laws, within part 2 Energy industry there is point 9 – equipment for storage (planned for more than 10 years) of spent nuclear fuel or radioactive waste at a different place as originally produced.

The proposed activity corresponds to the mandatory evaluation without limit.

II.5 Location of the Proposed Activity

The proposed activity will be located in the eastern part of Nitra Region, in the north-west part of Levice district, in a close proximity of borders with Nitra distrcit and Zlaté Moravce district, in the area of Mochovce Nuclear Power Plant in cadastral area of Nový Tekov and Kalná nad Hronom (within the cadastral area of Mochovce). Due to the erection of Mochovce Nuclear Power Plant, the municipality of Mochovce was abolished and transferred under the government of the municiplaty of Kalná nad Hronom.

The Area of Mochovce Nuclear Power Plant is common for operational power plants, i.e. EMO 1, 2 and EMO 3, 4 (in construction) and FS KRAO (operated by JAVYS, a.s.).

The spent nuclear fuel storage facility in Mochovce is planned to be built within the area of EMO 3, 4 on the area located to the north of the 4^{th} unit of SE-EMO.

The current location of SE-EMO parcels is stated in the extracts of property sheet no. 103 for municipality of Kalná nad Hronom and no. 342 for municipality of Nový Tekov. The current versions are available on www.katasterportal.sk.

II.6 Detailed Location of the Proposed Activity

Intended area of Spent Fuel Storage Facility in Mochovce is in MO34 area between the cooling towers and cooling water pumping station. The southern part of the area is defined by existing railway siding (Fig. 1).

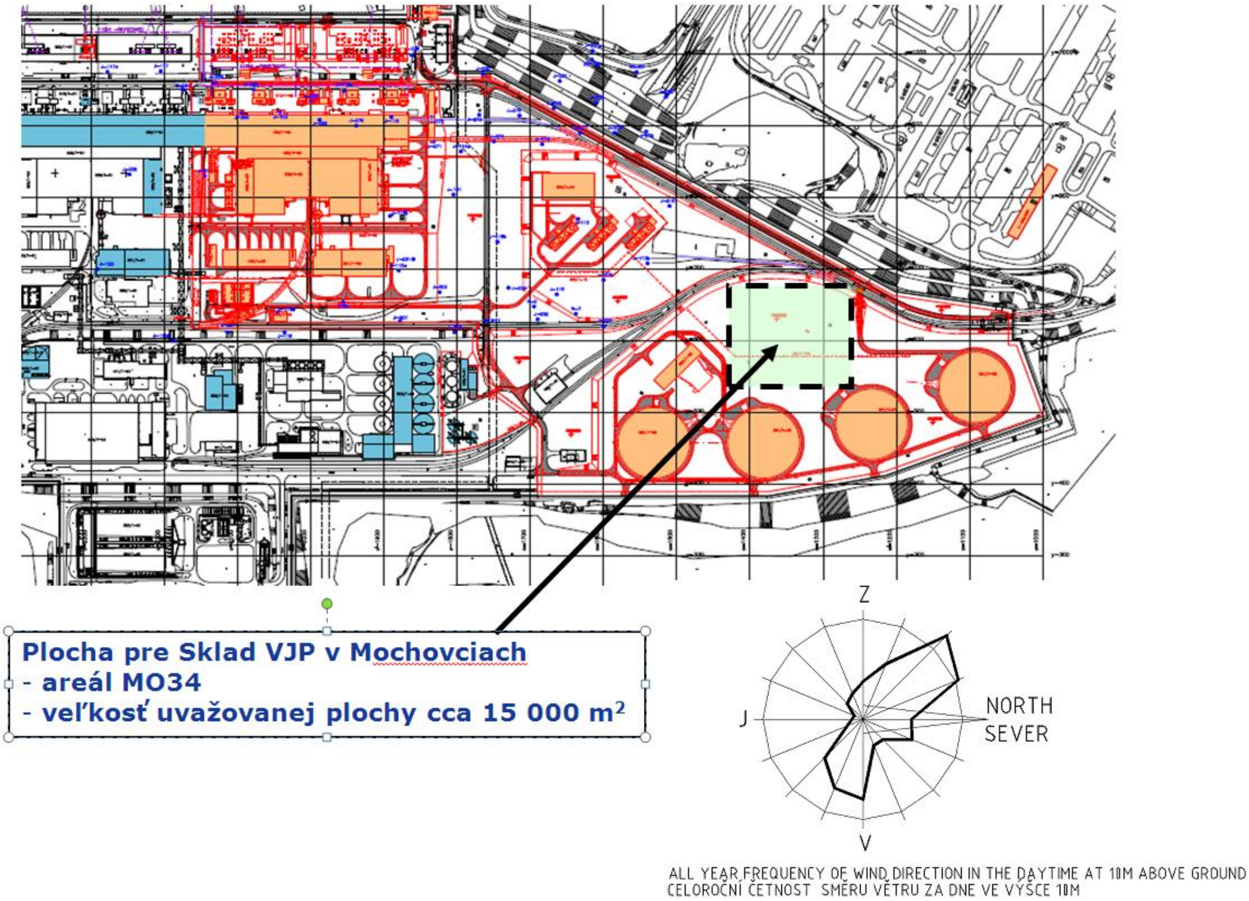


Fig. 1 - The location of Spent Fuel Storage Facility in Mochovce within NPP EMO3,4 area.

Map of the broader relations of proposed activity Spent Fuel Storage Facility location in Mochovce locality is shown in Fig. 2.

Fig. 2 - Spent Fuel Storage Facility in Mochovce - the broader relations of location within region.

II.7 Starting and Ending Dates of Construction and Operation of the Proposed Activity

Expected start of storage supplier selection:	2013
Expected end of storage supplier selection:	2014
Expected start of design preparation:	2014
Expected end of design preparation:	2016
Expected start of erection:	2016
Expected end of erection:	2018
Operation:	2019
Operation is expected until:	2078*

*Spent nuclear fuel will be stored 60 years with the possibility of extension to 100 years. After the operation, the facility will be decomissioned or used to a different aim.

II.8 Brief description of the technical and technological solution

Safe control of handling of the spent nuclear fuel is an important factor for assurance of a reliable operation of the nuclear power plants. Responsible, correct and economic handling of the SNF has significant impact on assurance of nuclear safety and radiation protection of the personnel and population, as well as on operation costs of such facilities.

SNF, created during operation of nuclear reactors, is at first, after discharge from the reactor, stored in the storage pool, located in a reactor building (one for each reactor). SNF is from the reactor removed in regular intervals, determined by the fuel replacement program. Spent fuel is discharged from the reactor and placed in the storage pool and a fresh nuclear fuel is loaded into the reactor. During storage in the pool is the thermal output and radiation of the spent fuel reduced to a level enabling its further handling.

The SNF is after certain period of time, required to achieve physical parameters, enabling its further handling, discharged form the storage pool and enters into so-called back-end of the fuel cycle; its character is given by the strategy of individual states or companies, operating the nuclear power plants. In principle we can talk about two alternatives:

1. SNF is reprocessed and used for production of a new fresh fuel (this option is not used for VVER 440-type reactors),
2. SNF is stored for a long time and consequently will be stored in a deep geological repository.

In the Slovak Republic is currently accepted a long-term storage strategy of SNF (60 ÷ 100 years), which will be followed by its storage in the deep geological repository, which is planned to be build on the territory of Slovakia (or in some international repository).

There are two technical solutions for long-term storage of SNF after a period of its aftercooling in the storage pool. The original solution was a wet storage (in particular in the countries which have opted for reprocessing of SNF), but in recent decades, a dry storage of the spent nuclear fuel has been developed and is increasingly used. In both cases are considered facilities, built outside of the reactor building, but most often on the locality of a nuclear facility, in which was the SNF produced.

Both variants will be described in following chapters, i.e. dry and wet type of storage, taking into account differences and demands on construction and technological part of the building, as well as the impact on the environment.

II.8.1 Concurrently submitted variants of the intention

In following section are presented descriptions of basic variants of conceptual and technical solutions of SNF storage. The zero variant is used as a reference variant, describing situation, which would happen, if the proposed activity have not been performed, i.e. the present state of SNF storage in SE remains intact. Submitted are following variants of the intention:

- zero variant,
- dry repository of the spent nuclear fuel Mochovce (variant 1),
- wet repository of the spent nuclear fuel Mochovce (variant 2).

Capacity of the spent nuclear fuel repository will be 21,200 spent fuel assemblies, with parameters - initial fuel enrichment 4.87% 235U and spent fuel 72 MWd.kg-1235U. The repository will be built in the complex of Slovenské elektrárne in Mochovce.

Pursuant to the document IAEA Safety Guide No. NS-G-1.6 (Appendix), the dry or wet spent nuclear fuel repository Mochovce is classified into a seismic category 3.

Supplier of technology will be selected via tendering procedure, in accordance with legislation in force.

II.8.2 Zero variant

The zero variant represents preservation of current status, i.e. no spent nuclear fuel repository will be built in SE-EMO. This situation may lead to two alternatives of further development of handling of the SNF:

1. Possibility of relocation of the spent fuel to another location does not exist and the spent fuel is stored in the storage pools next to the reactor. But when they will be full, the relevant power plant units must be shut-down, because there will be no place for next spent fuel in the pools. But in the operation must remain systems, providing operation of the spent nuclear fuel pools (fuel pool cooling and purification system, air-conditioning and ventilation system, system of radiation inspection and dosimetry, electricity power supply, etc.). But this status is unsustainable and the issue of the spent nuclear fuel will have to be solved until liquidation of the power plant, or until adoption of a decision on further procedure for handling of the SNF and subsequently until its implementation.
2. The spent fuel is moved to another location. However, this option (transport to reprocessing plant, or to another repository) is currently either not considered at all, or only in a limited extent (capacity of the ISFS in Jaslovské Bohunice would be sufficient only until 2021).

II.8.2.1 The status of storage of the spent fuel

Part of the fuel is at the end of its energy utilization discharged from the reactor and placed in the storage pool, located near the reactor. The need of SNF storage in the storage pool is given by progress of the residual heat of the fuel after removal from the reactor.

The SNF will remain in the storage pool for about 7 years. SNF is in SE-EMO stored in a compact storage grate. Capacity of the compact storage grate of one pool is 603 positions. Assemblies of the SNF with defective coverage are stored in hermetic casings. There are 54 hermetic containers in each storage pool.

Transport of the SNF into a wet SNF storage in Jaslovské Bohunice is performed via railway transport in a transport container of TK C-30 type, in containers T 12, T 13 and KZ 48. Preferred is a compact container KZ 48. Conditions and technical constraints defining transport options of the SNF from the storage pool to the ISFS Bohunice, using an approved TK C-30 type, are defined on the basis of the safety analyses, evaluating subcriticality of transported fuel. Currently, the capacity of storage pools in ISFS Bohunice is utilized to approx. 77%.

II.8.2.2 Civil structure

Technological systems of handling of the spent nuclear fuel and storage of the spent nuclear fuel are located in the main production unit in the reactor's hall.

II.8.2.3 Technological systems

II.8.2.3.1 Fuel handling system

The fuel handling system consists of equipment required for safety of operations during exchange and storage (crane with carrying capacity 250t, special traverse-beam and reloading machine) of the fuel at a VVER 440 type reactor, V-213Č.

The fuel exchange system operates at the tripped reactor. This system is not active during operation of the unit and does not affect operation of the reactor or of other vital equipment. It must ensure security of the personnel during fuel replacement.

The fuel assemblies with proved defective coverage are stored and transported in hermetic casings for defective assemblies. All operations with casing are performed under the water, using a reloading machine.

II.8.2.3.2 Water cooling and purification systems in the spent fuel storage pools

The heat from storage pool is discharged via two independent and in terms of performance equivalent refrigeration circuits. Water, heated by the spent fuel assemblies, is discharged from the pool level and the container casing to the heat exchanger and after cooling is through the pump transported back to the pool and the container casing.

II.8.3 Dry repository of the spent nuclear fuel Mochovce (variant 1)

Systems of dry SNF repositories are in last 10 ÷ 15 years significantly growing. Developed and implemented were several systems of dry SNF storing systems (storage chambers - cases, silos, containers); their common characteristic is storage of SNF in dry conditions.

The main advantage of a dry repository, especially if dry containers are used, is its easy implementation. Dry repository can be easily operated and only few or no active systems are required. Its capacity can be easily adjusted according to the need (the so-called modular storage systems). If required, the SNF stored in this method can be easily transportable.

Method of a dry SNF storage is prioritized especially where the reprocessing of SNF is not considered. Furthermore, except of demonstrable favourable economic aspects, this method, if compared to wet repositories, is recommended mainly due to following reasons:

- it does not require active systems (or minimum quantity - like the pressure monitoring, dose rate and temperature measurement systems),
- small maintenance requirements,
- easy operation and the possibility of adapting to changed requirements of the client,
- smaller amount of secondary waste,
- inherent, based on a storage principle, low risk of accidents.

Dry SNF storage is a newer and simpler method, comparing to the wet storage method. Simplicity of this method allows utilization of several technical solutions. The basis is used packaging casing for the storage, eventually for the transport and storage of SNF in accordance with the legislation in force.

Packaging casing is a multi-barrier system, which must allow safe transportation and handling, including the long-term storage of SNF without any need of planned intervention during the whole storage period.

Around the world are several producers of packaging casings. Considered are either concrete or metal storage containers. If the concrete containers are used, the spent fuel is inserted into metal canisters and these are transported in the transport container to dry repository; the SNF is here moved to the storage container. If the metal containers are used, the SNF is inserted directly into a metal container and it is then transported to the dry SNF repository (it is both the storage and the transport container).

II.8.3.1 Construction part

Metal containers with SNF are stored in a building, which primary function is to protect containers from atmospheric exposures. Structure of this building also allows passive heat dissipation from surface of the storage containers. Secondary, but not an unavoidable function, is a further biological shielding. The repository building is equipped with the necessary manipulation means.

Concrete containers will be placed on a baseplate, either in the open space, or in a storage hall, eventually under a shelter.

Heat, which is released from stored SNF, is from containers discharged by natural ventilation. The repository building is connected with other equipment on the site via roads and a rail siding. Electric power supply is solved from existing equipment of the nuclear power plant. The building is also connected to fire-water circuits in the SE-EMO complex.

The repository building consists of a technical zone, reception area and a storage area. Technical zone consists of an entrance hall, changing rooms and sanitary rooms, electrical switchroom and a storage room. There is also an area for storage of transportation means.

Reception area consists of a zone for storage of empty containers and a zone for preparation and inspection of containers. Reception area is designed to receive a towing vehicle or a railway wagon, able to transport the container. Inside the reception area is also parking position of a crane.

II.8.3.2 Technological and transport part

II.8.3.2.1 Container

The SNF repository in SE-EMO will be built either on a base of dual-purpose containers, allowing transportation and storage of SNF, or on a base of concrete storage containers. Fuel assemblies are stored in a dry, inert atmosphere. Containers must provide following main functions:

- safe retention of radioactive substances,

- assuring subcriticality of stored fuel,
- provision of cooling of the fuel and removal of residual heat,
- provision of shielding,
- protection of he spent fuel assemblies against external influences and risks.

Escape of radioactive substances into the environment, except of coverage of fuel assemblies, is prevented by a container body, with double closing system.

Subcriticality of stored spent fuel assemblies is ensured by geometrical arrangement of assemblies in a container (canister). Heat, released during storage, is usually removed by passive air movement.

II.8.3.2.1.1 Metal containers

Metal containers may be designed either for storage purposes only, or as dual purpose containers for transport and storage. The shielding layer of ionising radiation for metal containers is provided especially by construction material of the container, which is a forged steel, ductile iron, or composite materials. Metal containers may be stored in an open area, in a vertical position on a concrete plate, or stored in a storage hall, as is the case for example in the Czech Republic, Switzerland, Belgium and Germany. A typical metal container consists of following components:

- Storage basket (reservoir) - ensures position of individual assemblies in a container and subcriticality of SNF by absorption of neutrons.
- The container vessel - consists of an inner shell, composed of welded rings made from carbon steel, with integral welded bottom, also made from carbon steel; to the shell are welded flanges, on which is screwed a cover made from carbon steel. The cover is provided by penetrations for venting and drainage. On each penetration is installed a mechanical lock with a double seal. The cover is fitted with metal sealing, with monitoring of internal leakages. In order to prevent entry of air into the container, the container is overpressurized by an inert gas - usually helium.

- Shielding against gamma radiation is provided by other plates made from carbon steel, which are displaced around the perimeter and at the bottom of a container.
- Shielding against neutron radiation is superimposed of the shielding against gamma radiation and is closed by the external steel shell of a container. Neutron shielding is provided by a boron compound of a polyester resin.
- Surface finish of a container against atmospheric exposure, protecting the cover and seals of a container.
- Pressure monitoring system.
- System of upper and lower pins for hoisting and rotating of the container.

Presented containers are used in several countries.

II.8.3.2.1.2 Concrete storage container

Shape of concrete containers is similar to the metal containers, except that the concrete external storage shell provides shielding, while the internal steel insert of this concrete shell provides containment. Typical concrete container contains following components:

- transportable metal canister, what is a circular cylindrical vessel with a welded bottom plate, designed for storage of SNF,
- fuel basket,
- shielding cover,
- upper cover.

External concrete storage shell for transportable metal canister also provides supporting structure for a long-term storage, shielding, protection against external environmental conditions and cooling via natural convection. It is a reinforced concrete structure with an inner lining from carbon steel, with an annular passageway for air, which allows natural airflow around the transportable metal canister.

II.8.3.2.2 Technological systems

Monitoring system

Storage areas are monitored for gamma and neutron radiation, with light and acoustic signalization, which is activated upon exceeding of permissible values for normal operation. Storage containers are equipped by a leakage monitoring system, ensuring the tightness inspection of internal spaces and an early indication of potential loss of tightness.

Decontamination

In the repository building are not performed any decontamination works. Those are performed in other buildings of NPP, which are equipped for such work.

System of repair and maintenance of containers

Maintenance works during normal operation of the repository are only in a limited scope and they consist mainly of a visual inspection of the pressure monitoring system and of replenishment of the helium tank, or of removal of dust from the surface of containers. After certain period of time, a renewal of painting of containers may be necessary.

Activities, during which is necessary to open the container, will be performed outside of the repository building (in a reactor hall).

Ventilation system

Purpose of the repository building ventilation system is to remove the residual heat, generated by spent fuel assemblies in containers and to ensure that the maximum design temperature will not be exceeded. Ventilation is provided by natural convection and air circulation (passive system). The air enters through shutters at the bottom of the external wall and leaves through openings in the repository ceiling structure.

Electrical system

Systems and equipment, supplied by the electrical system, can be divided into two groups:

- systems and equipment, for which the power supply is not secured,
- systems and equipment, for which the power supply is secured.

This can be realized through two power substation: main substation (unsecured supply) and emergency power substation (secured supply). The main power substation is supplied redundantly.

Drainage system

Purpose of a drainage system is a discharge of potential liquid radioactive waste into the collecting tank. After dozimetric inspection it will be discharged from the collecting tank either into sewage system, or transported to the NPP for re-processing.

System of radiation inspection

Handling with spent nuclear fuel (loading and unloading) is performed by equipment and according to working procedures, minimizing the scatter of ionising radiation and neutrons and their effects on personnel and population. The storage area is monitored for detection of potential growth of gamma and neutron fields, which may indicate degradation of the containment or the shielding.

Areas with significant potential of creation or accumulation of unacceptable concentrations of radionuclides in the air must be kept either in underpressure condition relative to atmospheric pressure, in order to prevent spreading of contaminated air into other parts of the repository, or their ventilation and filtration must be organized, so that concentration of radionuclides in the air is preserved below the limit values.

Monitoring of the radiation in open dry repositories with a shelter or without a shelter is provided at the boundary of the repository complex, so that eventual abnormal levels of radionuclides in the atmosphere can be detected.

Fire protection system

A dry repository will be connected to the fire protection system of the SE-EMO complex.

II.8.3.2.3 Handling with containers at the locality

Loading and unloading of the fuel into and from containers is performed only in the bay no. 1, next to the spent fuel storage pool, in the reactor building of a relevant unit. Decontamination of containers is also carried out inside HVB premises, in a decontamination bay.

Containers are from the reactor building to the repository transported via a towing vehicle or a railway wagon. The container is in the reception area lifted from transportation means by a crane and then is positioned in the vertical position in the preparatory zone. After performance of required checks and manipulations is the container transported to its storage position in the zone and is connected to the gas pressure monitoring system in the container (tightness check of the container).

II.8.4 Wet repository of the spent nuclear fuel Mochovce (variant 2)

The main advantage of wet storage systems is the fact, that the stored fuel can be easily accessible and controllable. In the storage pools may be at the same time stored quite large amount of fuel. Aquatic environment allows better heat removal, due to higher thermal conductivity of the water, compared to the air.

But the disadvantage of wet storage is the need for active cooling systems and water treatment, other support systems and permanent activities of the operator. During purification of cooling media is created a liquid waste, which (depending on the level of activity) must be modified. This also means, among other things, the need for additional capacities for processing, treatment and storage of this waste.

Technical solution for storage of SNF from the SE-EMO operating site consists of construction of a wet repository, based on an analogous principle, like storage used for a long-term storage of SNF in ISFS in Jaslovské Bohunice, operated by JAVYS. Spent fuel assemblies are stored below the water surface in the storage pools in vertical position in the storage container. Storage container is designed to provide subcriticality of the stored fuel and integrity of the fuel assemblies in case of an earthquake. Shielding of the spent fuel is created by water, surrounding fuel assemblies, concrete walls of pools and a building of the unit.

If this method of storing SNF is used, the storage containers are placed in water pools. Water provides residual heat removal from the spent fuel and at the same time represents sufficient biological protection against radioactive radiation. For storage are used containers T 12, T 13 and KZ 48. Transport of the SNF is performed in a transport container TK C-30, by a railway transport. Conditions and technical limitations on the transport using approved transport containers are defined in PpBS of the transport container C-30, on the basis of analysis assessing subcriticality of transported fuel. Determining parameters are spending of fuel, residual output of the fuel assembly and enrichment of the fuel.

Requirements on output of a dose equivalent during transport (TK C-30), as well as technical requirements on a packaging casing in terms of nuclear safety and durability are the same than for packaging casing for a dry type repository.

II.8.4.1 Construction part

Building of the SNF repository is usually divided into the container and the storage section. From a structural point it is a combination of monolithic reinforced concrete (bottom structure and storage pools) and a steel construction (container hall and hall of storage pools). Storage section is usually composed of several storage pools. One pool is a reserve for a case of necessity to remove the fuel from permanently filled pools.

Container section of the building includes a container hall, siding rail area and other facilities of auxiliary operations. Storage section is formed by monolithic concrete pools. Building is founded on a basemat. Water-construction concrete of storage pools has besides to its static function, also a function of biological protection.

Technological auxiliary operations are represented by pumps and heat exchangers of the pool cooling water, pumps and filters of the pool water cleaning station, air-conditioning systems, distribution boxes and transformers, laboratory, pipe corridors with collection and control of escapes from pool water, hygienic loop with sanitary facilities and premises for operators.

The repository building will be connected to already existing infrastructure of the SE-EMO complex (roads, siding, electrical power supply, connection to fire water circuits etc.

II.8.4.2 Technological and transport part

Spent nuclear fuel from the reactor hall will be transported to the repository building via transport container C-30. In container hall is for transport and further handling of containers used a special bridge crane. Container with spent fuel assemblies is by a crane moved from the transport container to the storage pool.

Transport and technological systems are composed also of a system of television cameras and ancillary equipment of transport technology, like container hinge, handhold with illumination, container screw tightener, submersible reflectors, etc.

II.8.4.2.1 Technological systems

Pool water cooling system

Cooling of fuel assemblies is provides by water, which is consequently cooled in the cooling circuit, using temperature gradient comparing to the surrounding. The pool water cooling system consists of pumps, heat exchangers and piping system. In the pools with stored fuel, the system maintains a constant water temperature. Heat removal is performed by two mutually separate circuits - a pool water circuit and a cooling water circuit.

Pool water cleaning system

Pool water cleaning system provides required purity and quality of the pool water. This function is generally provided by the mechanical filtration and the ion exchange. Hydraulic pool water cleaning system consists of pumps, cleaning station and piping system. The pool water from discharge of pumps passes through individual filters of the cleaning station. Microbiological inspection of the storage pool water is also performed.

Air-conditioning and ventilation system

An air-conditioning equipment provides ventilation and forced warm air heating of the whole facility. Purpose of the air-conditioning equipment is:

- to ensure the conditions for radiation protection in the SNFR and surroundings of the repository,
- to create suitable working conditions for personnel and technological equipment of SNFR,
- to ensure internal and external safety from the activity liquidation aspect in areas with their possible occurrence.

From conceptual aspect of individual systems are HVAC systems divided into entry, discharge and circulation systems. For the HVAC concept will apply a principle that the air between individual spaces can flow only from the room with a lower activity to the room with a higher activity. Comparing to surroundings, an underpressure is maintained in rooms with activity.

Air, which aerated a space with activity, is discharged to the atmosphere via a HVAC chimney, equipped by system of filters for capture of radioactive aerosols.

Electrical system

Systems and equipment, supplied by the electrical system, can be divided into two groups:

- systems and equipment, for which the power supply is not secured,
- systems and equipment, for which the power supply is secured.

This can be realized through two power substation: main substation (unsecured supply) and emergency power substation (secured supply). The main power substation is supplied redundantly.

System of radiation inspection

Radiation protection in SNFR is secured by series of measures, main of them are:

- location of the SNFR building inside the protective zone of existing SE-EMO complex,

- division of the SNFR buildings into zones, i.e. consistent separation of active and inactive premises by a sanitary loop - therefore establishment of a controlled area,
- biological protection (shielding), providing reduction of a dose equivalent to acceptable values,
- ventilation system, providing controlled movement of the air, towards the room with higher level of radioactive pollution,
- discharge of polluted air through a ventilation chimney, with eventual filtration,
- pool water cleaning and cooling system,
- system of decontamination of transports, technological equipment and transportation means,
- organised collection and discharge of liquid and solid radioactive waste,
- radiation inspection.

Fire Protection System

The wet repository will be connected to the fire protection system of the SE-EMO complex.

II.9 Reasoning of the necessity of the proposed activity in the given location

Spent nuclear fuel is, after the end of its usage, transported to the spent fuel pool which is located in the proximity of the reactor. For each reactor there is a separate spent fuel pool. The spent fuel stays in the pool for the period of 3 to 7 years. Regarding the limited capacity of the pool it is necessary to relocate the spent nuclear fuel to the storage facility of spent nuclear fuel where it is stored for a longer period (decades of years). Since 2006 the spent nuclear fuel has been transported from storage pools in SE-EMO to interim storage in Jaslovské Bohunice which is used for storing spent fuel from all the nuclear power plants in the Slovak Republic. It is a wet type of a storage which is operated by state company JAVYS, a.s.

The aim of the storage facility in Mochovce is to storage spent nuclear fuel from the operation of SE-EMO reactors (JE EMO 1, 2 and EMO 3, 4) and SE-EBO (JE V2) for the period of 60 years with the possiblity of extension to 100 years.

Spent nuclear fuel from the operation of JE EMO 1, 2 is expected to be transported to interim storage in Jaslovské Bohunice until 2018, i.e. until the new storage facility in Mochovce is put into operation. Since 2019 the spent nuclear fuel originated in SE-EBO will be transported to the new storage of spent nuclear fuel in Mochovce.

The erection of storage facility in Mochovce area will minimize the necessity of transports of spent nuclear fuel from SE-EMO to another area (interim storage in Jaslovské Bohunice). This will significantly reduce the risk of unexpected situations related to the transportation of spent nuclear fuel as well as uncertainty of accepting transportation by the public. By erection and operation of the storage facility in Mochovce the necessary assumptions for operation of JE EMO 1,2 and JE V2 units for another 30 will be created and, after the erection is completed, also for JE EMO 3, 4 units. The conditions for safe storage of spent nuclear fuel will be created as phases in the system of spent fuel management before the final solution which is, according to the valid *Strategy of final part of nuclear energy* as well as *Strategy of final part of peaceful use of nuclear energy in the Slovak Republic* (being prepared), its disposal in the deep underground repository.

The intention is in accordance with current international practise in nuclear energy which pursue erection of storage facilities of spent nuclear fuel in area of nuclear power plants or in their proximity what eliminates or minimizes the necessity of transportation of spent nuclear fuel.

A convenient place for erection of storage facility is a free area in EMO 3, 4 area between cooling towers and pump station of circulation cooling water.

II.10 The Total Cost

Investment costs for storage capacity 21,200 pieces of spent nuclear fuel assemblies and the expected storage period 60 years (extendable to 100 years), taking into account data from the EIA report of 2003 (Matejovič et al., 2003), considering inflation and storage capacity, is estimated 1.5 - 3 times the planned cost et that time:

- Alternative 1 - Spent nuclear fuel dry storage facility 41,25 - 82,50 million €,
- Alternative 2 - Spent nuclear fuel wet storage facility 96.75 - 193.50 million €.

The costs are considered when placing containers in SFSF during test commissioning so-called first of equipment (for about 144 spent fuel assemblies). Other containers are purchased gradually as needed during operation of the storage facility.

The costs of the zero alternative, the losses that would be incurred if it would prevent the construction of spent fuel Mochovce, would gradually fill the interim spent fuel storage facility in Bohunice and would not be possible to transport spent fuel to another spent fuel storage facility. This would lead to the gradually phasing out of NPPs EMO1,2, V2 and economically would be questioned and completion and subsequent operation of the NPP EMO3,4. Negative economic impacts would be felt not only most sectors of the economy, but also the population of the Slovak Republic.

II.11 Affected Municipalities

Area of SE-EMO, which will implement the proposed activity, is located in the cadastral area municipalities Kalná nad Hronom (cadaster Mochovce) and Nový Tekov (Levice District, Nitra Self-Governing Region). Village Mochovce was in connection with the construction of Mochovce cancelled and administrative passed under the administration of the village Kalná nad Hronom.

Municipalities territory which may also be affected by the proposed activity are Malé Kozmálovce, Veľký Ďur, Starý Tekov villages and town Tlmače (Lipník) (Levice District, Nitra Self-Governing Region), Nemčiňany village (Zlaté Moravce District, Nitra Self Governing Region) and Čifáre (Nitra District, Nitra Self-Governing Region). These are municipalities whose cadastral area extends into 1th zone (5 km) of threatened area of SE-EMO or are in its immediate vicinity (see Fig. 3).

Fig. 3 - Threatened area of SE-EMO.

II.12 Self Governing Region

Nitra Self-Governing Region

II.13 Affected Authorities

District Environmental Office Levice,

District Environmental Office Nitra,

District Environmental Office Zlaté Moravce,

Ministry of Health of the Slovak Republic –Public Health Office of the Slovak Republic,

District Office Levice, Civil Protection and Crisis Management Department,

District Office Nitra, Civil Protection and Crisis Management Department,

District Office Zlaté Moravce, Civil Protection and Crisis Management Department,

District Office for Road Transport Land Communications Levice,

District Office for Road Transport and Land Communications Nitra,

District Office for Road Transport and Land Communications Zlaté Moravce.

II.14 Permission Authority

Nuclear Regulatory Authority of the Slovak Republic.

II.15 Departmental Authority

Ministry of Economy of the Slovak Republic.

II.16 Type the Required Permission for the Proposed Activity Under Special Regulations

The proponent will seek permission NRA SR for new activity Spent Fuel Storage Facility Mochovce according to § 2, letter u of the *Act No. 541/2004 Coll. On the Peaceful Use of*

Nuclear Energy. To begin the construction of spent fuel storage facility will need planning permission NRA SR as a construction office and approval for siting - zoning permission - the relevant local civic office, which is the Municipal Office Kalná nad Hronom (Joint Building Authority Levice, respectively).

II.17 Statement on the Expected Trans-Boundary Impacts of the Proposed Activity

No significant impacts of construction, operation and decommissioning of spent fuel storage facility dry or wet type are expected beyond national borders.

III Basic Information About the Current Status of the Environment of the Investigated Area.

III.1 Characteristics of the Natural Environment Including Protected Areas

III.1.1 Characteristics of the Boundaries of the Investigated Area and Regional Geological and Geomorphological Division

The boundaries of the investigated area are reflected in interactive geographic, regional geological, hydrogeological but also, phyto-geographical and zoo-geographical divisions of the broader area. Natural conditions are specified by the geological structure, which is copied by geomorphology. Consequently, we characterize the boundaries of the investigated area from the regional geological and geomorphological viewpoint. The investigated area in sense of regional-geological division (Vass et al., 1988) is considered the Komjatická priehlbina depression flanked by foothills of the Štiavnica stratovolcano on the north and northeast (Fig. 4).

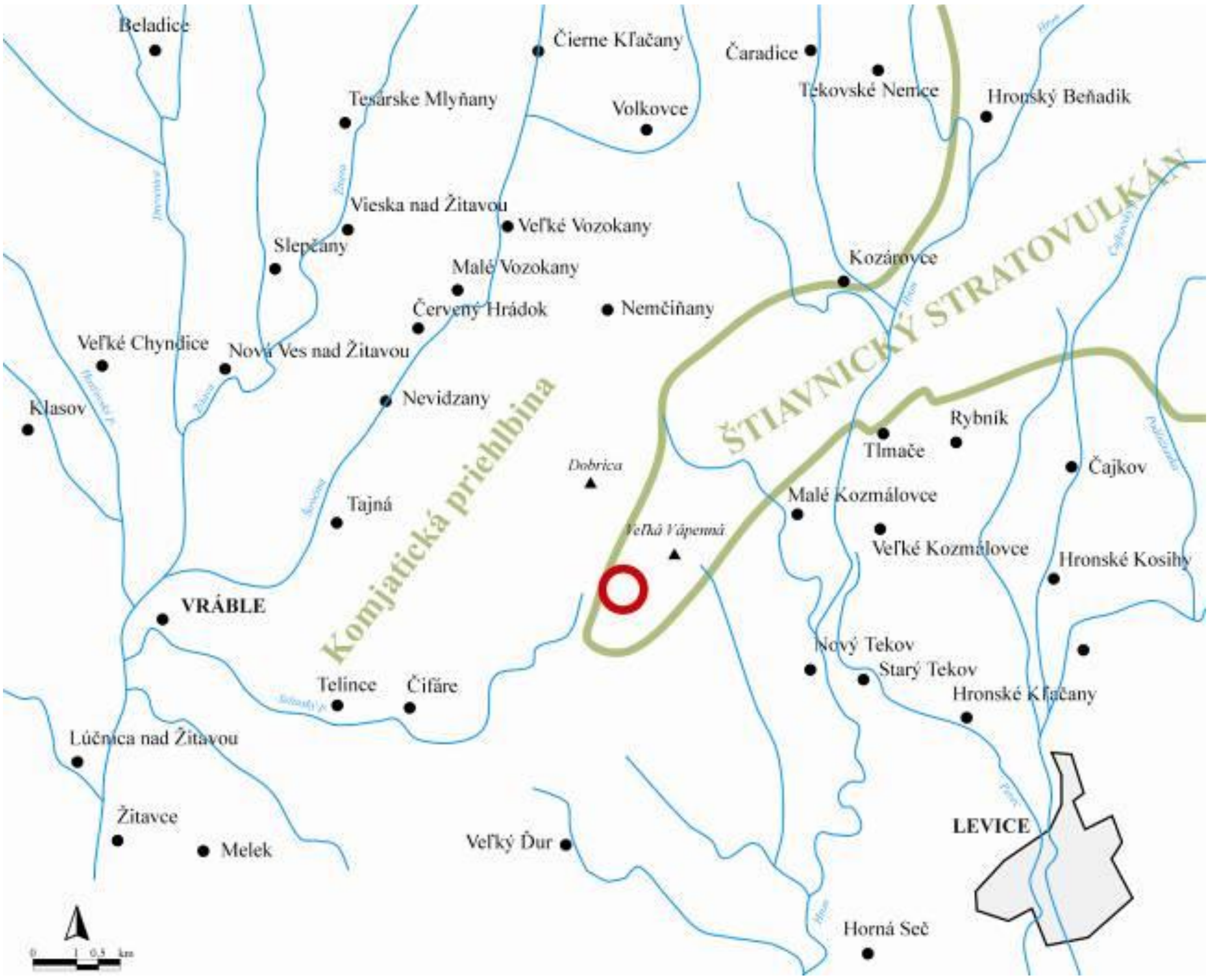


Fig. 4 - The regional-geologic division (Vass et al., 1988).

According to geomorphologic division the Mochovce NPP is situated near the boundary of major geomorphologic units – the Carpathians system and Pannonian Basin system. The boundary is situated in immediate vicinity of the Mochovce. Neovolcanic elevation of the Veľká Vápenná hill belongs to the Carpathians system, while the sedimentary fill of the Bešianska pahorkatina Uppland belongs from geomorphological point of view to the Pannonian Basin system.

Part of the territory belongs to the Pannonian Basin. In more detail division belongs to the Západopanónska panva province, sub-province Malá Dunajská kotlina Basin, Podunajská nížina Lowland. An essential part of the territory belongs to the Podunajská pahorkatina Upland, which includes subdivisions Nitrianska pahorkatina Upland, Nitrianska niva

Floodplain, Žitavská pahorkatina Upland, Žitavská niva Floodplain, Hronská pahorkatina Upland and Hronská niva Floodplain (Fig. 5).

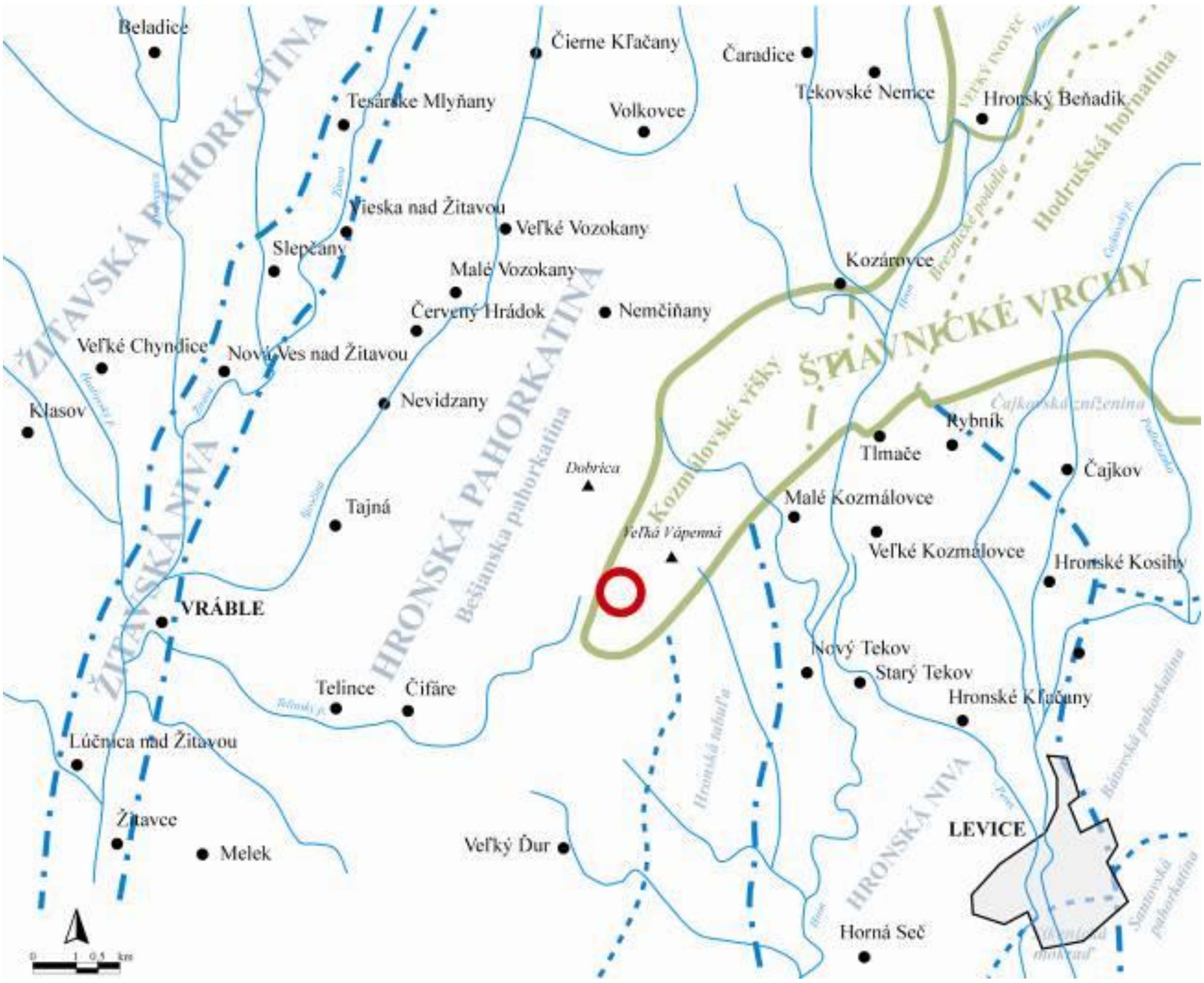


Fig. 5 – Geomorphological division (Mazúr & Lukniš, 1986).

Geomorphological division of area reflects the Cenozoic and especially Quaternary geological and tectonic evolution. This was accompanied by segmenting of the whole region into the uplands, which are built by the Upper Miocene and Pliocene sediments and alluvial zones formed mainly Quaternary infill.

Northern and northeaster part of the investigated area belongs to the Carpathians system. In frame of the Carpathians system belongs to the Western Carpathians province, sub-province of Inner Western Carpathians and Central Slovakia Highlands region. To the Central Slovakia Highlands belong Pohronský Inovec Mts. and Štiavnické vrchy Mts. units, with its large subunits Veľký Inovec, Hodrušská hornatina Highlands, Kozmálovské vŕšky Hills and the Breznické podolie Depression, which represent volcanic mountains. In elevation parts on the north and northeast of the region, which belong to the volcanic mountains, dominate tectonic to structural-tectonic surfaces of volcanic morphostructures and a positive trend of the vertical motion. Elevation parts characterized predominantly erosion-denudation relief.

The predominant portion of the investigated area, which geomorphological belongs to the Pannonian Basin system, is characterized by the presence mainly tectonic to tectonic-structural surfaces of the Intramontane basins, mostly moderately differentiated to a lesser extend undifferentiated morphostructures. Relief in those parts of the territory is predominantly erosion-accumulative. The highest point of the investigated territory is Stará hora elevation (474.3 m a.s.l.) east of Kozárovce, the lowest point is near the Hron River close to the Žitavce (137 m a.s.l.).

The territory of the Bešianska pahorkatina Upland contains soft relief features typical mostly rounded ridges. The highest point is elevation Pod Dobricou - 291 m a.s.l., the lowest is valley of the Ďurský potok Creek - 172 m a.s.l. Hronská pahorkatina Upland has flat relief with altitudes ranging from 174 m by 158 m a.s.l. Dissected relief of the Kozmálovské vŕšky Hills reaches 349.8 meters a.s.l. (elevation Veľká Vápenná). River network is usually represented by permanent streams, but the valley, especially in Kozmálovské vŕšky Hills and partly also Bešianska pahorkatina Upland are drained by ephemeral streams. Most of the streams drain the water into the river Žitava on the west, less to the river Hron on the east.

III.1.2 Geological Structure of the Investigated Area

The basic concept of geological structure is expressed in geological maps at a scale of 1:50 000 (Harčár and Priechodská, 1988; Nagy et. al., 1998; Konečný et al., 1998). Geological structure is shown in a simplified geological map (Fig. 6).

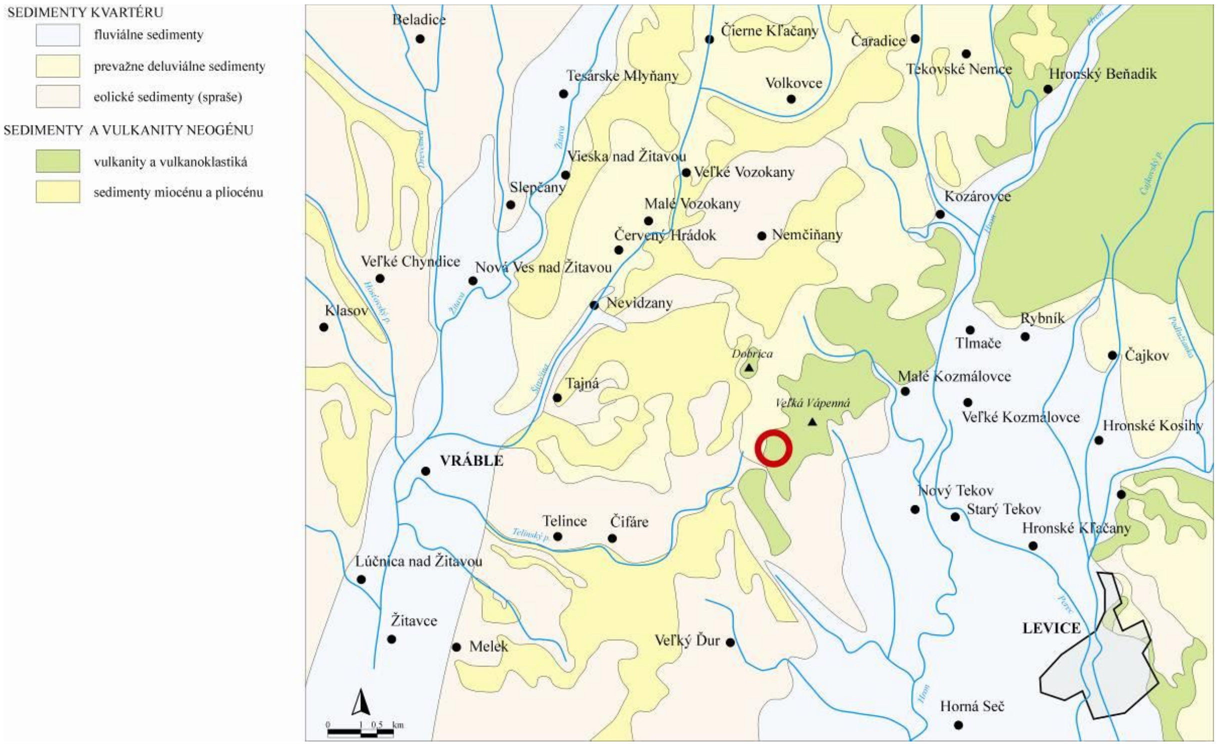


Fig. 6 – Simplified geological map of the investigated area

The investigated area is built by the Upper Miocene to Pliocene (Sarmatian – Dacian) sediments of the Komjatická priehlbina Depression. Miocene volcanics of the Štiavnica stratovolcano interfere with the sedimentary fill of the Komjatická priehlbina Depression from the northeast. Pre-Cenozoic basement of the Neogene sediments and volcanics constitute principal paleo-Alpine tectonic units of the Western Carpathians. In investigated area it is mainly the Hronicum allochthonous tectonic unit. The Veporicum and the Tatricum tectonic units are presented in pre-Cenozoic basement further to the west, respectively northwest.

III.1.2.1 Neogene Sediments and Volcanite

The oldest deposits in the investigated area include Sarmatian sediments (Tab. 1). Sarmatian sediments (Vráble Formation) occur only at the periphery of neovolcanites. Lithological content of rocks is limited to coarse-grained conglomerate (pebbles up to 30 cm diameter) sediments, which are composed mainly of surrounding volcanites. In space and time, the deposits become soft-grained and pass into sandstones and calcareous pelitic rocks. Rarely are presented organogenic limestone containing a rich fauna of oysters. Volcanic rocks are represented by the Sitno effusive complex (Sarmatian). It consists of different varieties of andesites lava flows (e.g. Čifáre andesite) and their volcaniclastics e.g. hyaloclastic breccias, redeposited pyroclastic and epiclastic volcanic breccia represent of the Štiavnica stratovolcano destruction products.

The Pannonian sediments (Ivánka Formation) do not appear on the surface, but have found in numerous boreholes in Mochovce vicinity. Lithological content consists of grey or green-grey, mostly calcareous clays. Sediments of the Beladice Formation were by Kováč et al. (2011) included into Pannonian age (before Pontian). They are typical with the occurrences of variegated clays and coal seams. Within the investigated area were identified by drilling in the western part. Sediments of the Volkovce Formation gradually evolved from Beladice Formation (Kováč et al., 2011) and represent of the fluvio-limnic sedimentation. The Volkovce Fm., contain mostly gravels to sands sediments with significant extension on the surface. Sedimentation environment represents the delta river, which flowed into the lake. The thickness of the Miocene to Pliocene sediments reaches 2000 m, in the deepest part of Komjatická priehlbina Depression, further to southwest of the investigated area even up to 4 000 m.

Tab. 1 Lithostratigraphic column of the sedimentary infill of the Komjatická priehlbina Depression - northern part.

AGE				Lithostratigraphic Unit	Lithology
5,4 Ma	NEOGENE	PLIOCENE	Dacian	Volkovce Formation	Light grey and light green clays, brownish sandy clays, sands and gravels
7,1 Ma		MIOCENE	Pontian		
			Pannonian	Beladice Formation	Green, blue-green clays, sandy clay sands, coal clays and lignite
11,5 Ma				Iványka Formation	Grey calcareous clays, grey sands dark grey claystones grey-green calcareous clays
13,0 Ma			Sarmatian	Vráble Formation	Grey calcareous clays, calcareous sands and gravels andezite lava flovs and volcanoclastic rocks
PRE-NEOGENE BASEMENT					limestones, dolomites, quarzites granite

III.1.2.2 Quaternary Sediments

The Quaternary depositions are from point of view of their extension most frequent sediments. They are composed mainly of fluvial, aeolian and debris (diluvial) genetic types of sediments or their mutual varieties. The fluvial sediments are concentrated in the streams valleys and their tributaries. Massive occurrence is at the eastern edge of the investigated area, where they are the product of the Hron River. The debris-fluvial sediments represent a specific group of sediments which were generated from the Pleistocene to the present. They fill bottom parts of dry, semi-dry valleys and valleys with ephemeral flows. Eolian sediments have dominant extension in the investigated territory. They consist mainly of loess and loess loam (Würmian to Holocene). Loess sediments are extended solely on the flat southern slopes of valleys respectively on the eastern slopes of the Kozmálovské vŕšky Hills. This fact indicates the general direction of deposition by winds from north and west. Eolian-diluvial sediments are the product of young the Holocene to recent slope processes. They are typical for bottom fill of dry valleys situated on loess.

III.1.3 Engineering-Geological Conditions

The investigated area of the Mochovce NPP surroundings belongs in terms of engineering-geological regionalization (Hrašna and Klukanová, 2002) to the pre-Quaternary region as well as the region of Quaternary sediments. The Mochovce site belongs to the region of pre-Quaternary sediments further to the region of the alternating cohesive and non-cohesive sediment, which is bounded by the region of Quaternary sediments, represented the region of debris / diluvial sediments. The region of alternating cohesive and non-cohesive sediments represent pyroclastic breccia and volcanic complex of the Štiavnické vrchy Mts., with the transition to hard rocks (lava flows of andesite – class: R3, R4 and R5). To the region of debris / diluvial sediments belong clays with varying proportions of sandy and loamy component (class: F6, F8, granularity: CV, CI, CH, clays of medium, high and very high plasticity, mostly solid consistency). The region of sandy-gravel sediments and volcanic rocks (pre-Quaternary sediments) and the region of fluvial sediments, loess sediments, river terraces and dry valleys sediments belong to the investigated area (Fig. 7).

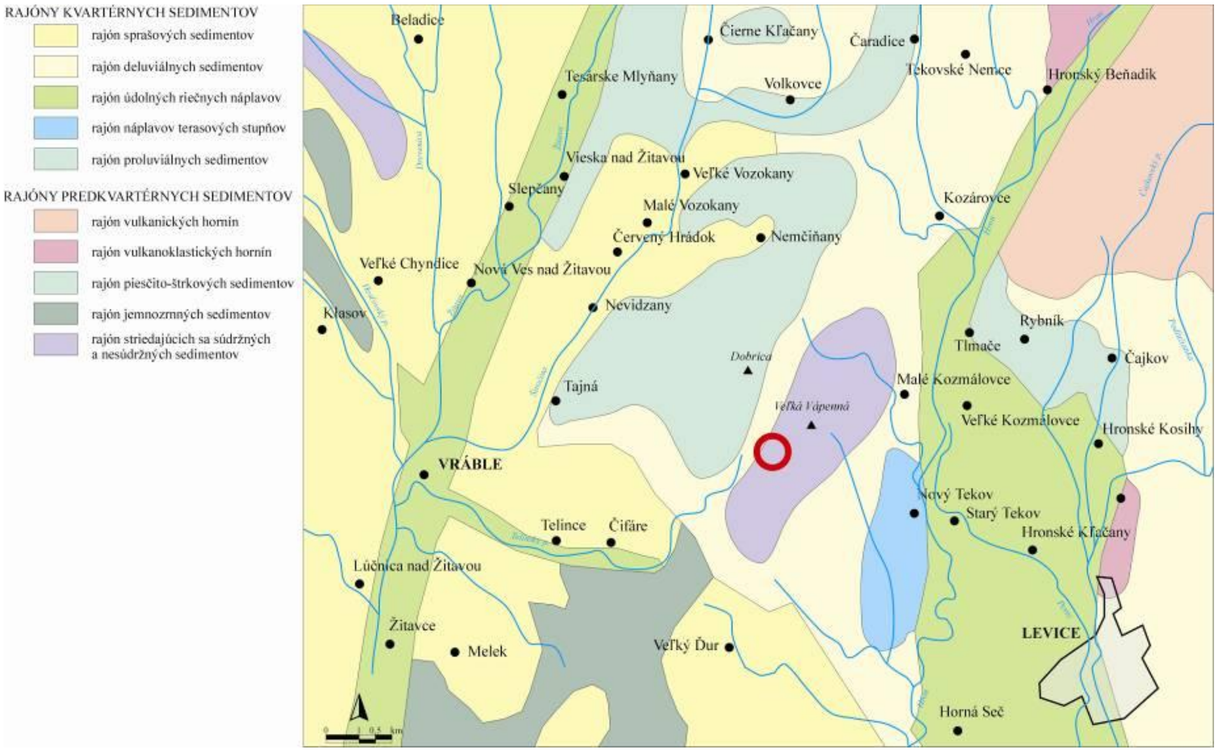


Fig. 7 – Map of the engineering-geological regionalization of investigated area

In terms of suitability for waste disposal is the investigated area situated on border among the suitable, conditionally suitable and unsuitable regions (Fig. 8).

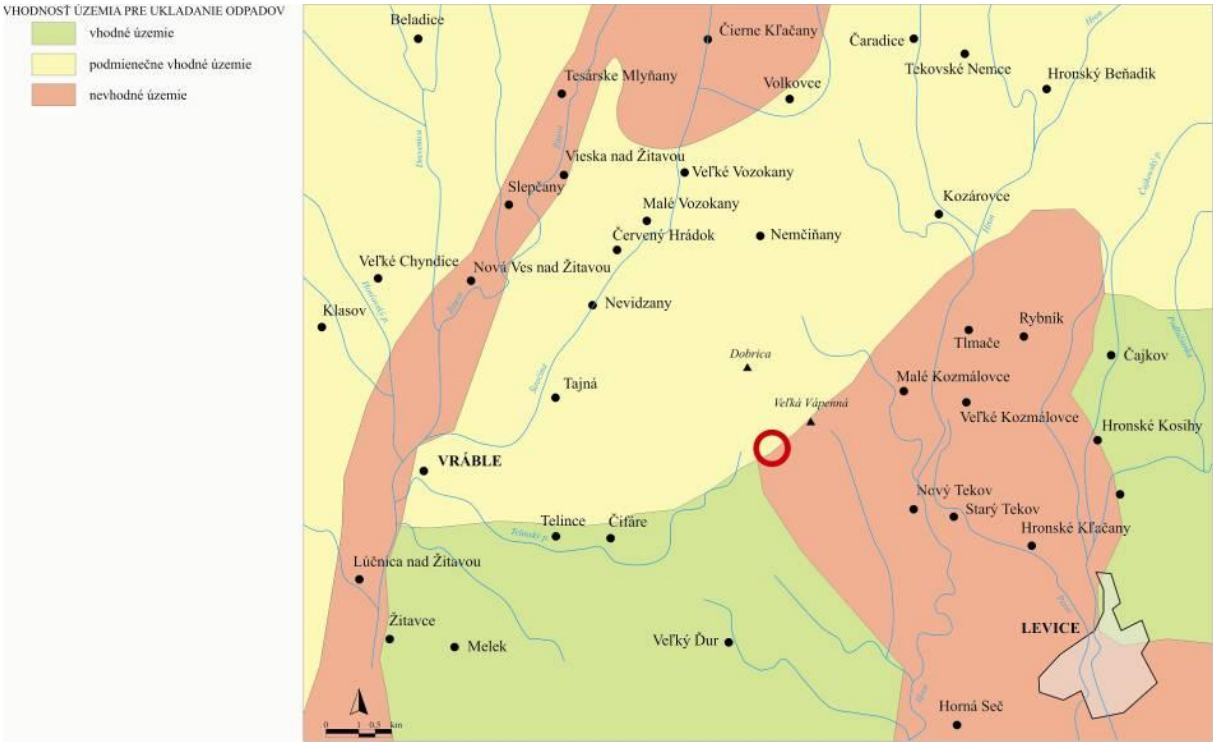


Fig. 8 – Map of the suitability for waste disposal

III.1.4 Seismicity

For the investigated area is set at a maximum seismicity 8° MSK.

III.1.5 Tectonics

The majority of faults, which has been identified in the area, belong to the category of extensional faults with a predominant vertical component of movement on the fault plane (normal faults). Based on the age and nature of their activities can be divided into two groups. The most significant faults are identified only by drilling and geophysical data and their surface evidence are unknown (aerial photographs, geomorphology, geological mapping, paleoseismology). These faults controlled sedimentation of the Miocene clastics. They have considerable depth range and do not disturb Pliocene sediments.

Faults that can be topographically and geologically identified have local significance. Their range is small and disturbs Pliocene sediments. The first group of faults can include faults respectively fault zone or systems, which limit the extension of the Miocene sediments to paleo-Alpine units or against volcanic rocks (basin margin faults). Tectonic activity of the faults is concentrated in the Middle Badenian to Upper Pannonian period. Based on the thickness of sediments the most intense subsidence of depressions occurred during the Pannonian (11.0 Ma - 7.1 Ma).

The faults disturbed of the Upper Pannonian sediments to Pliocene belong to the special group. They offset ranges from 25 m to 40 m maximum. The real observed fault offset on surface outcrops reached first of tens centimetres. Their depth range is estimated the first ten to hundreds of meters. All observed faults have a predominant normal kinematic tendency on the fault plane (normal faults). They disturbed the Pliocene sediments, but for their activity during the Quaternary does not exist evidence.

III.1.6 Mineral Resources

In the investigated area are not registered mineral deposits. Potential accumulation of raw materials is connecting with the Neogene sediments and volcanics and Quaternary sediments. Significant are the Neogene volcaniclastic (bottoming and facing stone) and Quaternary fluvial sediments, representing gravels and sands. The Neogene sediments are locally mined mainly as sand.

III.1.7 Soil Conditions

Region SW of the Mochovce lying in the Hronská pahorkatina Upland and Kozmálovské vŕšky Hills is covered (Hraško et al., 1993, Šály & Šurina, 2002) mainly by brown soils, luvisols typical, luvisols modal and cultisols originating from thin cover of loess loam (Fig. 9). Additional soils are represented by cambisols, locally pararendzinas originating from skeletal, especially Tertiary sediments. Forested areas are characterized by ranker cambisols, with loamy to clayey texture. Fluvisols typically occurs in the area around Žitava and Hron River. Brown soils in the investigated area are typical in the Hron River floodplain; gleysols occur north of Levice. Locally near Širočina stram fluvisols, gleysols and phaeozems occur. Chernozem and pseudogley occur in the area of lower reach of Telinský potok Creek.

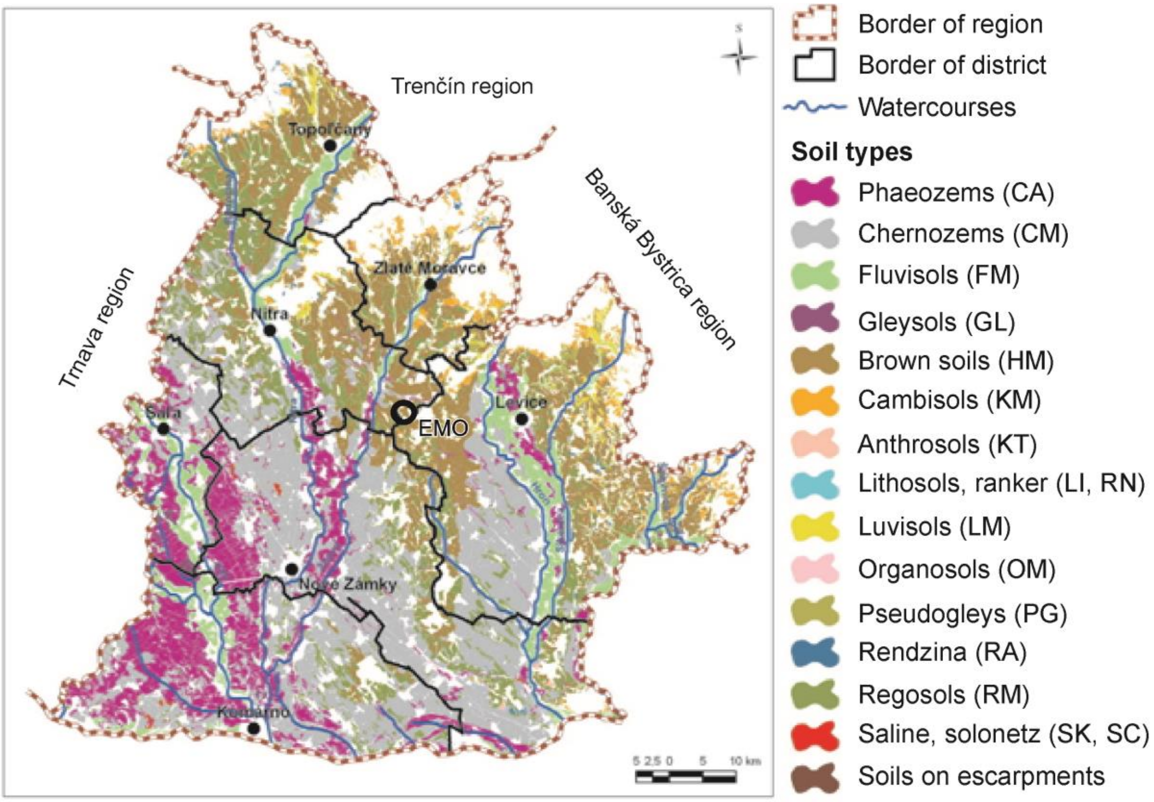


Fig. 9 – Soil types of Nitra region (Pálka et al., 2009)

Average production potential of soils in the Nitra region is 68.6 in the 100 point scale. In terms of grain size, soils in the Nitra region are represented in particular, moderately heavy soils, covering up 67,9% of the area. They are represented particularly by sandy-loamy soils to loamy soils containing 20-45% of fraction larger than <0.01. In terms of soil bonity 58% of soils in the Nitra region belong to group of protected soils with a high bonity (group 1-4). The investigated area, soils from group 2-5 prevail (Fig. 10).

Potential degradation processes endangering most of soil types in the investigated area is soil compaction and erosion. Steeper areas are more sensitive to soil erosion. Greater impact of steep topography in the investigated area has resulted in an increased potential for the occurrence and formation of water erosion.

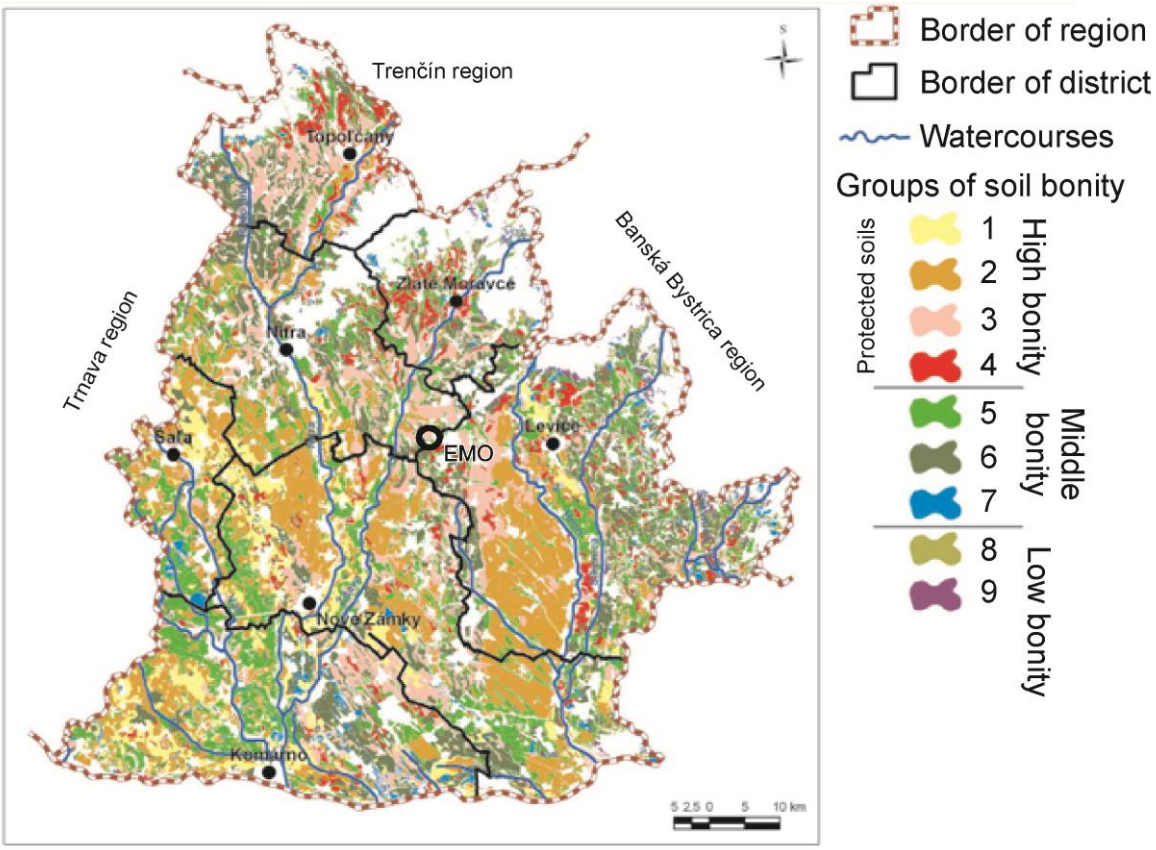


Fig. 10 – Map of groups of soil bonity for Nitra region (Pálka et al., 2009).

III.1.8 Hydrological Conditions

III.1.8.1 Water Courses

The area of Mochovce is located in the watershed of Hron and Nitra rivers. Water divide between Hron and Nitra rivers passes the ridge of Kozmálovské vŕšky Hills east and north of the SE-EMO. Source of service water (especially cooling water) is Veľké Kozmálovce reservoir where the sewage water from the complex is drained. The maximum amount of water taken from this source is 1.8 $m^3.s^{-1}$; the average amount of water taken is 1.5 $m^3.s^{-1}$. Long-term average discharge of the river Hron at Kozmálovce is 51.58 $m^3.s^{-1}$, in the river mouth 55.20 $m^3.s^{-1}$.

Complex of the EMO is immediately drained by Telinský potok Creek (tributary of Žitava, watershed of Nitra). Telinský potok Creek is water-course of IVth order, which runs into the Žitava River. It rises on the SE slopes of the Dobrica. The catchment area of the stream is 37,91 km², the length of the water-course is 15,8 km. Čifáre reservoir is built at 10,5 rkm. The stream is in the area of SE-EMO covered from rkm 15,1 to 13,7 and later further flows in open channel. Average discharge during the year at rkm 11,8 (below the right nameless tributary) is in the long term 40 ls^{-1}.

III.1.8.2 Water Bodies

The nearest water bodies in the investigated area are Čifáre reservoir on the Telinský potok Creek and Veľké Kozmálovce reservoir on the Hron River. Veľké Kozmálovce reservoir was built for the needs of SE-EMO and is used mainly for service water extraction from the river Hron. It also provides minimum discharge of Hron under the reservoir that is 6,6 $m^3.s^{-1}$. It serves as well as an important element of the landscape of the river floodplain ecosystem. Other features include water supply of Perec canal, irrigation, operation of smaller hydroelectric power plant, recreation, and sport fishing. At the minimum operating level of the reservoir, water level reaches elevation 171,5 m above sea level and volume 586 000 m³. At the maximum operating level the water level reaches elevation 175,0 m above sea level a volume of 2 584 000 m³. The Čifáre reservoir serves mainly for irrigation of agricultural land. The maximum operating altitude of the reservoir is 176,6 meters above sea level and the minimum operational altitude level is 173,7 m above sea level.

Other bodies of water in the study area are Nevidzany and Nemčiňany reservoir, Ďurský rybník fish pond and water reservoirs Kozárovce a Veľké Vozokany.

III.1.8.3 Groundwater

Complex of the JZ Mochovce lies in the hydrogeological region of Hronská pahorkatina Upland which covers the western portion of the area. Southern and south-eastern portion of the wider region is composed of the Hron River Quarternary terraces in the Podunajská nížina Lowland and Quarternary floodplain of Hron River in the Podunajská nížina Lowland (Malík & Švasta, 2002).

Prevailing rocks are composed of sediments of the Upper Neogene, mainly siliciclastic sediments with low to no permeability. Region is generally poor on springs, contact springs that underflood the superficial areas of water ascent, are most common. Groundwater is more frequent in the areas where the Pliocene gravel occur bellow the Quarternary sediments.

The north-western and western portion of the investigated area, especially floodplain of Žitava River as well as the western part of SE-EMO is located on lacustrine Pliocene sands with pore permeability. Aquifers consisting mostly of unconsolidated sediments have mostly an intergranular type of permeability. The water table in these rocks is usually free, around Nemčiňany mostly confined. There are spatially limited or discrete hydrogeologically highly productive aquifers, or large and medium productive aquifers. Larger quantities of groundwater occur in the Pliocene sediments that are overlapped by Quaternary deposits. Degree of water saturation in the area of Mochovce and Nevidzany ranges from middle through high to very high. The wells in the SE-EMO complex and Nemčiňany have water discharge ranging from 6,1 to 27,0 $l.s^{-1}$.

The northeastern portion of the region lying in floodplain of Hron River is built mainly fluvial gravels, sandy gravels and sands, mainly of Pleistocene age. They are often covered with sandy soils. Quaternary sediments are reaching a thickness of 4 – 10 m. They are characterized by pore permeability; groundwater table is free and hydrologically connected to streams. Sediments constitute hydraulic unit with fine Neogene gravels in basement. Unit constitutes restricted or spatially discrete hydrogeologically highly productive aquifers, or medium to highly productive aquifers. Filtration properties of alluvial sediments is characterized by filtration coefficient in the range of 10^{-5} - 10^{-3}. Values up to 20 $l.s^{-1}$ from single wells were detected in the Kozmálovce - Nový Tekov - Kalná nad Hronom area. Further south the aquifer yield is approximately 10 $l.s^{-1}$; in the lower parts of the stream 2 – 8 $l.s^{-1}$.

The areas build by Miocene to Pliocene neovolcanic rocks emerging from beneath the Noegene sediments are mostly related to foothills of the Štiavnické vrchy Mts. on NE and Kozmálovské vŕšky Hills in the immediate vicinity of SE-EMO. This region is an important infiltration area. The fracture type circulation of groundwater prevails in the andesites; volcanoclastics are characterised by fracture-pore type circulation. Lacustrine clays and alternating sandstones and clays of brackish-freshwater origin with sandy gravels on the edges of mountains are often covered with loess. Upper Miocene and Pliocene sediments, volcanic and volcanoclastic rocks are characterized by pore permeability with confined groundwater table. Minor aquifers with intergranular or fracture permeability, with negligible amounts of groundwater are characteristic feature. Locally minor aquifers with limited quantities of groundwater of local importance may occur. Tuffs, tuffites and agglomerates on the SW edge of the Štiavnické vrchy Mts. are characterized by largely variable water saturation related to varying granulometric composition. Groundwater with confined table is more common.

III.1.8.4 Thermal and Mineral Springs

There are no thermal or mineral springs in the investigated area.

III.1.8.5 Water Management Protected Areas

There are no water management protected areas in the investigated area.

III.1.9 Animal and Plant Kingdom

III.1.9.1 Animal Kingdom

The area of Mochovce is according to the zoogeographical zoning located on the border of Pannonian district of European steppe province and Carpathian district of deciduous forests, represented by the Kozmálovské vŕšky Hills. From the perspective of limnic biocycle, the territory is portion of the Danube district (Central Slovak and Western Slovak portion) of Pontian-Caspian province.

The most widespread habitat is represented by cultural steppe, tufts and preserved remnants of riparian forests and riparian vegetation along watercourses.

Invertebrates

Invertebrates (*Evertebrata*) known from the investigated area are mostly represented by the class of insect (*Insecta*). Oak forest area is characterized by the presence of species of cockchafer (*Melolontha melolontha*), stag beetle (*Lucanus cervus*) and longicorn (*Plagionotus arcuatus*). Butterflies are represented by nun moth (*Lymantria dispar*), tortix moths (*Totrix viridana* and *Totrix loeflingiana*). Butterflies *Stigmella trimaculella*, *Cossus cossus*, *Nymphalis antiopa* and beetles *Xylotrechus rusticus*, *Lamia textor*, *Carabus coriaceus* are characeteristic for riparian forests. Forests situated at the foot of the mountains are typical of springtails (*Collembola*), earwigs (*Dermaptera*), aphids (*Aphidenea*), ground beetles (*Cychrus carboides*, *Carabus auronitens*) and Longicorns (*Carambyx scopolii*, *Rosalia alpina*). Occurrence of dragonflies in the vicinity of watercourses is common. Gastropods like snail *Tachea hortensis* are known from riparian forest areas. Snails *Monachoides incarnata* and *Cochlodina laminata* are typical for the upland forests.

Vertebrate

Amphibians and reptiles in the investigated area are linked to the steppe, rocky slopes and vegetation in valleys of streams and similar. Presence of frogs like European tree frog (*Hyla arborea*), grass frog (*Rana* sp.), newt (*Triturus vulgaris*) was confirmed. Reptiles are represented by lizards (*Lacerta muralis*, *Lacerta viridis*), grass snake (*Elaphe longissima*, *Natrix natrix*).

Mixed birds species from the lowland, upland and foothills forests are typical. Birds are represented both by predators such as hawk (*Accipter nisus*) or European eagle owl (*Bubo bubo*) and *Coraciiformes,* e.g. kingfisher (*Alcedo attis*). Presence of grey heron (*Ardea cinerea*) from the family of herons was confirmed. Quails (*Coturnix coturnix*) and grey partridge (*Perdix perdix*) are characteristic bird species for the fields and. Valleys of Nitra and Hron rivers are secondary bird migration corridors.

Mammals are represented by different types of small species, e.g. shrews (*Sorex araneus*, *S. minutus*), Mediterranean water shrew (*Neomys anomalus*), common vole (*Microtus arvalis*) and water rat (*Arvicola terrestris*). Bats e.g. Bechstein's bat (*Myotis bechsteini*). Game animals are peculiar for the anthropogenic habitats of fields and meadows, e.g. red deer (*Cervus elaphus*), roe deer (Capreolus capreolus) and wild boar (*Sus scrofa*). Occurrence of mouflon (*Ovis must*) is known in the area of Kozmálovské vŕšky. Other common smaller animals are represented by hares (*Lepus europaeus*) and red fox (*Vulpes vulpes*).

III.1.9.2 Plant Kingdom

In terms of phytogeographical division most of Slovakia including the area of Mochovce lies in the Atlantic-European Province (Kolény & Barka, 2002). North subdistrict of Hronská pahorkatina Upland is located in lowland oak sub-zone. Beech zone affects the investigated area from the northeast (Plesník, 2002). Overlapping of thermophilic species of the Carpathian and Pannonian type is the characteristic feature. Most widespread are primary oak-hornbeam forests *Querco-Carpinetum medioeuropaeum* (*Quercus petraea*, *Carpinus betulus*) that according to Maglocký (2002) form potential vegetation of lowland areas of the region. Potential vegetation of higher areas (above approximately 200 m above sea level) is covered by oak forests *Quercetum petraeae-cerris* (*Quercus cerris*, *Quercus petraea*). Beech forests and smaller amount of Beech-fir forests affect the EMO region from the northeast from the foothills of the Štiavnické vrchy Mts. Secondary forests in the region are composed of mosaic pine monoculture (*Pinus sylvestris*) and acacia (*Robinietea*).

Wet, periodically flooded river floodplains, composed of Holocene sediments, are up to an altitude of 300 m above sea level covered by riparian forests. Riparian forests of the lower reach are original stands of willow (*Salix alba*, *Salix fragilis*). In many places, they were replaced by ash and poplar trees. Preserved remnants of riparian forests and riparian vegetation along watercourses, together with cultural steppe and hedgerows are the most widespread habitat in the region.

Scrub and grassland communities are linked to a variety of habitats, like the fringes of shallow soils, forests surrounding, grass stands on the andesites, meadows, fallow grasslands, wetlands and pastures.

Anthropogenic habitats formed by orchards, vineyards and agriculturally used areas are widely important.

Information about the vulnerability of plant taxa at regional and local level have not been developed yet for the investigated area. The endangerment of wild plants and plant communities has many causes. The most important factor is the destruction of their habitat through the human intervention (ranging from recreation and tourism, through the agricultural and industrial production, up to the occupation of new areas for building construction and other factors). Anthropogenic impacts may be multiplied by the occurrence and spread of invasive species that force out native plants.

III.1.10 Protected Areas

Several Protected areas, Nature reserves and National nature reserve are present in the investigated area (Tab. 2). Free territory is protected by a basic first level of protection within the *Act No. 543/2002 St. on Nature and Landscape Protection*.

CHKO Štiavnické vrchy represents a largest protected area in the investigated area. Other protected areas that extend into the investigated area are Special area of Conservation Natura 2000 Čajkovské bralie (SKUEV0262) and Hodrušská hornoatina Upland (SKUEV0263).

Tab. 2 – List of protected areas

Name	reg. num.	Category	Subject of conservation
Kusá hora	1104	Natural reserve	fragments of important xerothermal steppe developed on the andesites with some endangered species of plant kingdom
Krivín	809	Natural reserve	presence of a large number of protected, rare and endangered species of plant and animal kingdom
Patianska cerina	127	National natural reserve	best preserved examples of *Quercus cerris* stands in the uplands of southern Slovakia

Žitavský park	992	Protected area	historic park with 13 species of exotic woody species
Novoveský park	960	Protected area	historical park with 99 species of trees, large biological, architectural and aesthetic value
Levický park	950	Protected area	historical park in Levice
Arborétum Mlyňany	4	Protected area	arboretum with exotic trees (from Mediterranean, East Asia, Caucasus, Central Asia and North America)

III.2 Scenic View, Stability, Protection and Scenery

III.2.1 Landscape and Scenic View

Structure of actual landscape is built by landscape components formed during geological development and by anthropogenic landscape components. Characteristic feature of a current state of landscape structure of investigated area is imbalance between different structural types of landscape i.e. the ratio between the forested area, agricultural production areas, built-up areas and territorial infrastructure.

III.2.1.1 Natural Landscape Components

Bedrock environment and landscape relief are landscaping elements that are preserved in the original unchanged or slightly modified form. The decisive factor is particularly contact of neovolcanic rocks of the Štiavnické vrchy Mts. (Kozmálovské vŕšky Hills) with Pliocene and Quarternary sediments of the Hronská pahorkatina Upland (Bešianska pahorkatina Upland).

Water courses are in partially to completely modified form in the investigated area. Hron and Žitava rivers are determining rivers, along which Žitavská niva and Hronská niva floodplains were formed. Largely unregulated tributaries are significantly involved in shaping the relief

Hronská pahorkatina Uplands. Former (Upper Pleistocene to Holocene) gullies are now adapted for the use for agricultural technology.

Forest habitats are currently only relics and vegetation in the investigated area is more than 80% covered by agricultural monocultures.

Soils in the course mixing of urban and rural environmental landscape changed from forest and steppe soils to agricultural soils, which mostly preserve the original soil substrate and a certain extent of organic components.

Air and climate are currently modified by the increasing volume of emissions from industrial and transport sectors. They are also the most dynamic natural element whose changes are in open country difficult to describe.

III.2.1.2 Anthropogenic Landscape Components

Settlement structure and built-up areas of municipalities were based on prehistoric settlements whereby current rural architecture was formed within the last 500 to 700 years and the current built-up area of municipalities (except sacral buildings and historical monuments) mainly during the last 50-80 years. Distinctive element of the investigated area is complex of the SE-EMO, which also forms the closed zone surrounded by agricultural land.

Road network have evolved in the historical period with respect to the development of settlements as road network linking the villages and attraction and administrative centres mainly Zlaté Moravce – Vráble – Levice – Hronský Beňadik. Main roads constitute of state roads Vráble – Levice in west-east direction and state road Hronský Beňadik – Tlmače – Kalná nad Hronom / Levice in north-south direction. Road network is completed by class II roads Tlmače – Levice and Nové Zámky – Tesárske Mlyňany. Complex of SE-EMO is connected with higher class roads by class III road Čierne Klačany – Nemčiňany – Mochovce – Čifáre, resp. Mochovce – Kalná nad Hronom / Levice

Area is crossed by a railway track Hronský Beňadik – Tlmače – Levice – Kalná nad Hronom – Šurany and Zlaté Moravce – Levice. Delivery track from the complex SE-EMO leads to the railway station Kalná nad Hronom.

Technical infrastructure of the investigated area (electricity, conduction, pipelines, water supply and sewerage networks etc.) emerged during the last century. The construction of the SE-EMO is related mainly to building of power lines connecting the SE-EMO on a national and international electricity network.

III.2.2 Scenic View

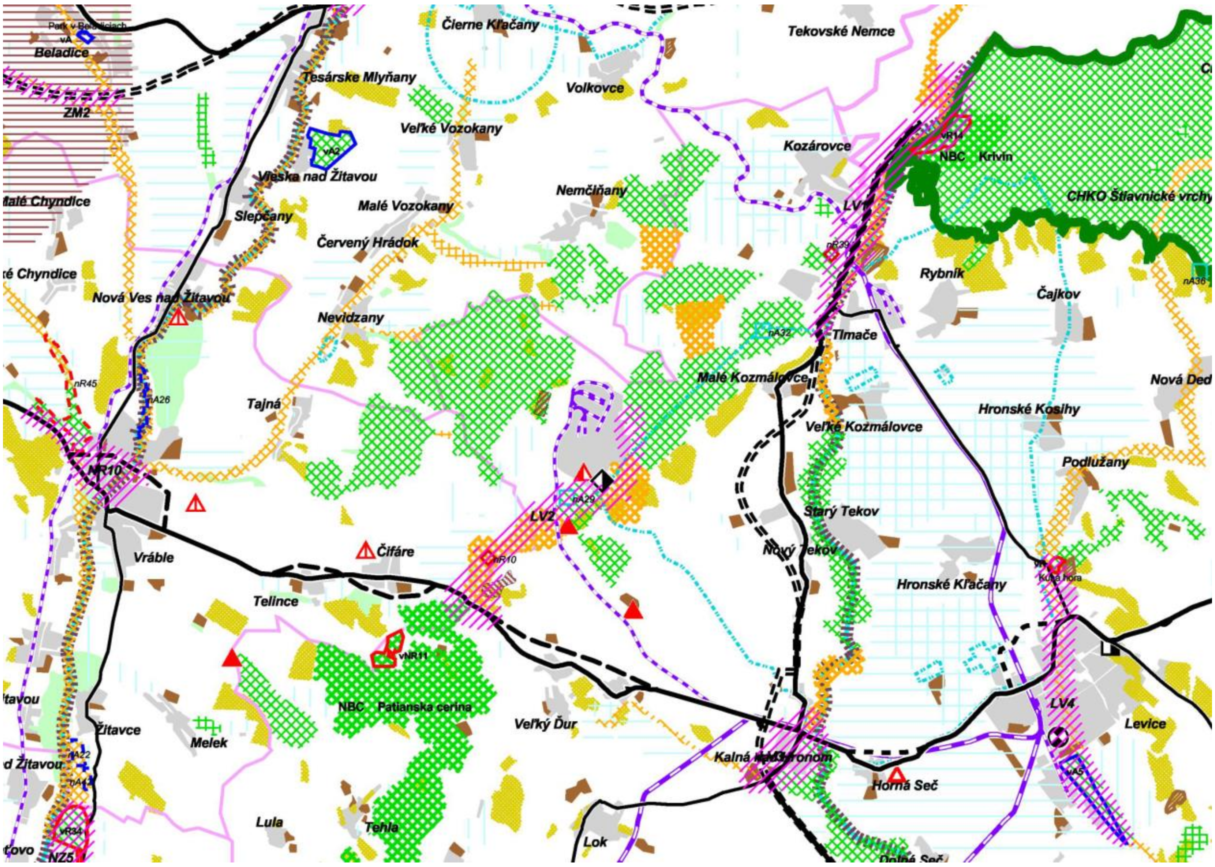
Scenic view of the SE-EMO is predetermined by location on the border of the Podunajská nížina Lowland and south-western spurs of the Štiavnické vrchy Mts. The dominant natural phenomenon is so called the Slovak gate, geomorphological phenomenon created by the river Hron in the hills and foothills of Pohronská pahorkatina Upland and south-western slopes of the Štiavnicke vrchy Mts. The immediate vicinity of the powerplant is made by the Veľké Kozmálovce reservoir, which serves as a reservoir of hot water for SE-EMO. Features of the location were affected by the construction of a nuclear power plant which has modified relief of the Kozmálovské vŕšky Hills.

III.2.3 Territorial System of Ecological Stability

A Territorial System of Ecological Stability (ÚSES) categorizes the legal status of the country (in particular biotic formation). The basic document is ÚSES Over-regional general scheme of ÚSES for Slovakia (1992), documentation of regional ÚSES for former Slovak regions (1993-1995) and the National Ecological Network in Slovakia (1996).

Several methods for the assessment of environmental (ecological) quality of the areas and their positive and negative factors are used in the Slovak Republic. All these methods have markedly regional dimensions and divide the territory of the Slovak Republic based on multiple criteria. Ground plan of large territory of Nitra region as regional ÚSES was based on a Government Regulation in the year 1998. According to the Generally binding legal regulations of Nitra self-governing region no. 2/2012 Binding portion of Ground plan of territory of Nitra region was declared together with the Territorial system of ecological stability (Fig. 11).

Constituents of the Territorial system of ecological stability on the regional scale are regional biocentres of the Štiavnické vrchy Mts. and oak forests of National Natural Reserve Patianska cerina, Wildlife corridors of regional importance: Hron, Podlužianka and Sikenica rivers.



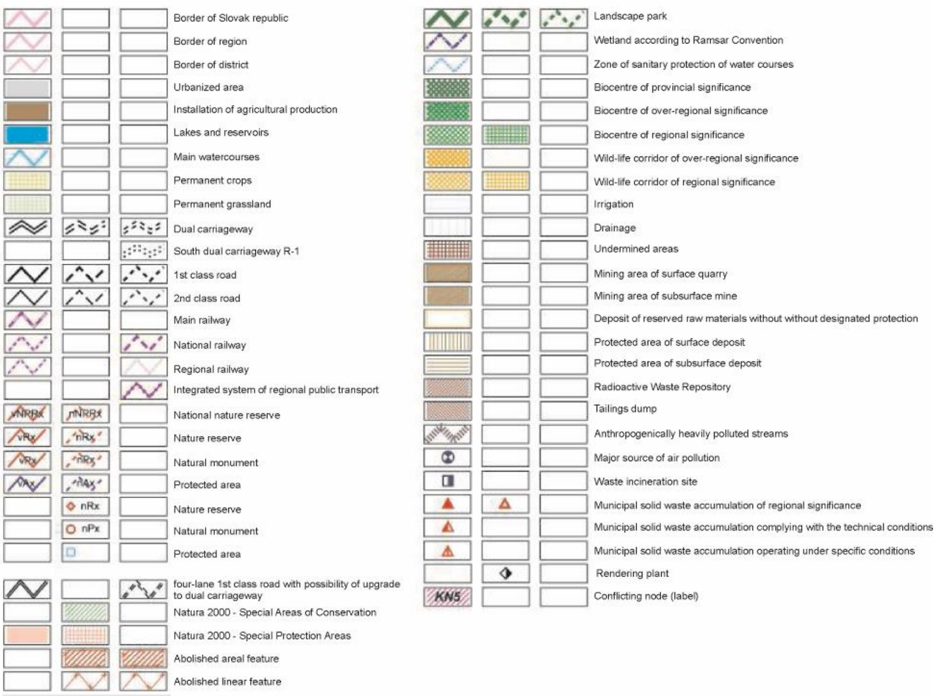


Fig. 11 - Territorial system of ecological stability of Nitra self-governing region

III.3 Population and its Activities, Infrastructure, Cultural and Historical Values of the Area

III.3.1 Definition of the Boundaries of the Affected Area

Construction of the spent nuclear fuel storage facility is planned in the area of the existing NPP Mochovce, which is a branch establishment of Slovenské elektrárne, a.s., Bratislava.

In accordance with the regulations of Public Health Authority, in terms of radiation protection of the population a protection zone without permanent settlement is established around the SE-EMO. The protection zone is the area between the NPP fencing and the nearest villages with distance from the center of the NPP area about 3 km. Populated parts of adjacent settlements do not fall within the protection zone.

There are two separate nuclear instalation areas at Mochovce locality:

SE-EMO nuclear instalation area with double unit of EMO1,2 NPP in operation and another double unit EMO3,4 in construction. Double units EMO1,2 and EMO3,4 are two independent branches of SE, a.s., Bratislava. Further, another facility - Final processing of liquid RAW plant is associated to EMO1,2 double unit. This facility provide bitumenation and cementation of liquid RAW from EMO1,2 operation and it is operated by JAVYS, a.s., Bratislava.

RÚ RAO Mochovce area is located approximately 1,5 km northwest of the SE-EMO. It is operated by JAVYS, a.s., Bratislava.

In terms of radiation protection of the population around the SE-EMO, the protection zone without permanent settlement within approximately 2 to 3 km from the area of nuclear facilities is established. There are no restrictions for agricultural production within this zone, except of monitoring of radiation situation and the contamination of agricultural production control.

Built-in and permanently settled territories of the municipalities are located outside the protection zone. Further, in terms of control of the radiation situation the closer threatened zone (9-12 km) around NPP as well as threatened zone to a distance of about 20 km are established, where monitoring of radiation situation is provided.

Boundaries of the affected area were set to include municipalities, in which cadastral area the SE-EMO site is situated (affected municipalities), as well as municipalities, in which cadastral area the first zone of threatened area of Mochovce nuclear installations passes through, or is in the immediate vicinity, as all activities carried out on the installations site may have a direct or indirect impact on their population, built-up area of settlements and the surrounding countryside, depending on the nature of the activity.

Nuclear facilities Mochovce site is approachable by roads from the direction of Nitra on the road no. 51, turn left in the village Čifáre, from the direction of Levice, the road no. 51 (76), turning in the village Kalná nad Hronom, from the direction of Zlaté Moravce on the road no.

65 (E571) (passing the village Nemčiňany) and from the direction of Tlmače on the road no. 76, turn to Nový Tekov.

Railway line leads from Kalná nad Hronom station to the SE-EMO area. In the area of SE-EMO are built in-plant communication and internal plant railway siding, which is completed in transport corridors of double units (units 1 and 2, respectively 3 and 4).

III.3.2 Number of Inhabitants in Affected Municipalities

Kalná nad Hronom village is documented in the 1209 as Kalon, later Kalnay (1283), Kalná (1286), Kalnany (1298), Nagkalna (1480), Welká Kalnicza (1773), Veľká Kálnica (1920), Kalná (1927), Kalná nad Hronom (1960), Nagykalna in Hungarian. An eneolitic settlement with canelled ceramics, settlement of north panonian culture from later bronze age, hallstatt, laten and barbaro-romanian settlements are archeologically documented at the territory of contemporary village. Village is situated 8 km on southwest from district capital Levice, on the right riverside of Hron and its surface area covers 3 413 ha. It is separated into two districts Kalná and Kalnica. Flat and slightly hilly area comprises of tertiary deposits with thick loessial covering and adequate clays. The village belongs to more developed villages in the region thanks to traditional agriculture, attractive environment and SE-EMO, which favourably influence the locality development.

Village **Nový Tekov** has evolved from market settlements Štvrtok and Sobota around the castle Tekov. Štvrtok is documented in 1320 as Cheturtekhel, Chuturtukhel later. Sobota is evidenced by writing in 1331 as Zombothel. Nový Tekov village is located in the Levice district, which falls in Nitra region. It trial along the right bank of the river Hron in altitude from 160 meters to 350 m above the sea level. Its total area is 2970 ha. The highest hill is Veľká Vápenná. Part of the village are also Marušová, Šándorhalma and Podvinica settlements.

Village **Čifáre** - first written evidence of Čifáre dates back to 1209, when it was called Chefar. During historical evolution its name has changed as follows: from 1235 is documented as Chyphar, from 1332 Chifar, from 1773 Cziffare, in 1927 Čifáry and in 1948

Čifáre. Official Hungarian name was Csiffár. Čifáre lie in the northern part of Pohronská pahorkatina upland in the valley of Telinsky potok Creek.

Village **Malé Kozmálovce** was inhabited in the Neolithic. Slavic settlement, fort and burial of the Great Moravian period is archaeologically documented at its area. The village was founded at the territory of Kozmálovce, evidenced by the year 1332. Malé Kozmálovce is documented in writing by the year 1372 as Kys Kozmal, Kozmal later (1390), Kyskozmal a. n. Apathfelde (1437), Malé Kozmalowcze (1773), Malé Kosmalovce (1920), Malé Kozmálovce (1927), Kiskoszmály in Hungarian.

Village **Nemčiňany** (Nemcsény in Hungarian, Nemtschin in German) is a municipality in the Zlaté Moravce district. The village is located in the northern part of Pohronská pahorkatina in the valley of Rohožnícky potok Creek at headland of Štiavnické vrchy. The local part of the village is Rohožnice that was a separate municipality until the merger with Nemčiňany in 1958. The earliest evidence dates from the 1283rd.

Village **Starý Tekov** is documented since 1075 as Bors, Borsu later Bors (1124), Burs (1208), Bors (1209), Suburbium Castri de Bors (1240), Boors (1287), Burs (1316), Bors (1318), Naghi Barss (1516), Old Tekow (1773), Obara in Hungarian, Alt Barsch in German. There is archaeologically documented settlement with cannel ceramics, fortified settlement of madarovska culture of the Late Bronze Age, Hallstatt age settlement, cremation grave, Slavic settlement of 9 century and the remains of a Romanesque church with in-line burial of 11 century. Old Tekov is located in the eastern part of the Danube lowland at the left-bank of Hron floodplain between the river Hron and her arm Perec.

Tlmače city is located at 48° 17' 21" north latitude and 18° 31' 55" east longitude. Downtown has the altitude 176 m.a.s.l., all territory 173-275 m.a.s.l. Local area is 4.64 square kilometres. City Tlmače comprise the original urban area Tlmače on the left bank of the river Hron and Lipník housing estate on the right bank of the river Hron. The lower part of Tlmače (the primeval one) has 689 inhabitants; housing estate Lipník has 3,375 inhabitants. The population density is relatively high - 577 inhabitants per km^2. Administratively belongs to the district of Levice in Nitra region. Town privileges and status Tlmače gained in 1986.

Veľký Ďur Village is located in the eastern hills of Pohronská pahorkatina upland in the valley of Ďurský stream. It was formed in 1960 by merging Upper and Lower Ďur and Rohožnica.

In the zone of sanitary protection of nuclear facilities in Mochovce recently does not live permanently any inhabitant. The nearest villages outside of sanitary protection zone lies in the district of Levice, Nitra and Zlaté Moravce. According to the latest census of population and housing censuses in 2011 lived in the nearest villages 11,036 inhabitants in total, of which 5,333 men (48.3%) and 5693 (51.6%) women. Summary population and the average population density of the respective municipalities of affected area are listed in the following table.

Tab. 3 - Population and average inhabitation respective to municipalities of affected area

Municipality	District	Number of Inhabitants			
		Men	Women	Sum	Women percentage [%]
Kalná nad Hronom	Levice	966	1056	2022	52,2
Nový Tekov	Levice	407	419	826	50,7
Čifáre	Nitra	308	286	604	47,4
Malé Kozmálovce	Levice	179	212	391	54,2
Nemčiňany	Zlaté Moravce	340	355	695	51,1
Starý Tekov	Levice	702	726	1428	50,8
Tlmače (Lipník)	Levice	1854	1969	3823	51,5
Veľký Ďur	Levice	577	670	1247	53,7

Sum		**5333**	**5693**	**11036**	**51,6**

According data of ŠÚSR, 2011 (final results 2012)

The age structure of the population in the affected villages has a less favourable composition compared to the national average. Compared to the national average is characterized by a lower share of pre-productive age and a higher proportion of productive and post-productive age.

Urban area of affected municipalities passed quite a long historical evolution. They have mostly historic buildings from the late 19th and the first half of the 20th century. Housing stock in these villages is quite old and partially unused, what is reflected as well as in the number of unoccupied houses and apartments.

III.3.3 Population Health

Population health is influenced by several factors, such as economic and social situation, dietary habits, lifestyle, level of health care and the environment. Regarding the size of affected communities, their population health is included in the statistical tracking for individual districts. The health status of the population is described by the criteria as follows:

Life expectancy: In Levice and Nitra districts, which include the affected communities, life expectancy in 2001 ranged between 66 to 69 years (men) and 75 to 76.8 years (women).

Overall mortality: Levice District, where the affected areas primary lie, belongs to the regions with the highest morbidity and mortality in Slovakia. Natality (births) in this district has in recent years (1999-2002) declining trend and ranges between 8.02 to 9.19 ‰. Mortality in the district is in average about 12 ‰ from 1999 to 2002.

By causes of death, mortality in Levice is predominated by diseases of the circulatory system, especially coronary heart disease. Other groups in order of the most common causes of death are cancer, diseases of digestive system and respiratory system. The risk factors in the region, workers are exposed the most to noise, dust, chemicals, and vibrations.

The radioactive substances can reach the individuals or whole groups of the population around nuclear power plant via discharges and subsequently via food chain. In assessing the impact of nuclear facilities on the environment and population health, discharges of radioactive substances into the atmosphere and hydrosphere are monitored and assessed.

Population health in the wider Mochovce nuclear installations assessed area was particularly monitored and evaluated by observing all basic demographic and epidemiological parameters from 1993 to 2006. The results of this monitoring are reported in the summary annual reports on monitoring of population health and the environment surrounding Mochovce nuclear instalation complex, which was prepared by VUJE, a.s. and Environment, a.s. Nitra.

It can be concluded that neither the direct analysis of data on environmental contamination around the Mochovce nuclear installations, nor monitoring of the populations health around Mochovce does not shown a correlation between population health status and operation of nuclear installations. Annual radiation dose from these nuclear facilities represent values of 3-4 orders of magnitude lower than the predicted values of natural background, cosmic radiation or artificial sources.

III.3.4 Economic Activity of the Population

On the one hand, the economic activity of residents in the affected area as well as in the wider area around the nuclear instalation Mochovce is positively influences by their construction and operation, on the other hand, it is strongly influenced by social changes of the last decades, when there was a significant restructuring of manufacturing and non-manufacturing sectors and the resulting changes in the economic activities of the population of the whole region.

Economy transformation in the Levice region, where the most affected villages belongs to, is characterized by loss of work opportunities and population migration away from residents, district and region. Registered unemployment rate in the district of Levice as at the end of 2012 was 15.70%, what is higher than the average 14.08% of Nitra region. Deficit of job opportunities in the residence induces increased commuting to other towns and cities outside the district.

III.3.4.1 Industry

In terms of industrial production and services, industrial premises of Mochovce nuclear power plant area are of great importance to the focus area as well as to the economy of the Slovak Republic. In the periphery of affected area the Tlmače town is situated with advanced machinery industry. Other industrial centers Levice and Vráble are located at a distance of about 10-15 km from the complex. Smaller industrial operations are located in Kalná nad Hronom and Santovka. Industry of local importance and the local manufactures are located in other municipalities. Civil construction in the affected area is concentrated mainly on MO34.

III.3.4.2 Agriculture

Agriculture is the most common activity in the affected area. Locality has very good natural conditions for growing almost any crop. There are virtually all basic types of agricultural land - arable land, hop gardens, vineyards, gardens, orchards, and to a lesser extent permanent grassland. The territory is characterized by a high proportion of arable land comparing to other agricultural land. Permanent grasslands are located mainly in submountain areas and at land of worse credit score, sloping or sloppy areas, but they are also located on land sloping uplands and on narrow strips along watercourses on the plains. On sunny slopes vineyards are located and orchards on slopes in generall. Gardens are most often found in conjunction with housing communities. The structure of sown areas have the largest representation densely sown cereals, maize, sugar beet and fodder crops on arable land. Irrigation systems are builded in Želiezovce and Kozmálovce. Čifársky pond is used for irrigation.

III.3.4.3 Forestry

The territory extends into forest areas Podunajská Pahorkatina 02 B and 27 A Štiavnické Vrchy. Woods are mostly represented by deciduous trees as oak, poplar, acacia, beech and other deciduous tree. Softwoods (conifers) occupy only a small percentage of vegetation. They occur mainly pine, spruce and fir tree. In forestry production slightly outweighs logging, followed by growing activity and other forest production. Part of the forest area has a protective function, which is mainly focused on the preservation and utilization of the forest as a natural environment particularly valuable for its authenticity. Recreational functions are mainly in the outer edges of the forests, often connected to orchard and vineyards. Primary forest industry is ensured by state owned forestry companies (Levice) and private organisations. In terms of hunting regionalization this territory belongs to the breeding region of deer and small game. There is also a genetic basis of fallow deer.

III.3.4.4 Transport

Road transport

Major roads in the vicinity of the affected area are state route I/51 Vráble - Levice in the west-east direction and state route I/76 Hronský Beňadik - Tlmače - Kalná nad Hronom - Želiezovce in north-south direction. Outside of the affected area the network of roads is supplemented by state route II. class no. 564 Tlmače - Levice, state route II. class no. 580 Šurany - Kalná nad Hronom, state route II. class no. 511 Nové Zámky - Tesarské Mlyňany. North of the affected area is state road I/55 Nitra - Zlaté Moravce. Road network in the area is complemented by local roads of III. class. Location of Mochovce NPP is connected to the road network through III. class Čierne Kľačany - Nemčiňany - Mochovce - Čifáre, respectively Mochovce - Kalná nad Hronom. In the Mochovce a need to build an escape route from Nový Tekov towards Starý Tekov is considered by bridging the Hron River and connecting roads I/76 and III/05156.

Rail transport

Railway No. 150 Hronský Beňadik - Tlmače - Levice - Kalná nad Hronom - Šurany and railway line No 141 Zlaté Moravce - Levice pass the affected area. From the SE-EMO railway siding leads to railway stations Kalná nad Hronom. Considering the economic importance of the region rail transport is insufficient. Its development is dependent on the construction of high-speed rail through Slovakia.

Air transport

There are no airports with regular public transport of passengers and goods in the affected area. The closest airport is in Piešťany with availability 49 km from Nitra and another one in Bratislava with the availability of 85 km. In the affected area, there are public and private airports with paved and grassy runway with a focus for sporting purposes and for aerial work in agriculture, forestry and water management. At the airport Nitra - Janíkovce the introduction of the international civilian non-scheduled air traffic is contemplated in the near future.

III.3.4.5 Power Lines and Pipelines

In the wider vicinity of assessed area is one of the most important sources of electricity distribution system of the Slovak Republic - SE-EMO, where is in operation two blocks, each with a capacity of 440 MWe. In Veľký Ďur and at a distance of about 12 km from the site in an east-southeast substation are constructed of high and very high voltage, which are connected with lines 400 kV, 220 kV and 110 kV to the electricity grid of SR. Those stations are the key nodes of the power system of national importance.

Area in the direction Ipeľské Úľany - Semerovce - Santovka - St. Hrádok – Kalná nad Hronom is intersected by very high pressure gas transit system 1 x 1400 + 3 x DN 1200. In the direction of the Plášťovce - Slatina, Krškany, Nová Dedina and Tlmače is kept very high pressure interstate pipeline DN 700.

In Šahy in Levice district is operating Transpetrol plant, which is pumping station of Družba oil pipeline and its branch, which joins the Adria pipeline at the Hungarian territory.

III.3.4.6 Services and Civic Amenities

Services and civic amenities in the affected municipalities have a more or less comprehensive range of services and amenities to implement the basic needs of daily life, including basic education, cultural and social needs. Implementation of more advanced needs (education, health, culture, sports and leisure activities, etc.) of these municipalities and its inhabitants are provided in surrounding towns Levice, Tlmače and Vráble, which are found in good time and communication distance.

III.3.4.7 Recreation and Tourism

In the investigated area and its vicinity several small water reservoirs are situated which are used mainly for agricultural purposes. In the wider surroundings are many huts, vineyard cottages, gardens and vineyards used for tourist recreation.

Veľké Kozmálovce reservoir at the river Hron has the potential to be used for aquatic sports. However, dredging spoil respectively arms flows (Horná Seč) are more used. On the appropriate sections of streams, reservoirs and farm ponds are good conditions for sport fishing.

In the wider vicinity of the investigated area rich geothermal waters incidence is recorded. These waters are used for recreation and water sports (thermal bath Santovka, Margita - Ilona, Diakovce and others), but also for the provision of rehabilitation and reconditioning stays and outpatient treatment (Podhájska and Nesvady). The occurrence of geothermal with potential to be used for tourism is registered in Želieznovice, Marcelová, Nesvady etc.

III.3.4.8 Cultural and Historical Values of the Area

Wider surroundings of investigated area belong to specific traditional cultural and historic Tekovský region near Levice and Zlaté Moravce. The oldest traces of settlement in the area of interest come from the Palaeolithic, while the more intensive colonization occurred during the Neolithic period (5 000-1 900 BC). Between the older and middle Bronze Age the Mochovce area was not populated. Settlement began to increase gradually from the late Bronze Age (200-700 BC) after an earlier period of iron age (700-500 BC). The period of the Bronze Age is documented by housing material called Čačianska culture of cadastre of Nový Tekov. The entire territory later gained strategic character as gateway to the mountainous region of central Slovakia. This is also indicated by relatively dense network of settlements from the Great Moravian period widening from Veľké Kozmálovce up to Hronský Beňadik. In the more recent period, the monastery of Hronský Beňadik became an important historical center, Levice Castle of 14 century and now defunct castle Tekov of 11 century.

III.3.4.9 Archaeological and Paleontological Sites, Geological sites

In the wider surroundings there are a large number of archaeological sites of regional as well as of European importance. Better known sites of Levice district are mainly Horný Pial and Želiezovce and in the district of Zlaté Moravce - Čierny hrad Castle near the village Zlatno and Kostoľany pod Tríbečom.

There is settlement from the Neolithic, Roman-barbarian and Slavic housing discoveries in Čifáre village, in Kalná nad Hronom discoveries of settlement from the Eneolithic, settlement with cannel ceramics, settlement of Northern-pannonian culture of the Early Bronze Age and Hallstad, Laten and Roman-barbarian settlements. Neolithic, Lengyel culture and Roman times settlements, as well as extinct medieval settlement were found in Telince.

There are no more significant paleontological or geological sites in the vicinity of the site of JZ Mochovce.

III.3.5 The Current State of the Environment Including Health

III.3.5.1 Climatic Conditions

Climatic characteristics of the locality are measured by the meteorological station Mochovce, which has been in operation since 1981. The area of nuclear facilities Mochovce lies within warm climate area (T), which is typical for an average of at least 50 days of summer when the maximum daily temperature exceeds 25° C (Lapin et al., 2002). Kozmálovské vŕšky Hills is part of the region T4 characteristic warm, moderately dry climate with mild winters. Surrounding hilly areas, especially in the valley of the rivers Žitava and Hron are warmer parts of the region T2 characterized the warm, dry climate with mild winters. Veľká Vápenná elevation area east of the area of nuclear facilities Mochovce belongs to a mountain climate, temperate, humid to very humid, with negligible temperature inversion.

III.3.5.2 Precipitation

Average annual precipitation in the area ranges from 550 to 600 mm. In the Štiavnické vrchy Mountains, in the northern part of the area is rainfall higher of about 100 mm. Average precipitations at the hydrometeorological station SHMÚ Mochovce during the period 1981 - 2004 ranged from 575 to 601,9 mm. The precipitation is most abundant in June, minimum precipitation is during July. Maximum precipitations were 186.7 mm in June 1999, the lowest 0 mm in February 1998. Maximum rainfall during one day (25.8.1994) reached 93 mm. Average number of days with precipitation ≥ 0,1 mm is 136, with precipitation ≥ 1,0 mm 87,1, with snow 32,6, with frozen precipitation (i.e. snow, sleet) 41 and snow cover 43,9. Monthly precipitations at the station Mochovce between 2001 - 2002 and 2008 are shown in Tab. 4.

Tab. 4 - Monthly precipitations at the station Mochovce between 2001 - 2002 and 2008 (in mm)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
2001	49,8	21,7	48,7	27,6	60,4	15	61,7	83,1	122	12,5	40,7	25,7	568,9
2002	18,6	39,5	22,9	43,8	103,5	62,3	48,2	89,3	54,5	70,9	46,9	45,3	645,7
2008	37,9	19,5	71,5	27,3	43,8	97,3	124,4	31,2	36,9	31,4	40,9	70,2	632,3

Source: SHMÚ

The overall amount of new snow cover for the month reached during the most exposed months of the year (December - January) more than half a meter. Maximum 58 cm was recorded in December 1986. Absolute maximum new snow cover reached 24 cm on 30.12.2005. Absolute monthly maximum total snow cover was observed in the period from December to March - from 30 cm to 40 cm, maximum 40 cm was measured 12.1.1987. Average snow cover (ratio of the sum of the total number of snow cover and snow cover days) was observed over 30 years 6.8 cm and average snow height (ratio of the sum total snow cover and the number of days from the first to the last day with snow) reached 3.3 cm, limits range from 0.9 cm (1990) to 16.5 cm (2005) and the 0.2 cm (1998) to 8.8 cm (2005).

III.3.5.3 Temperatures

The average annual temperature at the station SHMÚ Mochovce was measured in the period 1981 - 2004 ranged from 9.3 to 11.0° C. The highest measured temperature in 2000 reached 37.4° C, the lowest -30.8° C. Average air temperature in January reaches -1.6° C for July is

19.9° C. The average number of summer days is 65.5, tropical days 16.9 and in cold periods were recorded 101.6 frost days and 26.5 ice days.

III.3.5.4 Wind Conditions

North-western, eastern and south-eastern winds dominate in the area of SE-EMO. Northwest winds are characteristic for winter. Spring season is typically variable wind direction as well as temperature variations. Windlessness is rare during the spring because of unstable stratification of the atmosphere. Eastern and south directions of the air circulation are characteristic for the summer period. Autumn season is variable as well as spring. Average wind speed is in the range from 2.9 to 3.6 m/s.

III.3.5.5 Air Pollution

III.3.5.5.1 Emissions

Emissions of solid pollutants has long-term decreasing trend in the territory of Slovakia since 1990. Since 2008, the trend of solid pollutants emissions is stable. The territory of the EMO is due to favourable orographic and climatic conditions ventilated, thereby the pollutants are dissipated. Higher concentrations of pollutants are concentrated only in vicinity of the industrial sources located in the investigated area. Increased concentration of pollutants particularly in the area of larger residential areas (especially Levice and Vráble) can be seen. The investigated area belongs to a region with specific territorial emission of the solid pollutants less than 1.00 ($t.km^{-2}$) (Fig. 12).

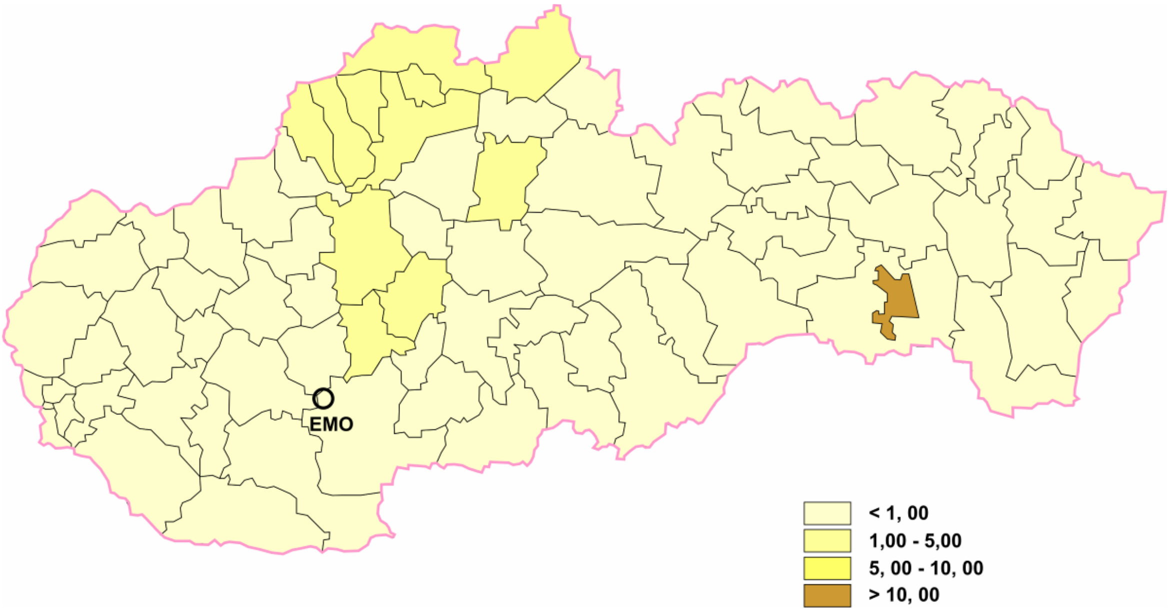


Fig. 12 - Territorial distribution of solid pollutants emissions in 2010 (t.km^{-2}) for each district of the Slovak Republic (Klinda and Lieskovská, 2010)

Emissions of SO_2 have similar decreasing character as the solid pollutants since 1990. Since 2008, the trend in SO_2 emissions is stable. The increase 8% in SO_2 emissions from major sources in 2010 compared with 2009 was due to increased consumption of lignite in SE, a.s., Nováky, and a slight increase in the content of sulphur in the fuel. The investigated area belongs to a region having a specific territorial SO_2 emissions less than 1.00 t.km^{-2} (Fig. 13).

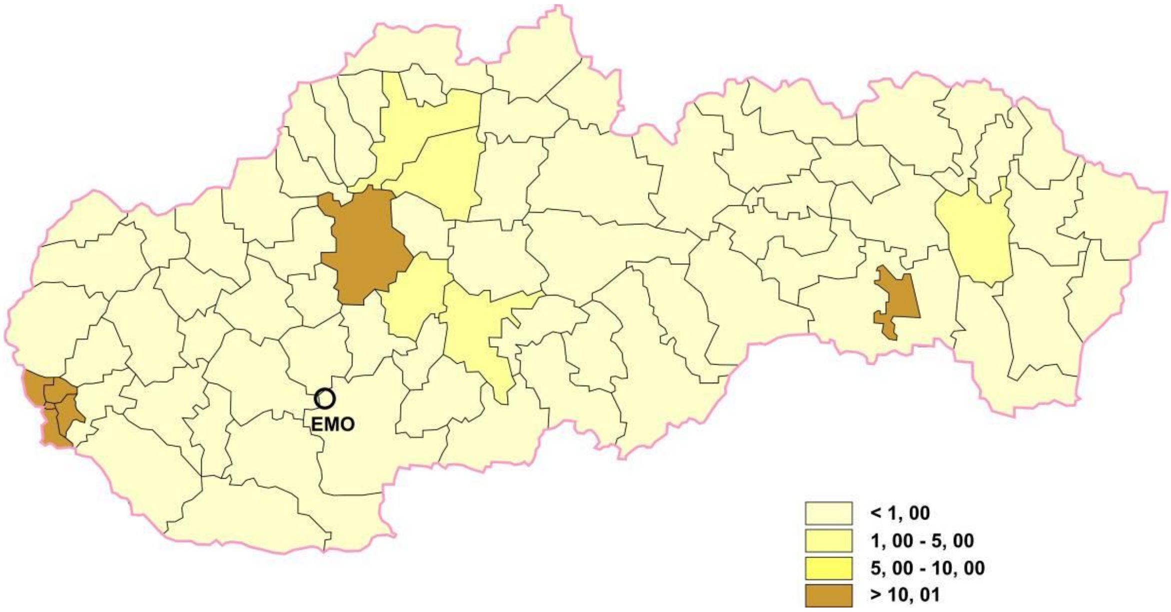


Fig. 13 - Territorial distribution of SO_2 emissions in 2010 ($t.km^{-2}$) for each district of the Slovak Republic (Klinda and Lieskovská, 2010)

Nitrogen oxide emissions have general downward trend from the 1996. The TMO locality has a territorial emission lower than 1.00 $t.km^{-2}$ (Fig. 14).

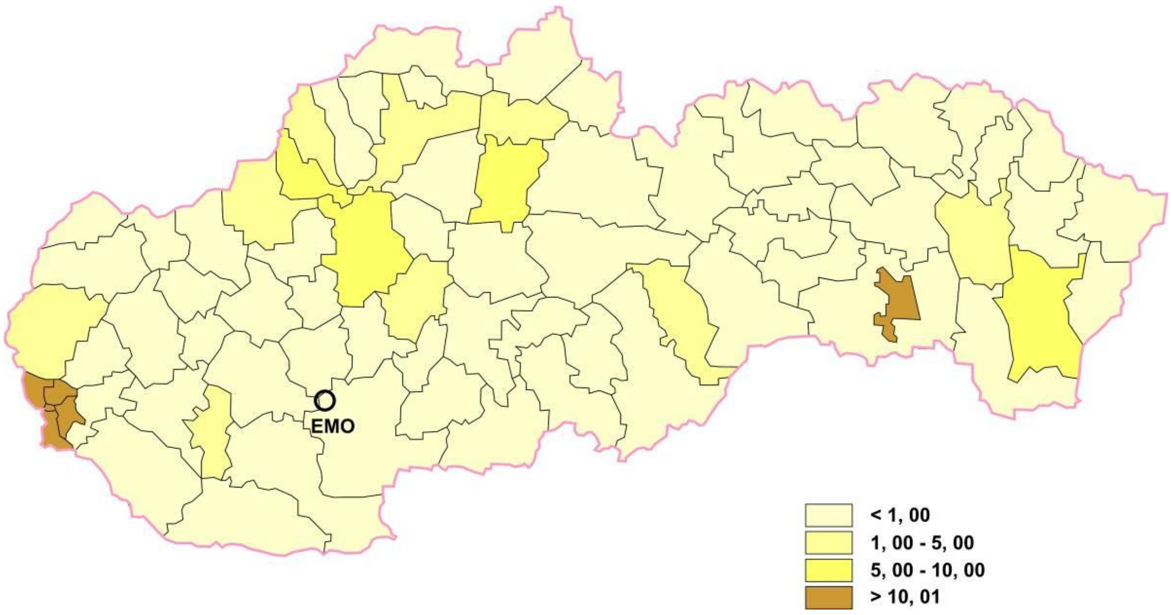


Fig. 14 - Territorial distribution of NO_X emissions in 2010 ($t.km^{-2}$) for each district of the Slovak Republic (Klinda and Lieskovská, 2010)

Amount of CO is related to industry, principally with the production of iron and steel and its long-term downward trend has also affected the decrease of consumption and change of composition of the fuel consumed by retail customers. The CO emissions around the EMO locality are less than 1.00 $t.km^{-2}$ (Fig. 15).

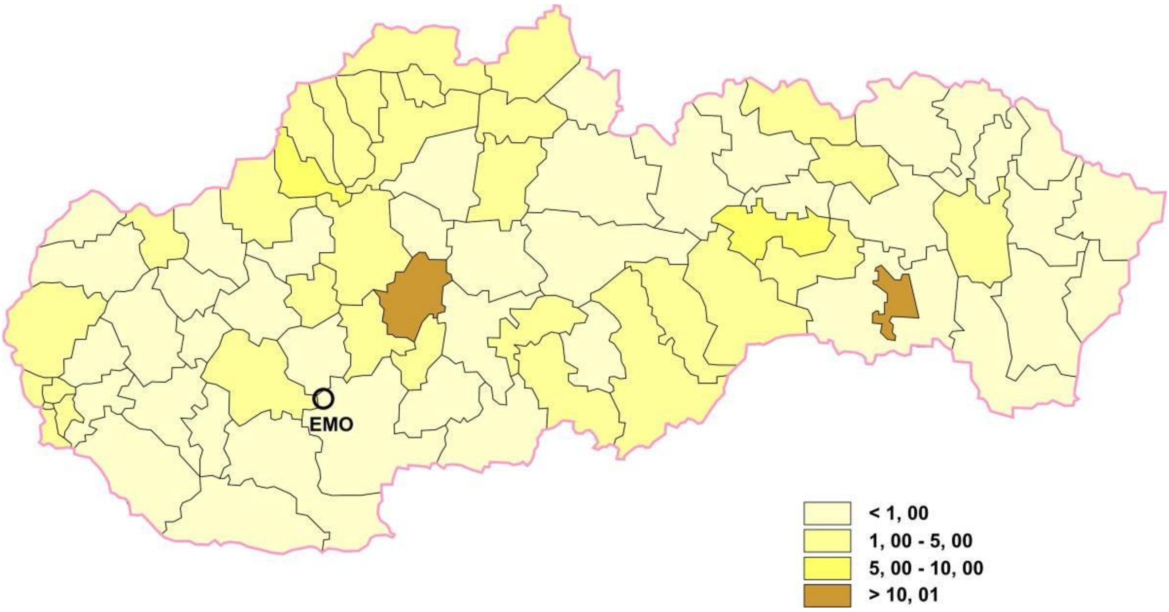


Fig. 15 - Specific CO emissions in 2010 ($t.km^{-2}$) for each district of the Slovak Republic (Klinda and Lieskovská, 2010)

III.3.5.5.2 Immissions

The immissions are airborne pollutants that come into contact with the environment and can accumulate in water, soil and biota. In regional scale pollutants from combustion processes (SO_2, NO_X, hydrocarbons, and heavy metals) operate. The duration of these substances in the air is a few days, so they can be transferred in the atmosphere up to several thousand kilometres from the source.

The starting point for assessing air quality in Slovakia are the results of measurements of air pollutants, which implements SHMÚ stations of the National Air Quality Monitoring

Network (NMSKO). Pollution situation is not monitored in the investigated area. The nearest monitoring station is located in Topoľníky (Dunajská Streda district). Average annual concentrations of pollutants in the air for Topoľníky are in Tab. 5 - Average annual concentrations of air pollutants in 2006 for Topoľníky station (Klinda and Lieskovská, 2006)

Tab. 5 - Average annual concentrations of air pollutants in 2006 for Topoľníky station (Klinda and Lieskovská, 2006)

Station	**Dust [μg.m^{-3}]**	**SO_2.S [μg.m^{-3}]**	**NO_2.N [μg.m^{-3}]**	**HNO_3.N [μg.m^{-3}]**	**SO_4^{2-}-S [μg.m^{-3}]**	**NO_3.N [μg.m^{-3}]**		**O_3 [μg.m^{-3}]**
Topoľníky	24,50	1,34	2,80	0,04	1,37	0,97		60,00
	Pb [ng.m^{-3}]	**Mn [ng.m^{-3}]**	**Cu [ng.m^{-3}]**	**Cd [ng.m^{-3}]**	**Ni [ng.m^{-3}]**	**Cr [ng.m^{-3}]**	**Zn [ng.m^{-3}]**	**As [ng.m^{-3}]**
	13,10	6,92	3,59	0,31	2,83	2,94	20,84	1,26

III.3.5.5.3 Ground Level Ozone

The annual average concentrations of ground level ozone in Slovakia in polluted urban and industrial areas in 2011 ranged from 48 to 96 μg.m^{-3}. Concentrations of ground level ozone are not monitored in the region of Mochovce. Concentrations of ground level ozone in the nearest monitoring station Topoľníky are not recorded due to failure since 2011. In 2010, the average annual concentration of ozone in the was 55 μg.m^{-3}. The reference annual average concentration for the protection of materials 40 μg.m^{-3} was in the last 4 years exceeded throughout the Slovakia. Number of exceedances of the information threshold (IP) and alert threshold (VP) for ozone alert and warning the public (in hours) for Topoľníky station has not yet been recorded. Number of days exceeding the target value for the protection of human health (8 - hour ozone concentration of 120 μg.m^{-3}) for Topoľníky station for the years 2009 to 2011 was 32, while the allowed number of exceedances is 25 days on average for 3 years.

III.3.5.5.4 Sources of Atmosphere Pollution in the Region

Significant contributors to the pollution of the atmosphere of Nitra region are located either in this region or in its vicinity. Main sources of atmosphere pollution are not only industrial facilities such as Duslo, a.s., SES, a.s., Smurfit Kappa Štúrovo, EUSTREAM, a.s., Calmit, s.r.o., Wienerberger Slovenské tehelne, but also automobile transport.

Sources of pollution are represented by energy sources of industrial facilities, central heat sources, block boiler rooms, domestic furnaces, automobile transport and dust from streets, unpaved areas and agricultural soils in particular.

23 sources of pollution, registered in NEIS system (National emission inventory system) were located in administrative area of surrounding municipalities in 2008. Overview of amount of emission from particular sources in 2008 is stated in the following Tab. 6:

Tab. 6 - Overview of sources of pollution in vicinity of area of interest

Administrative area	Source ID	Name of source	TZL [a] (t)	SO_2 (t)	NO_2 (t)	CO (t)	TOC [b] (t)
Kalná nad Hronom	823112	Boiler room – Business training institution. Kalná nad Hronom	0,004	0,001	0,086	0,035	0,006
Kalná nad Hronom	823112	Gas station Kalná	0	0	0	0	0,718
Kalná nad Hronom	823112	Boiler room	0,016	0,002	0,305	0,123	0,021
Kalná nad Hronom	823112	Gas station Jurki Kalná	0	0	0	0	828
Kalná nad Hronom	823112	Dry kiln of corn	0,326	0,001	0,125	0,051	0,008
Kalná nad Hronom	823112	Boiler room	0,001	0	0,022	0,009	0,001
Kozárovce	827860	Bakery Pekný deň	0,005	0,001	0,101	0,041	0,007
Kozárovce	827860	Elementary school Kozárovce	0,551	0,447	0,318	2,687	0,367
Kozárovce	827860	Stock raising	0	0	0	0	0

Administrative area	Source ID	Name of source	TZL [a] (t)	SO_2 (t)	NO_2 (t)	CO (t)	TOC [b] (t)
Malé Kozmálovce	835587	Stock raising Malé Kozmálovce	0	0	0	0	0
Mochovce	838152	Diesel generator station	0,114	0,002	0,403	0,064	0,009
Mochovce	838152	Boiler room GDT	0,009	0,001	0,178	0,072	0,012
Mochovce	838152	Boiler room – Locksmith workshop	0,001	0	0,027	0,011	0,002
Mochovce	838152	Boiler room – Steel lining	0,005	0,001	0,099	0,04	0,007
Mochovce	838152	Boiler room – Carpentry workshop	0	0	0	0	0
Mochovce	838152	Boiler room SA-3	0,013	0,002	0,255	0,103	0,017
Mochovce	838152	Boiler room Šala	0,004	0,001	0,084	0,034	0,006
Mochovce	838152	Boiler room PSV	0,003	0	0,052	0,021	0,004
Mochovce	838152	Main boiler room	0,009	0,001	0,185	0,075	0,012
Mochovce	838152	Boiler room – Watching area	0,009	0,001	0,178	0,072	0,012
Mochovce	838152	Auxiliary boiler room	0,055	0,007	1,211	0,406	0,052
Nemčiňany	839566	Stock raising Nemčiňany	0	0	0	0	0
Nový Tekov	842931	Pig farming Nový Tekov	0	0	0	0	0

Source: NEIS, 2008

a TZL: solid polluting substances

b TOC: total organic carbon

Besides the common polluting substances, atmosphere of the affected area is polluted also by releases of radioactive substances from operation of SE-EMO. These releases are monitored and evaluated considering guidance level values (annual limit values) determined by regulatory authority (see Chapter III.3.5.10)

III.3.5.6 Water Pollution

Underground water

The closest boreholes to the area of interest for monitoring of pollution of underground water by common polluting substances are located at alluvium of river Hron (SK1000700P Inter-grain underground water of quaternary deposits of river Hron). Based on the monitoring in these bore holes (the middle part of the river Hron), indicators for Mn, Fe, SO_4^{2-}, NH_4^+, CHSK-Mn, Na^+ mostly do not meet requirements of Government Decision No. 296/2006 Coll.

Surface water

The locality of JZ Mochovce belongs to the basin of river Nitra (brook Telinský potok Creek) and to the basin of river Hron (brook Malokozmálovský potok Creek). Tab. 7 includes water grades for section of rivers Žitava and Hron according to set of indicators.

Tab. 7 - Water grades of river Žitava and river Hron in 2001

Station	Biological indicators	Physical chemical indicators	Oxygen regime	Microbiological indicators	Micro-pollutants	Nutrients
Žitava	III	II	III	IV	IV	III
Hron	III	III	III	IV	IV	V

Source: SHMÚ, 2003

Water in Levice region polluted by industry and services are gathered in affluent Podlužianka and Sikenica. Besides waste water from industrial and agricultural production, the major polluter in the whole basin is represented by communal waste water. River Hron gathers also waste water from SE-EMO locality.

Released waste water from SE-EMO is monitored and associated evaluation is published on web site of Slovenské elektrárne, a.s. (see Tab. 8).

Tab. 8 – Released pollutants to river Hron – data relevant for February 2013

Indicator	Permitted limit concentration mg/l apart from pH and T	Average concentration mg/l – apart from pH and T
$CHSK_{Cr}$	35	19,75
$N\text{-}NH_4$	1,5*	< 0,1
Cl	100	91,25
BSK_5	12	2,5
NEL	0,5	< 0,1
RL_{105}	1 500	954,5
RL_{550}	1 000	756,75
P_{total}	1	0,136
T [°C]	30	13,9
NL	40	< 10,0
SO_4^{2-}	690	269,75
pH	6,0 – 9,0	8,86
Hydrazine	0,5	< 0,02
Active chlorine	0,1	0,095
AOX	0,2	< 0,06
$N\text{-}NO_3$	16**	10,22

Concentration values „p“ are determined based on new water Decision of Environment Office of Nitra District No. 2007/00029

* at the time of release of waste water from neutralizing tanks 3,0 mg/l –existence of this release will be find out prior and during sampling

** possible excess 5 times per year up to 22 mg/l

Total amount of released waste water from SE-EMO into the river Hron is 5 628 735 m^3 in 2012, of which 100 707 m^3 is sewage water. Amount of released industrial water is 5 753 068 m^3.

Amount of released waste water does not exceed permitted annual limits determined in Decision of Environment Office of Nitra District No. 2007/00029 dated 25.1.2007. This Decision includes also determination of grades of released water. Validity of Decision was prolonged up to 31.12.2015 by the Decision No. 2010/00729 dated 6.12.2010. Moderate increase of amount of released waste water is connected with increased consumption of technological and cooling water. Approved limits for release of pollutants into the river Hron from operation of NPP was not exceed in 2012.

Besides the common polluting substances, water of the affected region is polluted also by releases of radioactive substances from operation of SE-EMO. These releases are monitored and evaluated considering guidance level values (annual limit values) determined by regulatory authority (see Chapter III.3.5.10).

III.3.5.7 Land Pollution and Land Threated by Erosion

Regarding threat in form of wind erosion of agricultural land, almost whole area of Nitra district belongs to the category with no or low intensity of erosion. Higher levels of erosion threat (high and extreme erosion) may appear on plains with light sandy soil. High and extreme influence of water erosion may appear on slopes with high angle of inclination in mountainous north-east parts of analysed region.

The most productive soils, particularly muck soil, in districts Komárno, Nové Zámky, Levice, Šala and Nitra are threaten by wind erosion along with luvisols located in hilly areas and uplands (municipalities Rišňovce, Podhorany and Skýcov).

Based on the analysed soil samples from municipality Kalná nad Hronom, content of phosphor is high (according to Egner), content of potassium is good (according to Schachtschabel) and content of metals (cadmium, lead, chromium, mercury and arsenic) in tinctures 2M HNO_3 are below limits.

Considering properties of rock massive located in region and anthropogenic intervention into the rock environment during building, vulnerability of the rock environment in the locality of JZ Mochovce is relatively low, medium vulnerability is valid for location of cohesive rock of Kozmálovce hills and high in case of valley and alluvial sediments. Vulnerability of relief is low on urban or paved areas and plain terrain, medium up to high level of vulnerability is relevant for slopes (it is depends on angle of inclination, rock properties and character of vegetation cover).

III.3.5.8 Pollution of Rock Environment

Based on current knowledge, the rock environment in JZ Mochovce locality and its vicinity is not significantly contaminated by liquid, solid nor gaseous pollutants.

III.3.5.9 Noise and Vibrations

Noise has significant position in set of stress factors decreasing quality of the environment and negatively affecting the flora, fauna and health of human being. The major source of noise in area is intensive road and railway transport. Besides the noise related to transport, also stationary sources, such as areas and operations of industrial an agricultural production, should be mentioned.

Noise relevant for operation of NPP in Mochovce locality is insignificant regarding wider surroundings. The closest habitation is approximately 3 km away, where level of noise from operation of JZ Mochovce is practically negligible.

III.3.5.10Radioactivity and Ionising Radiation

Considering operation of nuclear installations in Mochovce, there is possibility of their impact on level of radioactivity in the environment and exposure of inhabitants. This is relevant mainly for districts Levice, Zlaté Moravce, Nitra, marginally also for districts Topoľčany and Nové Zámky.

Currently, there are operated EMO12 NPP, FS KRAO and RÚ RAO in Mochovce. Unit 3 and 4 unit of SE-EMO NPP is in building phase at the moment. Facility for management of institutional radioactive waste and orphan radioactive materials (ZRAM), which will be located in vicinity of RÚ RAO site, is in stage of investment preparation. This facility will not be characterised as nuclear installation in accordance with Atomic Act. Currently, JAVYS, a.s. prepares investment projects regarding Extension of RÚ RAO in Mochovce served as repository for disposal of low level radioactive waste and Construction of repository for very low level radioactive waste (completed EIA process according to Act No. 24/2006 Coll.).

Operators of nuclear installations must ensure detailed monitoring of radioactive substances released into the environment directly at the point of discharge and in addition they must also carry out control measurements in the vicinity of nuclear installation (this activity is performed by Laboratory of radiation control of surroundings (LRKO) in town Levice). Complex programmes of monitoring were developed for this purpose. These programmes are assessed and systematically controlled by ÚVZ SR.

Permitted amount of released radioactive substances into the atmosphere and hydrosphere from SE-EMO and JAVYS is stipulated by annual limits. Goal of this limit values valid for releases is to ensure that total amount of radioactive substances released during normal or specific conditions into the atmosphere or hydrosphere from all sources located in the locality do not impose excess of dose constraint value 0.25 mSv/y valid for individual from critical group of inhabitants. Obligation for operator of nuclear installation is not only ensure that this constraint will be met, but operator has to ensure that releases from nuclear installation will be kept on as low level as it is reasonably achievable considering social and economic aspects (ALARA principle).

Liquid and gaseous releases of radioactive substances from SE-MO are monitored and evaluation is publish at web site of Slovenské elektrárne, a.s. (see Tab. 9)

Tab. 9 - Liquid and gaseous releases of radioactive substances from SE-MO – data valid for February 2013

	Gaseous radioactive releases			Liquid radioactive releases	
	Aerosols [MBq]	Iodine ^{131}I [MBq]	Noble gases [TBq]	Tritium [GBq]	Other radionuclides [MBq]
February	0,756	0,011	0,137	2	0,237
Year 2013	1,295	0,0198	0,282	1 720	1,052
Guidance level	$1,7 \times 10^{5}$	$6,7 \times 10^{4}$	$4,1 \times 10^{3}$	$1,2 \times 10^{4}$	$1,1 \times 10^{3}$
Percentage from guidance level	0,00076%	0,000029%	0,0069%	14,3%	0,096%

In accordance with Decision No. OOZPŽ/6773/2011 issued by ÚVZ SR, Slovenské elekrárne, a.s. Mochovce NPP is obliged to compare the radioactivity of radioactive substances released during year with determined guidance levels (before annual limits). This comparison has to be included in information and reports.

It is necessary for assessment of radiation situation after commissioning of nuclear installation to perform needed measurements at least one year in advance. This requirement was fulfilled in case of Mochovce NPP, since measurements of atmosphere hydrosphere and particular elements of food chain are systematically carried out, from year 1986. These measurement are performed by Laboratory of radiation control of surroundings in Levice city

Monitoring of gaseous and liquid releases is supplemented by systematic monitoring of particular elements of the environment based on the programme of NI surroundings monitoring approved by hygienic regulatory. There are monitored spreading of contamination by air mass (aerosols, snow, air, fallout, and soil), elements of food chains (food and agricultural products), hydrosphere (surface water, potable water and underground water), elements of hydrosphere (water flora, bottom sediments near banks), measurements of radiation from external sources and dose measurements.

15 stable dosimetric station are arranged in surroundings of Mochovce NPP and 1 station is located at RÚ RAO in Mochovce operated by JAVYS, a.s. Rates of spatial dose equivalent are regularly assessed and results are published on web site of Slovenské elektrárne, a.s. (see Tab. 10).

Tab. 10 - Rates of spatial dose equivalent measured in surroundings of EMO – data valid for February 2013 and period 2007 - 2001

		[nSv/h]		
Locality	**IK**	**TLD 100**	**TLD 200**	**ø IK valid for period 2007 - 11**
Levice – LRKO		87 ± 13	80 ± 10	-
Levice	80 ± 9	96 ± 14	92 ± 11	83 ± 10
Kalná nad Hronom	91 ± 10	86 ± 13	89 ± 11	95 ± 12
Nový Tekov	97 ± 8	87 ± 13	92 ± 11	97 ± 14
Malé Kozmálovce	92 ± 10	96 ± 14	92 ± 11	97 ± 11
Veľký Ďur	89 ± 10	100 ± 14	97 ± 11	95 ± 12
Čifáre	84 ± 8	94 ± 14	90 ± 11	89 ± 12
Vráble	76 ± 9	95 ± 14	88 ± 10	83 ± 16
Tajná	83 ± 8	88 ± 13	94 ± 11	87 ± 9
Červený Hrádok	84 ± 9	97 ± 14	93 ± 11	87 ± 9
Nemčiňany	85 ± 8	106 ± 15	101 ± 12	91 ± 11
Zlaté Moravce	87 ± 8	101 ± 14	100 ± 12	91 ± 9
Kozárovce	92 ± 8	98 ± 14	99 ± 11	96 ± 12
Rybník	89 ± 10	99 ± 14	95 ± 11	94 ± 12
RÚ RAO	69 ± 7	89 ± 13	94 ± 11	82 ± 11
SE-EMO	91 ± 10	90 ± 13	87 ± 10	96 ± 11

Calculation of radiation exposure of inhabitants living near SE-EMO is performed using computer code RDEMO.

Based on the analysis of release of radioactive substances from SE-EMO in year 2012, the highest values of annual individual effective dose was calculated in east-southeast sector in the locality Nový Tekov and are as follows:

- infant 329,8 nSv
- adults 263,5 nSv

50(70)-year committed collective effective dose for critical group of inhabitants in the zone No. 64 (848 inhabitants) is 181 manμSv for adults.

Value of committed collective effective dose for whole region (approximately 1.2 million inhabitants) is 20.9 manmSv.

Obtained results are negligible in comparison with annual dose limit for inhabitant (1 mSv) or in comparison with dose constraint valid for exposure of critical group imposed by releases of radioactive substances from NI (250 μSv), i.e. in comparison with values determined in Government Regulation No. 345/2006 Coll. Results are also negligible in comparison with radiological criterion for release of radioactive substances from Mochovce NPP (50 μSv) defined by regulatory authority or in comparison to exposure of inhabitants due to natural background. Based on the reported issued by UNSCEAR organisation in 2008, average value of dose imposed by natural background is 2.4 mSv/y valid for individual from world population.

Obtained results from monitoring of releases of radioactive substances from Mochovce NPP prove that releases in 2012 were well below defined radiological limit and radiological impact of operation of Mochovce NPP is negligible.

Considering protection of health of inhabitants, maximal value of 50(70)-year committed individual effective dose for representative person (0,3298 μSv) is lower than basic radiological criterion (50 μSv) defined by ÚVZ SR in permit for release of radioactive substances from Mochovce NPP. Calculated value represents 0.66 % from defined dose criterion.

According to the *Act No. 355/2007 Coll. on Protection, Support and Development of Public Health*, all activities conducted in environment with sources of ionising radiation are subject to control and optimization of exposure in process of approval and in realization stage as well.

Results of monitoring of LRKO prove that radioactivity of the environment was not increased by operation of nuclear power plants and measured values are well below acceptable limits approved by regulatory authorities. Level of radiation situation of workplace, technological processes, release from NPP and its vicinity and level of radiation protection of personnel in controlled area of NPP is permanently monitored, assessed and archived. System of radiation control of NPP surroundings is performed in accordance with monitoring programme developed in advance and approved by regulatory authorities.

III.3.5.11Waste and Waste Management

Managed landfill in municipality Kalná nad Hronom belongs to the affected area. This landfill is designed in order to disposal of waste with regard to hygienic, geological and ecological aspects in such way that threat to the environment is prevented. Landfill is appointed to disposal of waste – communal, other waste (categories with lower ratio of biodegradable content) and hazardous waste. Landfill is well secured, meets all given requirements and legislative regulations (from construction and operation point of view), security is ensured by regular monitoring.

Regional landfill is located in administrative area of municipality Nový Tekov. Hazardous waste can be disposed also at this landfill.

Dumps and non-managed landfill can be sporadically found at the end of urban area of surrounding municipalities. Devastated areas, e.g. former construction sites, were located also in the locality of JZ Mochovce and its vicinity. However, the technical and biological reclamation was performed in recent years.

III.3.5.12 Population Health Status

Data on population health status relevant for the affected municipalities are described in more detail in Chapter III.3.3. Regarding terrain barrier and distance of municipalities from nuclear installations in Mochovce locality (more than 3 km), it can be assumed that operation of nuclear installation has minimal impact on the total quality of the living environment of inhabitants.

III.3.5.13 Ecological Tolerability

Term ecological tolerability means ability of the environment to absorb new elements and inputs without necessity for change of level of balance, which keeps mutual interactions between components of landscape system by autoregulative processes at given ecological equilibrium. Interruption of this equilibrium depends particularly on vulnerability of natural features of landscape system and on perceptiveness of anthropogenic intervention into mentioned landscape system elements and interactions among these system elements and on quality of binding of anthropogenic elements to the elements and interaction of natural ecosystems.

The affected area and the locality of JZ Mochovce represents quasi-homogenous region from macro and mesoclimate characteristics point of view. This quasi-homogeneous region cannot be further divided without detailed microclimate measurements. Regarding this fact, vulnerability of atmosphere is the same for both the affected area and NI site. It can be said, that vulnerability of atmosphere is relatively low thanks to the hilly area Podunajská pahorkatina and related good dispersion conditions.

Considering properties of rock located in the affected area and anthropogenic intervention into this rock massive during building, it can be said that vulnerability of the rock environment in the locality of JZ Mochovce is relatively low, medium vulnerability is valid for location of cohesive rock of Kozmálovce hills and high in case of valley and alluvial sediments.

Vulnerability of relief is low on urban or paved areas of JZ site and on plain terrain, medium up to high level of vulnerability is valid for slopes (it is depends on angle of inclination, rock properties and character of vegetation cover).

Regarding the character of terrain and practical use of areas, the affected area has high vulnerability of agricultural arable lands from water or wind erosion and chemical degradation. Forest land is also vulnerable to water erosion, particularly steep slopes with low vegetation cover and vineyards lands in slope areas. Land with permanent grass cover, forest vegetation or lands of orchards and gardens are less vulnerable. High vulnerability of lands can appear also in vicinity of non-managed landfills, where leakage of contaminants into the environment can be assumed. In urban area, arable soils can be considered as low vulnerable lands thanks to the permanent care and intensive cultivation by their owner. On the other hand, urban degraded lands are very vulnerable.

Vegetation cover of dominant part of the affected area is represented by agricultural monocultures with high level of vulnerability. Permanent grass cover and vegetation cover of vineyard, gardens and orchards are less vulnerable than mentioned agricultural monocultures. In urban areas, annual plants are the most vulnerable (vegetable garden beds), trees and shrubs near family houses, that are regularly maintained, are less vulnerable. Forest lands are the most stable areas form ecologic point of view.

In spite of vegetation, level of vulnerability of fauna is decreased by higher migration ability of some animal species, natural area extension of progressive species or induced introduction. The most vulnerable is zoocenosis of fields or meadows; zoocenosis of vegetation cover near water streams and forest are less vulnerable.

The least vulnerable biotypes in the affected areas are forest areas, while the most vulnerable are biotypes monocultures of arable lands. Among the most vulnerable biotypes in the affected area belong also the gene pool locations mentioned in the previous chapter.

Regarding the urban area of municipalities and way of urban development, microclimate of urban area of assessed municipalities are strongly influenced by external open agricultural landscape. Good level of ventilation in urban areas is degraded by increased level of dustiness during non-vegetation period. During vegetation period, stink and possible dustiness from fertilization and protection of agricultural culture may sporadically spread into the urban area of municipalities. In the vicinity of farms and farmyards located at the periphery of municipalities, stink from this source may spread into the municipalities as well. Penetration of cold air from surroundings influences the microclimate of municipalities in case of winter months and snow cover.

III.3.5.13.1 Synthesis of Ecological Tolerability of the Affected Area and Its Classification According to Vulnerability

Assessed area represents part of region characterised by high production of economic activity and high level of land use. Current status is results of long-term development comprising remodelling of productive elements of landscape, particularly lands and vegetation. Transformations of these two elements, mainly due to the agricultural purposes, were performed in majority of administrative area of assessed municipalities. Less level of modification is valid for forest cover, rock massive, surface and underground water. Quality of atmosphere changed even lower. All mentioned modifications induced by human activity interrupt the system of natural ecological equilibrium of the environment.

Considering ecological stability, the rock massive may be consider as the most stable element in the affected area. This is also reason why the nuclear power plant was built there. Likewise, changes of quality level of surface and underground water do not reach the threshold level of ecological tolerability. They rather approach limit levels valid for health acceptability (e.g. brook Telinský potok Creek, Hron River) and serviceability for humans or rather reach limit level of their possible capacity of utilization.

Regarding low ratio of urban area in the affected area, character of urban development and good ventilation level of urban area, there is no critical concentration of imissions in atmosphere. Therefore atmosphere of assessed area cannot be considered as limiting factor for human activities or ecological tolerability.

Critical situation is in the field of land use and vegetation cover. Agriculture in the affected area reach present technological maximum considering surface area and intensity of exploitation, so level of ecological tolerability of original landscape was practically exceeded. Induced changed are rather irreversible or reversible considering very long-term period.

IV Basic Information About the Expected Environmental Impacts of the Proposed Activity, Including Health, and About Possible Mitigation Measures

IV.1 Input Requirements

IV.1.1 Zero Alternative

The zero alternative represents the status quo (no action), it means, the no spent nuclear fuel storage will be built up at the SE-EMO site. After filling of the interim spent fuel storage capacity at the Bohunice site, the spent fuel will be stored only in at reactor pools up to filling of the pools capacity. It will ultimately lead to the shutdown of the particular NPP units. However, the systems to ensure the operation of the at reactor pools (cooling systems and systems for water purification of the pools, air conditioning and ventilation systems, the system of radiation monitoring and dosimetry, electricity supply, etc.) will still have to remain in operation. Nevertheless this situation is unsustainable and the issue of the spent nuclear fuel management must be solved by the decision on how to proceed with the spent nuclear fuel with its subsequently implementation. This decision has to be adopted at the latest during the termination of operation before the decommissioning stage will start.

IV.1.1.1 Land Requirements

The zero alternative has no land requirement.

IV.1.1.2 Water Requirements

The total, maximum and average water consumption will be the same as at present. It is arise from the current practice, technology of spent nuclear fuel storage in storage pools near reactors and from the remaining of the necessary auxiliary activities.

Distribution of drinking and supply water are connected to the water management system and water for storage pool needs will be supplied from the chemical water treatment system of SE-EMO.

IV.1.1.3 Other Raw Materials and Energy Sources

The zero alternative has no needs on raw materials. However, the systems to ensure the operation of the spent fuel storage pools (cooling systems and systems for water purification of the pools, air conditioning and ventilation systems, the system of radiation monitoring and dosimetry, electricity supply, etc.) will still have to remain in operation. The electric energy will be supplied from SE-EMO.

IV.1.1.4 Transport and Other Infrastructure Requirements

The zero alternative does not impose any additional requirements on transportation and infrastructure like the operation of power plant imposes. Nevertheless, it is necessary to maintain the functionality of the current infrastructure for period of spent nuclear fuel storage in storage pools near reactor, respectively up to the adoption of the decision on how to proceed with the spent nuclear fuel with its subsequently implementation.

IV.1.1.5 Supposed Labour Force Requirements

Labour force requirements arise from the need to maintain systems for the spent nuclear fuel storage pools (cooling systems and systems for water purification of the pools, air conditioning and ventilation systems, the system of radiation monitoring and dosimetry, electricity supply, maintenance, etc.) in operation and in the same range as currently (Matejovič, et al., 2003):

mechanical technology (spent nuclear fuel storage pool and shaft 1)	24 employees
electric energy	3 employees
instrumentation and control system	3 employees
maintenance, dosimetry, collection and analysis of samples	14 employees

Activities will be performed by operating personnel of SE-EMO.

IV.1.1.6 Build-up Area Requirements

The zero alternative does not impose requirements on the build-up area. All activities related to the zero alternative will be carried out in the main reactor building. Other requirements are not anticipated.

IV.1.2 Alternatives of the Proposed Activity

IV.1.2.1 Construction Stage - Spent Nuclear Fuel Storage Facility of Wet and Dry Types

The proposed activity in the case of dry alternative (with metal and concrete containers) or wet alternative of spent nuclear fuel storage facility has in principle, the same requirements for inputs during the construction phase. Possible differences in the inputs are described in the text below.

IV.1.2.1.1 Land Requirements

There are needed only limited excavations (in the case of wet storage - on a larger scale) within the existing fenced area of SE-EMO. Land to be used during the construction phase will be completely enclosed inside the existing fenced area of the SE-EMO. There is no need for additional land occupation outside the fenced area.

IV.1.2.1.2 Water

Water required for construction will be taken from the water supply system and from water management system of the NPP.

IV.1.2.1.3 Other Raw Materials and Energy Sources

All building materials needed for construction will be imported to the construction site. For construction will not be used any local raw material resources. Part of the excavated soil will be trucked off from the construction site. The construction of the storage will requires a limited amount of energy resources particularly like an electricity and fuel. Electricity will be supplied from SE-EMO.

IV.1.2.1.4 Transport and Other Infrastructure Requirements

Raw materials will be transported to the construction site by existing access routes - roads and rail. There is no need for building of additional infrastructure.

The question, which towns or villages will be affected by activities associated with shipping, will depends on the chosen supplier of construction work, location of his production capacities and resources of the raw materials base.

Generally it can be stated, that it could concern to towns and villages situated in directions Nitra - Mochovce, Levice - Mochovce, Nová Baňa - Mochovce, Zlaté Moravce - Mochovce, or those that are in the extension of these directions.

IV.1.2.1.5 Labour Force Requirements

Maximum number of construction workers on the site can be estimated at 100 people for the dry storage alternative and 150 persons for the wet storage alternative.

IV.1.2.1.6 Build-up Area Requirements

The construction of the spent nuclear fuel storage will be carried out on a greenfield area in the SE-EMO site and it will be located northern of the 4th Unit. The construction has no need for additional land occupation.

IV.1.2.2 Operation Stage - Spent Nuclear Fuel Storage Facility of Wet and Dry Types

IV.1.2.2.1 Land Requirement

The land used during the operation phase of spent nuclear fuel storage will be completely located in the existing fenced area of the SE-EMO. The current site area will not be expanded due to the existence of the planned facility.

IV.1.2.2.2 Water

Operation of spent nuclear fuel storage facility of dry or wet type will require a very low consumption of water for the surfaces rinsing and for sanitary facilities and showers.

The demineralized water will be used for filling of the storage pools in the wet storage. Source of this water will be the chemical water treatment system of the SE-EMO. For stable operation will be needed only a very small amount of clean water for maintaining of water quality in storage pools and for its refilling. The spent nuclear fuel wet storage will also require the technical cooling water for operation. This water will be supplied and refilled from some of the NPP units.

IV.1.2.2.3 Other Raw Materials and Energy Sources

For operation of the dry spent nuclear fuel storage facility will not be used any local raw material resources. The wet storage operation will need the following materials and raw materials (estimates are based on operating experience in Interim Spent Fuel Storage of JAVYS, Jaslovské Bohunice):

- mechanical filters,
- cation and anion-exchange filters,
- regeneration solutions (sodium hydroxide, nitric acid),
- decontamination solutions (oxalic acid, nitric acid, pure condensate, denatured alcohol, benzine, detergents),
- technical gases (compressed air and nitrogen).

The spent nuclear fuel storage will use existing energy resources of the SE-EMO. The estimation of annual electricity consumption for the dry storage is depending on the technical solution like a natural and/or forced ventilation, heating, etc. It should be 100 - 500 MWh per year. The electricity consumption for the wet storage should be 800 - 1200 MWh per year. With regard to the nature of the storage facility it is expected that in the case of both alternatives of the proposed activity will be the electricity consumption stable without significant changes during the day operation.

IV.1.2.2.4 Transport and Other Infrastructure Requirements

There are no new requirements on transport or other infrastructure during the operation phase, except the connecting of the spent nuclear fuel storage to the already existing infrastructure.

IV.1.2.2.5 Labour Force Requirements

The operation of the dry spent nuclear fuel storage facility will not require permanent staff. Operating activities will probably be carried out by operating personnel of the SE-EMO. The operation of the spent nuclear fuel wet storage will need a 5-10 employees. During the maintenance phase there will be needed about twice number of the operating staff.

IV.1.2.2.6 Build-up Area Requirements

The operation of the spent nuclear fuel storage has no requirements for build-up area. All activities related to the operation will be carried out in the area of SE-EMO - in the storage building with has been built during the construction phase and in the NPP buildings in cooperation with the connected infrastructure.

IV.1.2.3 Decommissioning Stage - Spent Nuclear Fuel Storage Facility of Wet and Dry Types

IV.1.2.3.1 Water

The decontamination activities of wet storage surfaces will requires using of a certain amount of water that will be treated and monitored before the removal and discharge.

IV.1.2.3.2 Other Raw Materials and Energy Sources

Activities related to the decommissioning of spent nuclear fuel storage will require no raw materials from local sources. Activities related to operation termination of the storage will require only a limited number of energy sources, decontamination solutions and detergents.

IV.1.2.3.3 Transport and Other Infrastructure Requirements

For removal of waste arising from the decommissioning will be used existing road and rail transport infrastructure.

IV.1.2.3.4 Labour Force Requirements

Labour forces needed for the operation termination and decommissioning of the spent nuclear fuel storage will be about the same as in the construction phase (i.e., 100 - 150 employees).

IV.1.2.3.5 Build-up Area Requirements

Activities will be carried out in the SE-EMO site, using the infrastructure of the site.

IV.2 Data on outputs

Regarding outputs, like sources of air pollution, waste, sources of noise and vibrations and other expected impacts are in the chapter described both existing sources in the NPP Mochovce complex, as well as new sources, created as a result of construction, operation and termination of the SNF repository operation.

IV.2.1 Atmosphere

IV.2.1.1 Atmosphere pollution

Existing sources of air pollution in SE-EMO can be divided into sources producing emissions from combustion processes (auxiliary start-up boiler room on natural gas for SE-EMO, boiler room on natural gas for guard facility, DGS with diesel drive). The second group is composed of sources producing RAL aerosols, directly linked to the operation of NPP reactors.

IV.2.1.1.1 Sources producing emissions from combustion processes

Due to construction, operation and decommissioning are not generated any new point sources of air pollution, which could adversely affect cleanliness of the air. Emissions from the line sources of air pollution due to road transport (several vehicles daily) and rail transport (several transports of the SNF per year), are at the expected intensity of transport practically negligible. The rail transport will be used also for transport of SNF to the repository upon termination of operation of the storage area. Also in this case it will be a source of very low emissions. Non-point sources of air pollution are not considered in the plan.

IV.2.1.1.2 Sources of radioactive aerosols

Due to operation of SNF repository is expected just very small, or even negligible negative impact on current drains of radioactive substances from the ventilation chimneys, operating in NPP Mochovce, i.e. they will not have an impact on compliance with current limit conditions.

IV.2.1.2 Thermal emissions

The SNF repository will be a source of thermal emissions into the air, as a result of residual heat generated by fuel assemblies, but in a much smaller scale than in reactors of NPP EMO.

This heat will be in case of a dry repository emitted by convection from the external surface of the packaging casing into the internal repository environment and then by natural ventilation into the outer space with the use of a chimney effect. In case of a wet storage, the heat will be emitted through heat exchangers to the technical cooling water and then by natural cooling in the external recipients into the ambient environment.

During construction and decommissioning, the repository will not be a source of thermal emissions into the air.

IV.2.2 Waste water

Waste water from the NPP Mochovce complex is discharged to:

- the Hron river, for waste water from EMO1,2 and rainwater collected in the NPP Mochovce;
- Telinský brook for sanitary water from MO34 and drainage water from the decantating plant in Čifáre;
- Širočina brook for drainage water from sludge drying process, generated during treatment of drinking water from sources of Červený hrádok.

If the activity is higher than 40 Bq/l, the waste water is not discharged into the environment, but is returned back to treatment of radioactive liquids.

The waste water is collected according to the different typologies in three different pipelines (for the rainwater, for the treated waste and sewage water and for the low-active radioactive waste water), which are discharged to the Hron river.

IV.2.2.1 Technical waste water

The waste water is not expected during the construction, used water is part of the construction material, and the rest is evaporated. The technical cooling water, intended for cooling of the pool water using the heat exchangers, is by the operation of the wet-type repository re-used. Replenished is only in the case of leakages and evaporations in the open cooling systems; it does not become a waste due to operation.

IV.2.2.2 Sewage water

Sewage waters are waste waters from social facilities and from cleaning outside of the controlled area. The sewage waters will be during construction generated also from points of personal hygiene of the construction workers. It is possible to assume an increased utilization of existing social facilities in the power plant complex; the site will be eventually provided by temporary sanitary facilities.

It is expected that quantity of sewage waters will be lower than the quantity of supplied potable water, because of partial waste for needs in a controlled area. It is quite likely, that after radiochemical inspection, it would not be possible to pump these waters from the collection tank of the special sewer to the sewerage system.

Sewage waters will be discharged to the internal sewage tank, connected to the existing external sewerage system, discharged to the waste water treatment plant. Cleaned sewage water, together with sewage waters of the whole complex, will be after control of quality discharged through the final waste waters sewerage collector to the recipient of the Hron river.

IV.2.2.3 Rain water

Unsoaked waters (rain and snow precipitation) from the repository and its surrounding will be discharged into existing stormwater sewer of the power plant complex. Concerned are rain waters from the roof of the facility and adjacent roads, and in a smaller volume also from adjacent unpaved surfaces.

The rain waters will be discharged through new sewer branches into the rain water drainage system of the power plant complex and then, via the main sewer collector, will be discharged directly into the Hron river.

Total amount of rain waters from the repository complex will be approximately 5500 m^3 per annum.

IV.2.2.4 Waste water from the controlled area

Waste waters from controlled area during operation of the SNF repository means waste waters from cleaning and washing of floors, various cleaning works, personal cleansing in emergency showers, so-called impure dressing room and other waters from the reception and storage section of the repository. Such waters will be discharged via a special sewer system into the collection tank of a volume of 4 m^3 for a dry-type storage and 10 m3 for a wet-type storage.

Further handling with those waters will be determined according to the results of radiochemical analysis of removed samples and by comparison with criteria for release into the environment, according to the regulation of the MoH of the SR No. 545/2007, in accordance with the government decree No. 345/2006. If they will comply with these requirements, they will be pumped into the sewerage system; otherwise, they will be pumped to the transport container for liquid RAW and processed in facilities for treatment of LRAW, where the concentrate will be modified into a suitable form for storing at the RAW repository.

For a dry SNF repository is expected production of LRAW approximately 30 m^3/year; while for a wet repository it is approximately 300 m^3/ year.

IV.2.3 Wastes

Generation of the non-radioactive waste in SE-EMO corresponds to concentration of work activity, which does not have a nature of goods production, but a nature of maintenance and auxiliary works. Therefore, the place of waste collection is defined as a manufacturing place. Those are places included inside the complex and places on detached workplaces, which are managed by the plant.

Technology of the SNF storing is not a source of waste. Expected is generation of minimum waste quantity due to cleaning, inspection and service activities (personal protective equipment - gloves, shoe covers, etc.), as well as from the used ventilation filters and for a wet-type repository also the aerosol filters and filters from cleaning and treatment of the pool waters. Handling with these wastes during operation of the repository will be performed within scope of the power plant waste management. Overall is expected creation of approx. 1 t of inactive waste (other - paper and cardboard packagings, plastic packagings, glass, iron and steel; dangerous - packagings polluted by hazardous substances, fluorescent lamps and other waste containing mercury).

Inactive wastes and wastes from non-technological areas (outside of controlled area) will come primarily from periodic maintenance and normal facility operation - discarded personal protective equipment, disposable wipes, packaging material, paper, waste from illumination sources, spare parts and fast wear and tear items, etc. An indicative overview is shown in the following table.

Handling of these wastes will be performed within scope of the power plant waste management as a whole, in accordance with applicable legislation and internal rules of SE, a. s. Wastes will be collected through the waste collection yard, sorted and stored for short periods, depending on individual types (as defined in the waste catalogue), or according to method of their disposal. Disposal will provided by specialised companies, with appropriate authorisations for this type of activity. All wastes exported from the power plant complex will be monitored at the freight gatehouses by a dozimetric inspection.

Waste generated in a controlled area shall be handled in accordance with the legislation in force. It will consist of following activities:

- collection and sorting,
- radiation inspection before transport for their treatment and processing,
- transport to TSÚ RAW (incineration, pressing, bituminization and cementation),
- processing and treatment, together with other waste produced by the operation and decommissioning of nuclear installations.

Expected is a total annual production of solid waste from controlled area (PRAO) for a dry-type repository 3 m^3; and for a wet-type repository 5 m^3.

IV.2.4 Noise and vibrations

Storage of SNF does not constitute a source of noise or vibrations, which could be significant in terms of work hygiene or communal hygiene.

Transportation means during transport of OS emit noise only of a little significance, and all requirements of the work hygiene are fulfilled.

During the construction and decommissioning are at most expected several tens of heavy loaded vehicles daily, or several railroad wagons daily. These transportation means will increase the traffic intensity only insignificantly.

IV.2.5 Radiation and smell

The principle of technical solution of the SNF repository from the aspect of radiation protection is minimization of negative effects of the ionizing radiation to the lowest reasonably achievable level, taking into account economic and social factors (ALARA principle = As Low As Reasonably Achievable, i.e. as low, as reasonably achievable in relation to reduction of exposure of workers and population).

The upper limit that must not be exceeded, are exposure limits and limit values of the dose equivalent outputs, given by the Act No. 355/2007 on protection, support and development of public health and on amendments and supplements to certain acts as amended by later regulations and decree of the government of SR No. 345/2006, on the basic safety requirements for the protection of the health of the employees and population against ionizing radiation and Regulation of the SR MoH No. 545/2007, defining detailed requirements for radiation protection during activities resulting in irradiation and activities important from the radiation protection aspect.

For a dry-type repository is the packing casing used as a primary safety barrier (transport and storage container or storage pool); its material and thickness is significantly reducing the flow of ionizing radiation, generated by storage of the radioactive material. For a wet-type repository is the fuel assembly or the hermetically sealed housing used as a primary safety shell.

Smells of special nature, reducing comfort of the environment are not present in the NPP technological process.

Construction, operation and decommissioning will not produce any significant smell.

IV.3 Information About Expected Direct and Indirect Environmental Impacts

Experience from the operation of analogic facilities (as alternatives of proposed activity) i.e. interim spent fuel storage facilities operated abroad (IAEA TECDOC-1293, 2002), Interim spent fuel storage ČEZ-Dukovany and Interim spent fuel storage in Jaslovské Bohunice operated by JAVYS, a.s. (and also the others) unambiguously prove safety and reliability of such facilities constructed in the area of nuclear facility and also their minimal impact on the environment. The level of radiation is also significantly under the natural background level.

In this part, the common impacts of proposed activity alternatives on the environment are described. The different and specific impacts resulting from the technical solution of relevant proposed alternative are stated in the text separately.

In the case of zero alternative i.e. the proposed activity will not be implemented, the impacts on the environment, landscape, urbarian complex and land utilization will remain almost at the same level until the final decision on the management of SNF from the operation of SE-EMO will be taken.

IV.3.1 Impact on the Geological Environment

The construction of spent fuel storage facility of dry or wet type will slightly affect the geological environment on the area under the storage building. There are requirements on the building placement mainly considering the engineering and geological conditions for the building foundations.

Construction and operation of storage facility does not bring a risk of contamination of geological environment by radionuclides or by other toxic substance. But during the construction the small local contamination by fuel or lubricants could not be completely excluded. But this can be largely avoided by preventive measures.

IV.3.2 Impact on the Air, Local Climate Conditions and Noise Level

In construction period the increased dustiness could be expected due to performing of earthworks and escalated traffic. This could be largely avoided applying preventive measures.

During the normal operation of spent nuclear fuel storage facility of dry or wet type no potential sources of air pollution arising (increased dustiness, SO_2, NO_X or CO) and the impact on the climate changes is also negligible.

During the operation of dry storage with applied system of transport and storage containers, no radioactive emissions will be discharged to the air. Spent nuclear fuel is isolated from the environment by two barriers. The release of radionuclides form the container is practically excluded because these two barriers with permanently monitored helium overpressure in the space between them enables the detection of untightens and performing the measures to prevent leakages on time. Moreover, the continual monitoring of air volume radioactivity in the storage area will be installed to confirm and to document the avoiding of potential impacts.

Point source of air pollution needs to be taken into account only for the wet storage alternative. It will be approximately 25 metres high ventilation stack. Air-conditions system provides ventilation and hot-air heating of building. Beta and gamma activity of radionuclides will be monitored.

SE-EMO does not have a significant impact on the noise level. Storage of SNF will not be a noise source as well as transport of SNF containers of transport of new containers from the manufacturer by rail. Temporarily, the noise level could be increased because of escalated traffic or performing earthworks during the construction period. All the activities included in the proposed alternatives will be performed in the SE-EMO area and used technical devices will not be a source of excessive noise or vibrations.

The alternatives of proposed activity do not represent a significant source of heat, smell or other outputs. The heat load of the area due to the residual power heat output of spent nuclear fuel exhausted by ventilation (cooling) system will increase due to the more spent fuel to be stored during the time period but it still will be covered by heat load of the area caused by the NPP operation.

IV.3.3 Impacts on Surface and Ground Water

Rainwater captured on the roofs of buildings and on the strengthened areas will be conducted away to the rainwater sewer system of SE-EMO area. Buildings including strengthened areas will have only a minor impact on the change of characteristics of drainage area compared to the current state, mainly due to the reduced infiltration of rainwater into the soil and geological environment. Considering the location and distance to the nearest used wells, it could be assumed that the construction or operation of the spent fuel storage will not affect their yield.

Spent nuclear fuel dry storage facility will not produce any technological waste waters. Before transportation from Main production building the containers will be decontaminated and there is only a theoretical possibility that the containers have to be decontaminated in the storage manipulation area.

During the operation of spent nuclear fuel dry storage facility the waste water arising as a result of cleaning of containers surfaces and cleaning in a controlled area. Sewage waste water arising from the toilets and from the cleaning of the areas outside the controlled area.

In the case that radiochemical analysis proves that the activity of waste waters from the controlled area is below the limit value, it will be possible to discharge them to the sewer water system. Otherwise, they will be transported to the siding corridor of Main production building to be treated as contaminated water. Treatment of such waters will be performed together with the other waters in accordance with operating procedures.

Liquid radioactive waste from the operation of spent nuclear wet storage (water cleaning system, decontamination of equipment, treatment of ion exchanger filters) including the waters from sanitary locks will be transported by pipelines to the NPP for further treatment.

The system for discharging and cleaning of waste waters in the area of SE-EMO is sufficiently dimensioned and will not be significantly influenced by standard operation of SNF storage considering all the alternatives of proposed activity. Also the balance and quality of waste waters in the SE-EMO area will not be significantly changed. Proposed activity will not significantly influences volume and quality of waste waters of nuclear power plant and also surface and ground waters near the SE-EMO area.

IV.3.4 Impacts on the Soils

The construction of storage will be performed on the greenfield site in the area of SE-EMO. For every alternative of proposed activity, the construction of storage does not require taking agricultural land or forests and also in any way does not affect the extent of the used agricultural land.

Ensuring rainwater collection from the roofs of buildings and from the strengthened manipulation areas, the more significant impact of storage building on the stability and erosion of soil will be eliminated. Areas will be conducted away from the roof of the storage building and paved areas will be eliminated handling significant effect on the stability of the work and soil erosion.

During the construction, small local pollution from fuel and lubricants cannot be completely excluded. However, it is possible to largely avoid this situation by applying preventive measures. During the operation, there will be no contamination of soils by radionuclides or by other contaminants

IV.3.5 Impacts on the Gene Pool and Biodiversity

For every alternative of proposed activity, the construction and operation will not have a negative impact on plant and animal species or on their biotopes. In the affected area, the existing ecosystems will not be disrupted. During construction, the short and limited negative impacts could occur as a result of increased noise and dustiness. However, these impacts do not exceed the tolerable limits and will be effectively eliminated by appropriate preventive organizational and technical measures.

During normal operation of spent nuclear fuel storage facility of dry or wet types, the radionuclides with activity exceeding the limits set by regulatory authorities will not be released into the environment. Populations of flora and fauna will not be exposed by radiation which is significantly different from the level of natural background and their harming as a result of the proposed activity is not likely.

During the standard operation of spent nuclear dry storage facility, liquid radioactive waste will not be produced. Because the containers will be hermetically sealed, they will be not a source of radioanuclides leakages. Direct activation of air and dust will be very low due to low neutron flows.

The operation of spent nuclear fuel wet storage facility will be the source of liquid and gaseous effluents, but they will not significantly influence the total balance of effluents for nuclear installation in SE-EMO area. The operational radioactive waste will be treated in accordance with the existing system of RAW management in SE-EMO. The experience from the operation of MSVP in Jaslovské Bohunice shows, that the activity of gaseous radioactive effluents is less than 10 % in comparison with the defined limit values.

It is not expected that the operation of storage could (either by synergistic or cumulative effects from existing and constructed nuclear installations and by natural background) significantly influence the gene pool and biodiversity (population, fauna, flora or vegetation) or disrupt the function of ecosystems in the area of interest.

In the previous surveys of ecosystems of affected area, the impact of Mochovce NPP on the geofund, biodiversity or genetic (mutation) changes in the organisms caused by radiation was not registered. Natural ecosystems, gene pool and also biodiversity in the area of interest are determined mainly by agriculture.

IV.3.6 Impact on the Landscape

None of the alternatives of the proposed activity will have a significant impact on the structure and use of landscape. The landscape remains practically unchanged and current state remains untouched. The existing proportion rate among forested land, intensively agriculturally cultivated land and developed areas remains the same. Either the way of landscape use will not change. The implementation of the plan will also not affect the character of the developed areas and the nature of the area infrastructure.

The relief of the country landscape or the proportion rate of natural components in the affected area will be not changed by the proposed activity. Even the proportion rate between natural and anthropogenic components of the environment will not be changed. All the proposed activities (excluding transport) and its effects will be practically limited only to the area of SE-EMO.

Architectural design of the alternatives of proposed activities will respect the requirements of the single architectural and artistic concept of the Mochovce nuclear power plant area. Architectural and layout concept will also be subject of additional requirements on the SNF storage, on the protection against external impacts and also requirements on the security.

Building of SNF storage will be designed by using materials and constructions meeting the requirements for mechanical strength, stability, fire resistance, hygiene, environmental protection and energy saving and will be in line with international recommendations and regulations applicable to nuclear facilities.

Construction and operation of SNF storage will not significantly change the local landscape scenery; constructed building will not become the dominant of the landscape. The cooling towers of nuclear power plant will remain the dominant element of the landscape scenery.

IV.3.7 Impacts on the Urban Complex and Land Use

Urban complex is formed by existing settlement structure of the affected area, urban areas, civil and urban amenities, road and technical infrastructure of the area, which together with land use create an inseparable land complex for its inhabitants. The affected area is characterized by mixing the structure of historic settlement with modern power engineering complex with power distribution system that exceeds the borders of the area due to its territorial and economic significance.

All the alternatives of the proposed activity will have no direct impact on the cultural and historical monuments or on archaeological and paleontological sites in the area affected by the construction. Potential job opportunities creates an indirect positive impact on the development of municipalities, increased interest on the monuments conservation, etc. Implementation of the proposed activity will have a positive effect on the production of electricity and its stability in the long term supply for the manufacturing sector (agriculture, industry, local economy), for transport, services, recreation and tourism. It does not lead to the demand for creating other connected buildings, activities or infrastructure. Other impacts are not assumed.

If the proposed activity will not be realized (zero alternative), the impacts on the urban complex and land use will be on the almost same level as at present time until a final decision on the management of spent fuel from the operation of SE-EMO nuclear power plant will be made.

IV.4 Health Risks Assessment

Based on the identification of direct and indirect impacts of nuclear facilities on the environment, referring in the previous chapters, it can be concluded that the potential health hazards that come into consideration because of the operation of this nuclear facility are related only to ionizing radiation or to radiation exposure of population. All other kinds of health risks as pollutant emission of gaseous and liquid conventional chemicals, dust, noise, sewage water, etc. are not relevant because of the nature, location, operation procedures and distance of nuclear installation from human habitation.

Radiation exposure of personnel and population is legislatively defined in the *Government Regulation No. 345/2006 on the Basic Safety Requirements on Personnel and Public Health Protection against Ionizing Radiation*. In this Regulation, the legislative limits for effective doses of personnel and population are defined.

For personnel, the limits are defined in § 11 as follows: the effective dose of 100 mSv in five consecutive calendar years and the effective dose in any calendar year shall not exceed 50 mSv. The other limits are defined as equivalent doses for the eye lens, skin and hands from the toes up to the forearm and for the legs from the feet up to the ankles. The effective dose is the sum of the equivalent doses in all organs or human tissues multiplied by the appropriate weighting factor. In practice, the compliance with these limits is normally provided by the system of dosimetric measurements of personnel exposure using dosimeters for external exposure, as well as a laboratory and other device measurements for internal exposure. Such dosimetric system will be part of the proposed nuclear facility.

For the population, the exposure limits are defined in § 15 as follows:

- Effective dose - 1 mSv in calendar year,
- Equivalent dose in the eye lens - 15 mSv in calendar year,
- Equivalent dose in skin - 50 mSv in calendar year, which is defined as the average dose on the surface of 1 cm^2 of maximum irradiated skin, regardless of the size of the irradiated skin surface

The defined exposure limits are applicable on the average exposure of critical group of persons, calculated for all exposure pathways from all sources of ionizing radiation and for all activities leading to exposure, which could come into the consideration. In the Annex 3 of the

Government Regulation No. 345/2006 the limit of individual effective dose to the population in the locality near the area of nuclear installations is defined as 250 µSv / year.

In the site of Mochovce, the following nuclear installations are or will be in operation (limit for individual effective dose of population for each nuclear installation in operation or assumption of this value for nuclear installations which are not currently in the operation is also given):

- Nuclear power plant SE-EMO 1,2 (in operation) - 50 µSv/year,
- National radioactive waste repository (in operation) – 10 µSv/ year,
- Interim spent fuel storage (subject of the plan) ≤ 10 µSv/ year,
- Nuclear power plant SE-EMO 1,2 (in completion) ≤ 50 µSv/ year,
- Final processing of liquid radioactive waste (in operation) – 10 µSv/ year.

Total limit for individual effective doses for the Mochovce site could be assumed on the level of 130 µSv/year.

For reliable assessment of the radiological situation after commissioning of the nuclear facilities is the necessary to monitor the values of radiation background in the area in the long term, but at least one year before commissioning the facility. In the case of Mochovce area this requirement is met, because since 1986 the constant and systematic monitoring of radioactivity in various environmental compartments is performed by Environmental Radiation Monitoring Laboratory (LRKO) in Levice. The radiation situation at Mochovce area before commissioning of EMO1,2 and National radioactive waste repository was assessed by the evaluation of external exposure and the occurrence of radionuclides (with an emphasis on artificial radionuclides) in various environmental compartments - the ground layer of the atmosphere, soil, surface and ground water, feed for the animals and selected agricultural products (food).

Generally speaking, the radiation background at Mochovce area is at a very low level, which is consistent with the overall decrease trend in the level of radioactivity in the environment on a global scale, mainly due to the ban on nuclear weapons tests in the atmosphere since 1963.

The predominant part of the measured radioactivity in the individual environmental compartments comprises by the natural radioactivity of potassium isotope ^{40}K.

Existing results of monitoring in Mochovce area and in the near environment proved that the impact of the nuclear facility on the environment radioactivity is undetectable, despite the high sensitivity of the used measurement devices. An exception is the measurement of tritium in the river Hron during discharge of EMO1,2 control tanks just under the discharge point. At the sampling site Kalná nad Hronom, where the discharged water is well mixed with the water of the river Hron, significantly lower concentrations of tritium which are close to the background level were measured. The measured values of tritium and ^{90}Sr are consistent with the values of the project EMO1,2 and the requirements of the legislation.

In the results of the monitoring of air, soils, agricultural products, thermoluminiscent dosimeters and ionization chambers, no impact of the nuclear facilities operation on the background levels of radionuclides was found (formed by terrestrial radionuclides - ^{238}U, ^{232}Th, ^{40}K, ^{7}Be and anthropogenic radionuclides - ^{137}Cs, ^{134}Cs, ^{90}Sr originated from the nuclear tests in the atmosphere and from the Chernobyl accident). The differentiation of ^{137}Cs to the individual original sources is already considerably difficult.

The environment near the EMO area is currently monitored at regular monthly intervals on the 17 stable dosimetric stations (SDS). The ambient dose equivalent rate is measured using an ionisation chamber RSS-112. The dose rate values do not taking into account the contribution from cosmic radiation. The value of the ambient gamma dose equivalent rate varied from (71 ± 7) nSv/h (July, Vráble) to (197 ± 14) nSv/h (december, FS KRAO 3). The average annual value was at the level of (92, 8 ± 9.9) nSv/h. Investigation levels of the ambient dose equivalent rates were not exceeded on any SDS. The values of dose rates are highly dependent on the monitoring site and on the meteorological impacts (Cabáneková, H. and Melicherová, T., 2012).

Exposure of public in the affected area depends on many factors as disposition of radioactive sources, on the way how people use the environment, on their age, anatomical and physiological characteristics of people. Practically, it is not possible to determine the doses received by individuals and because of this fact the mostly exposed critical group of persons (representing individuals) is determined. This group is homogenous in terms of age and have stable lifestyle, which can affect the level of exposure.

For Mochovce site, the critical group was determined in a way that, for every human organ, the ratio of the maximum IDE behind the sanitary protection zone was calculated - about 3 km to limit doses. The highest value of this ratio indicates the critical human organ and determines the critical group. From the results of the calculations performed in the frame of EMO 1,2 safety documentation elaboration it could be concluded that the critical human organ is the thyroid and the critical group of the persons are the children under one year in the village of Nový Tekov.

The analysis of radioactive discharges from the EMO 1, 2 NPP to the environment, done in 2011, shows (Cabáneková H. and T. Melicherová, 2012), that the highest value of annual individual effective dose was calculated in the ESE sector in the area of Nový Tekov and reached a value of 329.8 nSv/year for infants and 263.5 nSv/year for adults. In the frame of public health protection it can be concluded that the maximum calculated value of 50 (70)-year committed individual effective dose for the representative person (0.3298 μSv) is lower than the basic radiological limit (50 μSv) defined by Public Health Auhority of the SR for discharging the radioactive effluents from the EMO1,2 NPP. The mentioned maximum calculated value represents 0.66% from the limit.

To have an indicative idea about the annual individual effective dose from the operation of proposed spent nuclear fuel storage, the analogy with the Interim spent fuel storage at Bohunice could be used. The POSAR of Interim spent fuel storage facility in Bohunice after the seismic reinforcement and increasing the storage capacity, defines the value of individual effective dose for critical group of person (children up to one year in the village Žlkovce) as 34.5 nSv/year. This value is relevant to the wet type of storage. In the case of dry storage it can be assumed that the exposure will be lower due to the fact that the fuel is hermetically sealed in the storage containers and practically there will be no discharges into the environment. From these stated values, it can be assumed that the annual individual effective dose from the activities of proposed Spent nuclear fuel storage facility in Mochovce can be roughly estimated at about 1/10 of the annual individual effective doses from the operated EMO1,2 NPP.

The population may be potentially exposed to radiation exposure during the transportation of spent nuclear fuel from NPP within the Mochovce site and also during transportation of SNF from Bohunice NPP. These transports must be performed in accordance with the requirements of the Decree of Ministry Health No. 545/2007 Coll. defining the details on the requirements for radiation protection in activities leading to exposure and activities relevant to radiation protection, respectively in accordance with Decree of NRA SR No. 57/2006 Coll. defining the details on the requirements for the transportation of radioactive materials. From the perspective of protection of personnel and public against ionizing radiation, there are particularly important requirements defined by the Decree of Ministry of Health No. 545/2007 Coll. § 27, par. 9 and § 28, par. 10 and Decree of NRA SR No. 57/2006 Coll. § 5 par. 3 letters a), d), e), f):

- The dose rate 2 mSv/h at any point of the outer surface of the package has not to be exceeded,
- The dose rate 10 mSv/h for exclusive transport conditions at any point of the outer surface of the package,
- The dose rate of 2 mSv/h at any point of the outer surface of the vehicle and 0.1 mSv/h at a distance of 2 m from the surface of the vehicle has not to be exceeded,
- Non-fixed radioactive contamination on the external surface of the package has to be kept as low as reasonably achievable. In the normal conditions of transport (except exclusive transport conditions) at any point of the surface of the package the non-fixed contamination has not to exceed 4 Bq/cm^2 for beta, gamma emitters and alpha emitters with low toxicity and 0.4 Bq/cm^2 for other alpha emitters.

In this context, it is also necessary to mention that the core section of the spent fuel shipment will be the fuel transports within the area (from spent fuel pools in main reactor building to SNF storage). The transport of SNF from EBO34 NPP will represent the smaller part of the shipment process. Previous experience with previous transports from Mochovce site to Bohunice site in transport containers C-30 with magazines T-12, T-13 and KZ-48 are positive, and there was no problem associated with exposure of personnel or population. Based on the above mentioned facts it can be concluded that, compared with the current state, there is no assumption of increase of health risks for the population of affected villages due to the transport of spent nuclear fuel.

Operational risks and potentially non-standard situations that can occur during the operation of spent nuclear fuel storage depend on the type of the storage (wet or dry), its general concept as well as on the specific technical solutions of potential suppliers of storage technologies. From the nuclear safety point of view, the most important issues are the method and reliability of systems for preventing criticality of spent fuel and ensuring the reliable residual heat transfer produced by spent fuel. These technical factors as well as the way of operation, safety culture and resistance to external natural factors determine the possibility of occurrence of non-standard operational situations with potential impact on the exposure of the population in the area of SNF storage. Taking into account the possibility of arising of non-standard situations during the operation of this type of nuclear facility, the following type of events could be considered:

- transport and handling failures,
- loss of functionality of the stored fuel cooling system,
- accidents leading to the criticality,
- external influences such as fire, explosion, flood, earthquake.

Due to the character of the first level document in the process of environmental impact assessment of nuclear facility, this Plan does not specify the details on this type of events. A more detailed description of the events will be the subject of EIA Report or Pre-operational safety assessment report which will be based on the specific technical solutions and the corresponding documentation for selected alternative and specific solutions of spent nuclear fuel storage in Mochovce.

IV.5 Information on Expected Impacts of the Proposed Activity on the Protected Areas

In the affected area, there are no bird protection territories, territories of European importance, protected territories of Natura 2000, national parks, protected landscape territories or protected water areas that could be affected by the operation of NPP Mochovce or by implementation of the proposed activity. In a zone 5-10 km from the site, there is Slovak Academy of Science area Arboretum Mlyňany and natural formation Patianska cerina. On the north-eastern edge of this zone, there is south-west projection of the protected landscape Štiavnicke vrchy Mountains. Impacts of Mochovce nuclear facility on these protected territories have not been proven, yet. It is also assumed, that the proposed activity will not affect mentioned protected areas or territories.

Construction of spent nuclear fuel storage facility will be performed in a closed area of SE-EMO and taking into account the purpose of the building, it is not expected a direct or indirect impact on the protected territories located near the assessed area. This follows from the operational experience of analogous facilities abroad, e.g. Interim spent fuel storage ČEZ Dukovany and also from operation of Interim spent fuel storage JAVYS in Jaslovské Bohunice. Therefore there is no reason to assume negative consequences in protected territories due to their absence in the area of EMO, respectively in near distances from the EMO site.

IV.6 Assessment of expected impacts from an aspect of their significance and time course of their influence

In the course of documentation preparation, in any of assessed circuits for both solution variants of the type of repository, by their technical and technological solution, as well as by their location, were not identified any facts, that would bear witness of exceeding the relevant statutory limits or the unacceptable influences.

Potential negative effects, even with consideration of concurrent effect of existing activities on given territory (operation of the Mochovce nuclear power plants) are in all circuits virtually insignificant or only with small significance, situated deep within zone of permissible or acceptable values. In the most rated circuits (impact on the population, natural environment and the country) are the potential impacts practically not detectable, measurable or distinguishable from existing background. Influences, almost in all cases in both scenarios for the construction, operation and decommissioning, almost do not differ; in case of noise, emissions and waste production and employment opportunities, though these effects are different, they are only of a small significance, either favourable or unfavourable.

All caused adverse effects show characteristics of effects reducible by suitably adjusted restrictive and protective measures. A significant favourable effect is the construction and the operation of the repository, because of its necessity for the operation process of nuclear power plants and for system of comprehensive and safe handling of the SNF produced in NPPs.

Standard effects induced to the individual components of the environment in connection with the construction, disassembly of installed equipment and subsequent demolition and removal of civil structures during decommissioning process are only of little importance and with limited territorial and time scope. It is necessary to note, that decommissioning of a nuclear installations must be performed according to an approved decommissioning plan, which must always fully respect all environmental requirements.

From a proposal of a locality can be assumed, that due to planned durability of nuclear power plants is in the EMO locality quite significant production of the SNF, therefore also the effects are in the large scale restricted by the boundary of closed and fenced complex of the Mochovce power plant. By this boundary is therefore also restricted so called the aggrieved territory for purposes of assessment of environmental impacts (except of transport of the SNF from the EBO locality). The aggrieved territory is an uninhabited territory, publicly inaccessible and specifically used for industrial purposes (power generation).

The above conclusions apply, if corresponding level of nuclear safety of the repository is ensured by fulfillment of legislative requirements, given by the Act no. 541/2004, what means:

- uncontrolled development of the fission reaction is prevented,
- unauthorized release of radioactive substances is prevented,

- unauthorized escape of radioactive ionising radiation is prevented,
- consequences of accidents are limited.

IV.7 Anticipated Transboundary Impacts

According to § 40, section 1, letter b) of the *Act No. 24/2006 Coll. (EIA Act)* to transboundary impact assessments are subjected proposed activity on the territory of the Slovak Republic listed in the Annex. 13 and proposed activities listed in Annex. 8, which may have a significant impacts on the environment beyond national boundaries.

According to the Annex. 13, section 3 of the *Act No. 24/2006 Coll.* proposed activity belongs to facilities „intended solely for the production or enrichment of nuclear fuel, reprocessing of spent fuel or the storage, disposal and processing of radioactive waste“ which are subjected to mandatory international assessment of their transboundary impact on the environment.

Obligation to assess transboundary radiological impact of the nuclear facilities for members of the EU follows from the Euratom Treaty. *The European Commission Recommendation of 11 October 2010 on the application of Article 37 of the Euratom Treaty (2010/635/Euratom)* determines the content of such assessment.

Contribution of spent nuclear fuel to radiological impacts (releases and radiation), both under normal conditions and in the events at nuclear installation will be negligible in comparison with conventional or radiological impacts of NPP units that are already in operation and under construction in SE-EMO site. No significant impacts of construction, operation and decommissioning of dry or wet storage of spent nuclear fuel are expected beyond national borders.

IV.8 Induced Relationships Potentially Causing Impacts with Respect to Current Status of Environment in Affected Area

Currently there are no known induced relationships that can cause impacts, considering the current status of the environment in the affected area.

IV.9 Other possible risks associated with the implementation of proposed activity

Environmental risks in terms of possible emergency and abnormal situations with an impact on nuclear safety is treated by the Act no. 541/2004 and its implementing regulations of UJD SR. Used technology and design of packaging casings must have such properties and safety functions, so that:

- uncontrolled development of the fission reaction is prevented,
- unauthorized release of radioactive substances is prevented,
- escape of ionizing radiation is prevented,
- consequences of accidents are limited.

Analysis of design basis accidents

Analysis of design basis accidents, caused by external and internal factors is performed in order to limit consequences of accidents. External factors are particularly fire, explosion, earthquake, crash of an airplane and flood. Internal factors are equipment failures or error of the operator. Analyses are prepared in accordance with procedures and methods in accordance with IAEA recommendations. These analyses are part of the POSR nuclear facility and before commissioning of the nuclear facility must be approved by UJD SR. Solution of these incidents must be embedded in the technical design of the facility and technology of the SNF repository in a process of its design. In a course of the process for building permission and for commissioning, the UJD SR will investigate in details, whether the nuclear safety, the radiation protection and the physical protection of the repository are sufficient. If not, the appropriate permission will not be granted.

Thanks to design of the construction and the technological equipment (mechanical, thermal and seismic resistance, shielding capability), qualification and training of the personnel, the operating incidents caused by internal factors will have considerably limited scope and no incident will cause damage to the integrity of the building or of the packaging casing. Liquidation of possible minimum consequences in the facility will not affect the environment.

Because the thermal resistance of the packaging casing will be declared (against fire) and its tightness will be tested and demonstrably proven before each transport and storage, handling with it will be limited with regard to the safety (by safe values of handling height and speed, by pre-specified and well-known path of the movement), then at incidents caused by external factors will not be exceeded intervention levels and guide values of intervention levels for immediate and follow-up measures, nor the exposure limit of population will be exceeded in vicinity of a workplace with ionizing radiation sources, pursuant to Regulation of the Government of SR No. 345/2006.

Risks of interaction of other nuclear facilities and the repository

Operation of the SNF repository and other nuclear facilities in the Mochovce nuclear complex (EMO, final processing of LRAW, national repository of RAW) are independent of each other, so that the accident at any of them cannot jeopardize the basic functions of a repository. Also the design basis accidents incurred in the SNF repository have no relation to important technological systems of the nuclear complex and therefore cannot affect the operation of other nuclear facilities in the complex.

IV.10Mitigation Measures of the Adverse Environmental Impacts of the Proposed Activity Alternatives

Identified adverse impacts are mostly limited to SE-EMO and proximate area. The most significant impacts are noise and vibrations. Whereas proximate area is not populated, public comfort will not be disturbed. The exception might be the staff (especially during construction and decommissioning of spent nuclear fuel storage).

Transport of materials during the facility construction and decommissioning will have an influence as well on population of affected area (higher traffic, noise and vibrations). Proponent (operator) of the facility shall define measures for prevention, elimination and mitigation of influences in co-operation with representatives of affected municipalities (e.g. space or time optimization of transport routes etc.). These measures are typical for any big industrial construction and are not connected to nuclear safety or radiation protection.

Technical measures to prevent and mitigate adverse impacts of proposed activities on environment are following: design of storage area, layout of storage area, fire protection project, monitoring dosimetric system location and project items for insertion into physical protection system. Mitigation of gaseous and liquid effluents and elimination of any uncontrolled leakages are integral parts of technical solution of installations and civil constructions.

Operation of Spent nuclear fuel storage facility Mochovce according to operational regulations represents a set of organization measures to prevent and mitigate adverse impacts of proposed activities - storage of spent nuclear fuel assemblies. This includes also limits and conditions of safe operation approved by regulatory body. Operational regulations refers to (besides others) nuclear and radiation safety assessments. Functional quality management system is considered to be a tool for normal operation sustainment. Another organizational and operational measures within the radiation protection and occupational and health safety fields shall be applied on the basis on safety assessment of proposed operation.

Some of measures to mitigate adverse impacts of proposed activity are of socio-economic domain, e.g. utilization of operational staff and recruitment of employees form affected municipalities preferably.

IV.11 Assessment of the Expected Area Development in Case the Proposed Activity is Not Implemented

Proposed activity Spent nuclear fuel storage facility Mochovce has direct influence on area development. In case the proposed activity is not implemented the nearby area will develope according to zero alternative with all socio-economic consequences on both local territory and state economy.

Zero alternative represents conservation of actual status, i.e. no storage of spent nuclear fuel will be constructed within the SE-EMO area. Spent nuclear fuel will be stored in the at-reactor pools until their capacity allows. Finally this will cause operation termination of NPP units. Systems providing spent fuel pools operation (systems for water cooling, air conditioning systems, ventilation, radiation control, dosimetry, electric energy supply etc.) must remain in operation. However, this status is not sustainable for ever, the question of final solution for SNF must be solved until NPP decommissioning at the latest, or until decision on next procedure of SNF management followed by its realization.

If the proposed activity is not implemented (zero alternative), environmental impacts, influences on scenery and urban complex and land utilization will remain on the same level as nowadays until decision on final solution of SNF from operation of nuclear power plant SE-EMO.

IV.12 Assessment of the Accordance of the Proposed Activity with Valid Territorial-Planning Documentation and Other Relevant Strategic Documents

The proposed activity in both storage variants is in direct connection to the operation of the power plant and has the same character as the main activity. In case of both variants it will be realised only in SE-EMO area; it will not require the extension and the influences of storage facility on the envrionment will not overreach the current valid limits based on which the valid territorital-planning documentations were elaborated.

According to the Nation's Memory Institute of Upper-Tier Territorial Unit of Nitra Self-Govering Region, which binding part was declared by generally binding legal regulation no. 2/2012, is SE-EMO area an area of technical infrastructure and transportation. The proposed activity is in accordance with mentioned solution of functional usage of the area.

The proposed activity is in accordance with approved *Strategy of final part of nuclear energy* (and proposal of new *Strategy of final part of peaceful use of nuclear energy*). The strategy in 2008 went through evaluation of influences of proposal of strategical documents with whole-state range on the environment according to the Act. No. 24/2006 Coll. and was approved by the Decision of the Government no. 328 from 21st May 2008.

IV.13 Further Steps in the Impact Assessment and Identification of the Most Serious Problems

Considering the fact that investment proposal is in pre-design preparatory stage of Spent nuclear fuel storage facility Mochovce construction and prior to procurement for technology supplier (but also nature of proposed activity and its implementation), this Intention is developed concisely and on the level of details responding to given stage of preparation.

After developing safety documentation, which will be elaborated for next steps of licencing process, on the basis of its results will be finalized project documentation for construction permission. This kind of documentation shall include all information needed to assess radiation protection of personnel and public, environmental protection, preliminary safety report (later pre-operational safety report), preliminary plan of RAW management, preliminary emergency plan, and preliminary plan of radiation protection during operation, preliminary limits and conditions of safe operation and preliminary definition of area threatened by nuclear installation.

V Comparison of variants of proposed activities and design of optimum variant

Spent nuclear fuel can be regarded as a potential future source of energy. To the options of handling with the SNF may be included its storage (as integral part of the so-called "open fuel cycle") or its reprocessing (as integral part of the so-called "closed fuel cycle"). Both options is composed of several steps, which necessarily involve storage of the SNF for certain period of time. The length of this period of time may, depending on selected strategy, differ in the range from several months up to several decades. Length of the storage is an important factor for the repository structure design. The definitive method of handling with the SNF may not be known at the time designing the storage facility, what in turn leads to uncertainties associated with the length of storage of the SNF assemblies, a factor, which must be considered during selection of the storage type and its final design (Lee, J. S. 2003).

Delay in implementing plans for construction of deep repositories creates prerequisites for a need to extend the storage of the SNF by several more decades. It is expected that this trend of storage for longer periods will continue and some countries are already considering the storage period of 100 and more years.

There are two categories of currently available technologies of the SNF storage, according to the cooling media. Technologies differ between each by their main characteristics, especially method of the heat transfer, type of shielding, transportability, positioning with regard to the geological surface, degree of independence of individual storing units and by the storing structure.

V.1 Creation of a set of criteria and determination of their importance for selection of an optimum variant

Generally, the storage facility should be designed to comply with the essential safety requirements, such as to ensure subcriticality, removal of residual heat, suitable barriers for escape of radionuclides, radiation shielding and option to handle with the stored SNF assemblies. The structural design should, if possible, have following properties:

- Systems for residual heat removal from the SNF assemblies should be secured by the energy produced by the SNF assemblies (i.e. by natural convection).
- A multi-barrier approach should be selected for preventing the escape of radionuclides in respect of all its components: fuel matrix, fuel pin envelope, storage containers and any engineering structures, for which is possible to demonstrate their reliability and suitability.
- Safety systems should be designed to perform all the required safety functions without the need for monitoring.
- Safety systems should be designed to operate without human intervention.
- The storage building, or in case of a dry storage the container, should be resistant against risks considered in the safety analyses.
- Access to the facility should be provided for the event of incidents.
- The SNF storing facility should be designed to allow handling of the SNF assemblies for their inspections or modifications.
- SNF and the storage system should be sufficiently resistant to degradation.
- The storage environment should not have an adverse affect to the SNF properties, SNF storage casings or the storage system.
- SNF storage system should allow control and inspections.
- SNF storage system should be designed to prevent or to minimise the production of the secondary radioactive wastes.

These functions are ensured by proper positioning, design, construction and operation of the storage facility. Already during the design of the facility is necessary to consider its future decommissioning.

A necessary condition for construction of the SNF repository is to ensure that operation of the facility will not cause excessive exposure of employees, population and components of the environment by radiation sources associated with operation of such facility. Outlets from the SNF storing facility should be inspected in accordance with requirements of the authority responsible for this type of operations and they should also be included into estimates of radiation doses of employees and general public.

For determination of assessment criteria for proposed variants was selected a set:

- of environmental criteria, reflecting effects on individual components of the environment,
- of technical and technological criteria, reflecting level of technical and technological solution of activities, while an important criterion for the evaluation of given activity is also its importance for the safety and complexity of handling of the SNF within the national concepts resulting from international commitments,
- of criteria, assessing effects on population, its state of social and economic situation.

V.2 Selection of optimum variant or determination of order of suitability for assessed variants.

Wet storage in pools

SNF is stored in standard or compact containers, where the fuel assemblies are stored in smaller intervals, in order to increase their storage capacity. The most frequently used option for the SNF storage immediately after removal from the reactor, are pools with water, as they provide excellent heat transfer, essential for the initial cooling phase. For nuclear power plants, these pools are usually integrated into the power plant design and storage of the SNF in these pools is part of the power plant operation. The wet storage of the SNF in pools with water was for a long time prevailing storage method. As an established practice since the onset of nuclear energy, for initial cooling and shielding of the spent fuel after removal from the reactor, were from certain technical and economic reasons almost exclusively used pools with water. But storage in pool requires an active technological systems to ensure the required activity and permanent attention for maintaining the water purity. The topical issue, which was dealt by some studies focused on the SNF storage, is protection against the possible crash of an aircraft. There are some current proposals of storage pools with advanced features, like passive cooling and protective roof construction against crash of an aircraft, with a perspective of changes of these shortcomings of the wet storage (Lee, J.S., 2003).

Dry storage in containers and engineering constructions

The spent fuel, after several years of initial cooling in the water of a pool next to the reactor, becomes suitable for dry storage based on principle of natural or forced heat removal. Minimum required time of initial cooling in the pools depends mainly on spending and history of fuel operation. If we take into account the 20-50 years or even longer required period of storage, it is clear that the dry storage with natural (passive) cooling could be an attractive alternative to the pools. Summary of the spent nuclear fuel repositories, implemented during last 10 years shows, that storage in a dry environment is becoming more common. There are several standard types of these technologies and they are available from several suppliers in the international market. There is also plenty of design solutions for facilities, on the basis of standard technologies, which are now available. These technologies differ between each other especially in terms of construction material, size, modularity, spent fuel configuration, layout of storage containers (horizontal, vertical, etc.) and methods for handling of the fuel. In some countries were conducted studies of the multi-purpose technology, i.e. one technology for the storage, transport and deposition. There may be other differences in terms of storage above or below the earth's surface (Lee, J.S. , 2003).

Dry storage in single or dual purpose (e.g. transport and storage) containers.

Containers are modular in their principle. Such systems are hermetically sealed to prevent escape of radioactive material during storage. They provide shielding and containment of the SNF by their barriers, which include metal or concrete body of the container, inner metal lining, or metal barrel and cover of the container. They are usually of a cylindrical shape with horizontal or vertical longitudinal axis. Accurate position of the fuel assemblies inside the container is provided by a basket, which may or may not be a part of a container. The heat is from stored SNF removed by convection and radiation, while the cooling may be either natural, or forced. Containers may be stored inside the storage building, or outside in the open area (IAEA Safety Guide No. SSG-15).

Dry storage in engineering constructions.

Engineering constructions for storage of SNF are either light-weight construction, or massive and shielded ones. They can be located on the surface or below the surface of the earth; they can be the reinforced concrete constructions, containing storage boxes. SNF assemblies are stored and closed in a way preventing any escape of the radioactive material. Shielding is provided by building structures, surrounding the stored SNF. The heat removal is primarily provided by natural or forced convection of the air around storage boxes. Heated air is then discharged into the atmosphere, either directly or through a filtration system, depending on the construction. Several systems are also using a double-circuit cooling. If the natural cooling is used, the need of active components like pumps and compressors is minimized, thanks to higher operational reliability of the system. Therefore, it can lower the costs (IAEA Safety Guide No. SSG-15).

With regard to the fact that currently available technological solutions of the wet and the dry method of storage can without problems meet all requirements for safety of the personnel and the population, and compliance with those requirements is a necessary precondition for their particular application, the cost of storage is an important aspect for selection process.

At the end of the assessment of effectiveness of utilization of either wet or dry method of storage can be said, that, although there is no clear worldwide preferred technology of SNF storage, the dry storage of the spent fuel in containers is beginning to be recognized, in particular as a flexible solution with the advantages of transportability of the SNF in the event of a future need and with the option to lease the containers from suppliers.

V.3 Justification of proposal of the optimum variant

In a comprehensive assessment of variants of proposed activity from the aspect of their social, economic and environmental significance and aspect of the time effect, the variant 1 - dry SNF repository is more preferable when compared with the zero variant. Advantages of a dry repository of the spent nuclear fuel consists especially in:

- lower investment costs until start of operation of the repository,

- higher degree of modularity and adaptability to potential changes of requirements and needs of the client in the future,
- passive safety system, not requiring activity of active components,
- normal operation of a dry SNF repository will not be a source of any liquid waste or escapes of radionuclides into the air,
- lower demands and requirements for operation of the facility.

The zero variant represents preservation of current status, i.e. no spent nuclear fuel repository will be built in the SE-EMO locality. When the capacity of the ISFS in Jaslovské Bohunice will be full, the spent fuel could be stored only in the storage pools next to the reactor, until capacity of pools will be exhausted. This will ultimately result in shut-down of the EMO1,2 NPP V2 and economically would be put in doubt also the completion and then the operation of NPP EMO3,4. By the negative economic impact would suffer not only most sectors of the economy, but also the population of SR.

But in the operation will have to remain systems providing operation of the spent nuclear fuel pools (fuel pool cooling and purification systems, air-conditioning and ventilation system, system of radiation inspection and dosimetry, electric power supply, etc.). But this situation is not sustainable and the question of spent nuclear fuel handling must be resolved either by adoption of a decision on the further procedure of handling with SNF, followed by its implementation, or at the latest in the stage of operation termination, before decommissioning of a nuclear power plant.

From presented evaluation is obvious the economic and social disadvantage, eventually unacceptability of the zero variant. On the other hand, possible negative impact of the activities related to implementation of the proposed activity, e.g. impact of transport on the welfare environment, is negligible when compared to prevailing positive effects.

Activities related to implementation of proposed activity will in no one variant cause significant increase in activity of radioactive substances in gaseous and liquid discharges from the Mochovce NPP complex as a whole. It is expected that values of activity of radioactive substances released into the environment will remain below limit, even with a sufficient reserve.

There are even no grounds for concern, that during operation of the spent nuclear fuel repository will come to an unreasonable or unacceptable effect to the public health, and are also not any real reasons, that there would be a more significant deterioration of quality of individual components of the environment (see chapter IV.4).

In the course of documentation preparation have not been found any facts, that could, from an environmental aspect, prevent the construction, operation, termination and decommissioning of assessed repository. Potential negative effects of the repository on the environment in all of its components with consideration of contributory effects of operation of existing nuclear facilities, located in the aggrieved area, do not exceed limits laid down by the legislation (in particular effects related to the radiation burden of the territory).

From the aspect of the radiation burden of transport of the SNF from the Bohunice NPP complex we can say, that currently are respected all legislative requirements of the radiation protection of the population during transport of SNF from the Mochovce NPP locality to the Jaslovské Bohunice ISFS. Thanks to commissioning of the Unit 3 and 4 of EMO, effects of transport of SNF will be just minimum, thanks to expected 2/3 production of SNF in the EMO location and they will limit the aggrieved territory only to the nuclear facility complex.

With regard to the nature of given activity, as well as to position of the civil structure inside the Mochovce nuclear complex, the negative effects of technical and technological solution are demonstrated only in very limited scope. Identically may also be assessed effects related to the production of acceptable minimum quantities of created common operational waste. The technical and technological solution of the repository is optimized with regards to results of the state of current knowledge both from the area of construction and engineering technologies, and from the area of handling of the SNF.

Generally we can state, that given activity from the point of view of all assessed aspects, i.e. environmental, technical and technological, as well as the social and economic, while respecting all legislative requirements, appears to be an optimum solution of handling with the SNF in a stage of a long-term storage.

VI Maps and other Visual Documentation

All mapping and visual documentation is provided at the appropriate places of this Intention.

VIIAdditional Information to Intention

VII.1 List of Text and Graphic Documentation Elaborated for Intention and References

VII.1.1 Reports and Studies Related to the Proposed Activity

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VII.1.2 Legislation

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2. Nariadenie vlády č. 345/2006 Z. z. o základných bezpečnostných požiadavkách na ochranu zdravia pracovníkov a obyvateľov pred ionizujúcim žiarením (Government Regulation No. 345/2006 Coll. on Basic Safety Requirements to Protect the Health of Staff and the Population Against Ionizing Radiation).
3. Vyhláška ÚJD SR č. 57/2006 Z. z., ktorou sa ustanovujú podrobnosti o požiadavkách pri preprave rádioaktívnych materiálov (NRA SR Decree No. 57/2006 Coll. Laying Down Details of the Requirements for the Transportation of Radioactive Materials).
4. Vyhláška ÚJD SR č. 430/2011 Z. z., o požiadavkách na jadrovú bezpečnosť (NRA SR Decree no. 430/2011 Coll. on the Requirements for Nuclear Safety).
5. Vyhláška MZ SR č. 545/2007 Z. z., ktorou sa ustanovujú podrobnosti o požiadavkách na zabezpečenie radiačnej ochrany pri činnostiach vedúcich k ožiareniu a činnostiach dôležitých z hľadiska radiačnej ochrany (Ministry of Health Decree no. 545/2007 Coll. Laying down Details of the Requirements for Radiation Protection in Activities Leading to Irradiation and Activities Relevant to Radiation Protection).
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9. Zákon NR SR č. 355/2007 Z. z. o ochrane, podpore a rozvoji verejného zdravia a o zmene a doplnení niektorých zákonov (National Council SR Act No. 355/2007 Coll. on the Protection, Promotion and Development of Public Health and Amending Certain Acts).

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VII.2 List of Statements and Opinions Solicited to the Proposed Activity Before Intention

The Proponent solicited no statements and opinions on the proposed activity before preparation Intention.

VIII Place and Date of Intention Preparation

Place of Intention preparation: Trnava

Date of Intention preparation: June 2013

IX Confirmation of Data Correctness

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