NUCLEAR POWER PLANT MOCHOVCE
VVER 4×440 MW 3rd CONSTRUCTION

Environmental Impact Assessment Report, in compliance with act n. 24/2006 Coll.

Updated summary assessment

The assessment prepared by a person authorised according to legal regulations in the country of final destination

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SLOVENSKÉ ELEKTRÁRNE, A.S.
NUCLEAR POWER PLANT MOCHOVCE
VVER 4×440 MW 3rd CONSTRUCTION

Environmental Impact Assessment Report, in compliance with act n. 24/2006 Coll., Annex 11

REPORT

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I INTRODUCTION

Slovenské Elektrárne a.s. ("SE") has entrusted Golder (Europe) EEIG ("Golder") to undertake the preparation of the present Environmental Impact Assessment Report, in compliance with act n. 24/2006 Coll., Annex 11 for the proposed activity named "Nuclear Power Plant Mochovce VVER 4 × 440 MW 3rd construction".

The present report has been carried out after the presentation by SE of the document "**Nuclear Power Plant Mochovce VVER 4 × 440 MW 3rd construction, Intent pursuant to Act No. 24/2006 Coll." (Golder Report** 08508370478/R670, December 2008) and following the "Scope of Assessment" (No. 1277/2009 - 3.4/hp), issued by the Ministry of Environment of the Slovak Republic on 29 May 2009).

Golder has carried out the present Report also on the base of some data available from the previous environmental impact studies performed for the building authorization and licensing of Mochovce NPP.

The location of Mochovce NPP is reported in **Figure 1**.

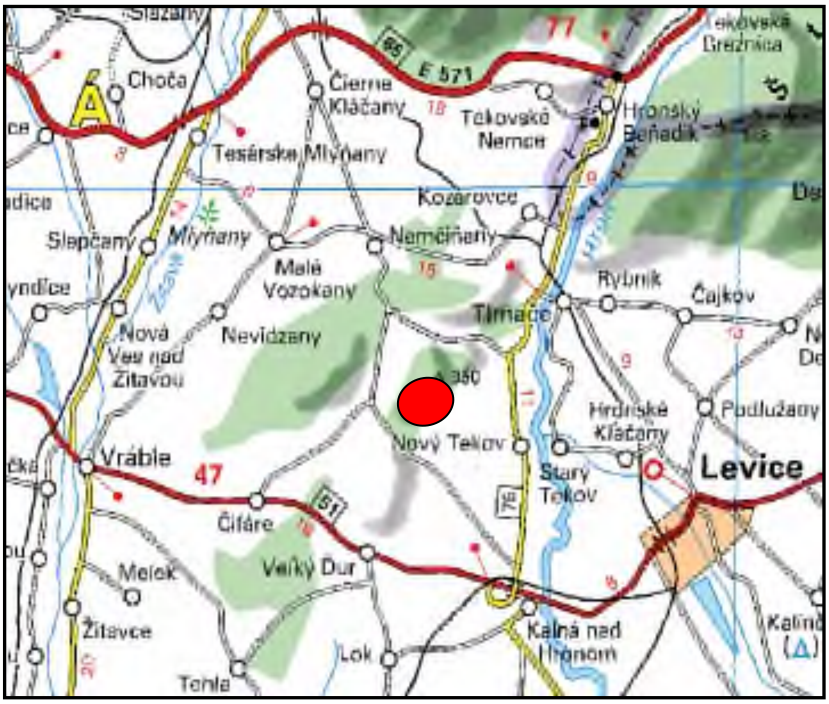


Figure 1 - General location of the site

1.0 LIST OF ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ASB	Active Service Building
AZ	Active Zone
BDBA	Beyond Design Basis Accidents
BIDSF	Bohunice International Decommissioning Support Fund
DNBR	Departure from nuclear boiling ratio
BTC	Bohunice treatment centre
BWR	Boiling Water Reactor
CCGT	Combined Cycle Gas Turbines
CED	Collective Effective Dose
CFA	Control Fuel Assemblies
CFB	Fluidized Bed combustion
CNPP	Country Nuclear Power Profile
CRCS	Central Radiological Computer System
CSKAE	Ceskoslovenska Komisia pre Atómovu Energiu (the Competent Nuclear Authority before division of Czech and Slovak Republics)
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organisation
DBA	Design Basis Accident
DCR	Dosimetry Control Room
DDO	Deferred Decommissioning Option
DGR	Deep Geological Repository
DNBR	Departure from Nucleate Boiling Ratio
EBO V1	Bohunice NPP Units 1&2
EBO V2	Bohunice NPP Units 3&4
EBRD	European Bank for Reconstruction and Development
ECC	Emergency Control Centre
ECCS	Emergency Core Cooling System
EdF	Electricité de France
EFWS	Emergency Feed Water System
EIA	Environmental Impact Assessment

EMO	Mochovce NPP
EMO12	Mochovce NPP Units 1&2
EMS	Environmental Management System
ENS	European Nuclear Society
EPCM	Engineering Procurement Construction Management
EPD	Electronic Personal Dosimeter
EPP	Emergency Planning and Preparedness
ERML	Environmental Radiation Monitoring Laboratory
ERO	Emergency Response Organization
EU	European Union
EUR	European Utility Requirements
FCC	Fibre Concrete Container
FL RWP	Final Liquid Radioactive Waste Processing
FP	Fire Prevention
GDP	Gross Domestic Product
GHG	Greenhouse gas
GPI SAS/GFÚ SAV	Geophysical Institute - Slovak Academy of Sciences
HEPA filter	High Efficiency Particulate filter
HLW	High Level Waste
HVAC	Heating, Ventilation, Air Conditioning
I&C	Instrumentation and Control
IA	Internal Announcement
IAEA/MAAE	International Atomic Energy Agency
IC	Information Support Centre
ICRP	International Commission on Radiological Protection
IDO	Immediate Decommissioning Option
IE	Initiating Events
IEA	International Energy Agency
IED	Individual Effective Dose
IEX	Ion Exchange
IFA	Independent Fuel Assemblies

IFC	International Finance Corporation
ILW	Intermediate Level Waste
JAVYS	Jadrová vyraďovacia spoločnosť (Slovak Public Company for decommissioning of NPPs)
LC	Labour Code
LLW	Low Level Waste
LOCA	Loss Of Coolant Accident
LRAWTF	Liquid Radioactive Waste Treatment Facility
LRKO	Off-site radiological control laboratory (in Levice)
LWR	Light Water Reactor
MCR	Main control room
MO34	Mochovce NPP Units 3&4
MOX	Mixed Oxide fuel (blend of plutonium and uranium oxides)
MPB	Main Production Building
MPSVaR SR	Ministry of Labour, Social Affairs and Family of the Slovak Republic
MRB	Main Reactor Building
NDT	Non Destructive Testing
NEA	Nuclear Energy Agency
NIP	National Labour Inspectorate
NNR	National Nature Reserves
NPP	Nuclear Power Plant
NSSS	Nuclear Steam Supply System
OAC	Off-site Assessment Centre
OECD	Organisation for Economic Co-operation and Development
O&M	Operation and Maintenance
OSaH	Occupational Safety and Health
OSC	Operational Support Centre
OÚ ŽP	District Authority of Environment
PAMS	Post Accident Monitoring System
PE	Polyethylene
PFD	Plant Fire Department

PIE	Postulated Initiating Events
POH	Waste Management Program
POSAR	Pre-Operational Safety Analysis Report
PPE	Personal Protective Equipment
PPMW	Personal Protective Means for Work
PSA	Probabilistic Safety Assessment
PWR	Pressurized Water Reactor
QA	Quality Assurance
RA	Radio Active
RAW	Radio Active Waste
RBS	Reactor Building Spray System
RCA	Radiation Control Area
RCS	Reactor Coolant System
RDEMO©	Standardized software that computes individual dose
RHRS	Residual Heat Removal System
RM	Radioactive Material
RP	Radioprotection
RPD	Radioprotection department
RPV	Reactor Pressure Vessel
RRWR	Republic Radioactive Waste Repository
RTARC©	Real-time accident release consequence (software for radiological forecasting)
RWP	Radiation Work Permit
S&EP	Safety and Emergency Planning
SAMG	Severe Accident Management Guidelines
SBU	Slovak Mining Office
SE	Slovenské Elektrárne
SEA	Strategic Environmental Assessment
SECC	Stand-by Emergency Control Centre
SEPS	Slovenská elektrizačná prenosová sústava (Slovak Public Company for electrical dispatching)
SG	Steam Generator

SGTR	Steam Generator Tube Rupture
SHMÚ	Slovak Hydro-meteorological Institute
SIA	Social Impact Assessment
SOD	State Technical Supervision
SPDS	Safety Parameter Display System
SR	Slovak Republic
SRAW	Solid Radioactive Waste
SS	Safety Service
SV	Safety Valve
SUBP	Slovak Occupational Safety Office
SZU	State Health Institute
TCCP	Turbine Condensate Conditioning Plant
TDS	Telodosimetric System
TLD	Thermo Luminescent Dosimeter
TSC	Technical Support Centre
TSES	The terrestrial system of ecological stability
UCTE	Union of the Co-ordinator for Transmission of Electricity
ÚJD	Úradu Jadrového Dozoru (Slovak Nuclear Regulatory Authority)
ULI	Upper Large Intestine
URD	Utilities Requirement Document
URSO	Regulatory Office for Network Industries
VEC	Valued Ecosystem Components
VVER	Vodo Vodni Energeticeskj Reaktor (Russian type pressurized water reactor)
WANO	World Association of Nuclear Operator
WENRA	Western European Nuclear Regulators' Association
WMO	World Meteorological Organization
ZRZM	Regional Interest Association of Towns and Villages Mochovce

II EIA STRUCTURE

The present EIA Report has been elaborated according to the Slovak legal provisions of the Act No. 24/2006 Coll. and the structure of the Report strictly follows the requirements of Act No. 24/2006 Coll., Annex 11 and consists of the following parts:

A. Basic Information;

I. Basic data on proponent;

II. Basic data on proposed activity;

B. Data about direct impacts of the activity on the environment;

I. Requirements for inputs;

II. Data about outputs;

C. Complete characteristics and evaluation of impacts on environment including health;

I. Delimitating of the borders of affected area;

II. Characteristics of the current state of the environment in the affected area;

III. Evaluation of the presumed impacts of the activity on the environment including health and estimation of their importance;

IV. Proposed measures for prevention, elimination, minimization and compensation of environmental and on health impacts;

V. Comparison of proposed activity with zero alternative and others;

VI. Proposed monitoring and post-design analysis;

VII. Methods used for assessment process of proposed activity on environment and methods and source of data on current environmental conditions in the area where proposed activity is to be undertaken;

VIII. Drawbacks and uncertainties in knowledge encountered during preparation of assessment report;

IX. Annexes to assessment report (diagrams, maps, tables and photographs)

X. General Final Summary;

XI. List of resolvers and organizations participating in preparation of assessment report;

XII. List of additional analytical reports and studies available at proponent used as support documents for preparation of assessment report;

XIII. Date and confirmation of correctness and completeness of data by signature (stamp) of authorized representative of elaborator of assessment report and the proponent.

In addition to the requirements of Act No. 24/2006 Coll., Annex 11, reported above, in the present section the following chapters have been included:

1. Programmatic framework;
2. Design framework.

The Report has been undertaken considering the following official documents:

- Preliminary Safety Assessment Report of Mochovce NPP, elaborated by Energoprojekt Praha (June 1984). This chapter takes into account the operation of four Units;
- Preliminary Safety Assessment Report of NPP Mochovce, elaborated by Energoprojekt Praha (March 1986);
- Safety Upgrade and Completion of Units 1 and 2 of the Mochovce Nuclear Power Plant: Environmental Impact Assessment“, elaborated by AEA Technology (November 1994);
- Environmental study of Unit 3 and 4 of NPP Mochovce elaborated by VUJE Tranava a.s. (November 2004);
- Nuclear Power Plant Mochovce VVER 4 × 440 MW 3rd construction, Intent pursuant to Act No. 24/2006 Coll.”, elaborated by Golder (December 2008).

The studies elaborated by Energoprojekt Praha in 1984 and 1986 were carried out in order to get the required authorization for the siting and construction of Mochovce NPP, Units 1 and 2 and Units 3 and 4.

The study elaborated by AEA Technology in 1994 was carried out in connection with a submission by the Slovak national power utility Slovenský energetický podnik (SEP) for financial support to facilitate the upgrading and completion of Units 1 and 2 of the Mochovce NPP.

Environmental study by VUJE Trnava a.s. from 2004 was elaborated on a voluntary basis only for internal use.

Answers to the specific requirements posed in the Scope of Assessment ("SoA") issued by Ministry of Environment of Slovak Republic can be found in the present Report according to the cross-reference matrix reported in Table 1.

Table 1 - cross-reference matrix SoA-EIA Report

SoA chapter	Requirements' description	EIA Report chapter
2.2.1	In part **II. Basic data on the proposed activity, item** 4. Location - to add (to describe the location of the complex of the nuclear installation of NPP Mochovce – dual unit of NPP MO 3&4 – region, district, cadastral area of the municipality, land plot, parcel numbers, property sheets).	A.II.4 *Basic data on the proposed activity - Location*
2.2.2	In part **II. Basic data on the proposed activity, item 14. Permitting authority** to add also the type of required permit for the proposed activity according to special regulations.	A.II.14 *Basic data on the proposed activity – Approving authority*
2.2.3	Add the list of abbreviations in Part A. INTRODUCTION or in part B. STRUCTURE OF THE REPORT.	I.1 *List of abbreviations*
2.2.4	To complement and precise the chapter Geology and seismology – with regard to the fact that in the new manual of the IAEA - Evaluation of seismic hazards for nuclear installations, DS422, which is currently undergoing the commenting procedure by the member states of the IAEA, art. 2.12 (page 6) mentions the minimal recommended value for the maximal horizontal acceleration on the terrain surface (PGA) for the new projects JZ 0.15 g, which is higher than the original recommended value of 0.10 g, which remains to be valid for the existing nuclear installations. In the event that the new recommended value of SL-2 applies for NPP Mochovce, 3rd project, then we are suggesting adjusting the wording on page 40 of the Intent, the last sentence in the meaning that the adopted value of PGA 0.15 g for NPP Mochovce 3rd project results also from international recommendations and it is not only a result of a conservative approach to setting the seismic level SL-2 for NPP Mochovce, 3rd project.	C.II.2.3 *The probability calculation of seismic risk at the Mochovce NPP*
2.2.5.	To complement chapter ***Surface water***...with the description of sediments – what kind of sediments, which form approx. 50% of the captured volume in the water reservoir Veľké Kozmálovce, due to documenting the yield of the service water source.	C.II:6.1 *Water conditions - Surface water*
2.2.6	To precise chapter on Energy sources (p. 70 of the Intent). Numerical data on generated/consumed electricity to be reviewed or confirmed (482.976 MWh is not 1.07% from the total generated energy per year).	B.I.4 *Energy sources*

SoA chapter	Requirements' description	EIA Report chapter
2.2.7	To make adjustments in the chapter ***– Emergency plans***: *Para 1* - Legislation governing emergency planning for the case of incident or accident of a nuclear installation does not include a notion of external and internal emergency plans – to be modified; - To complement the scattering model for forecasting radiation in the atmosphere; *Para 2, first indent* - Committee of the Government of SR - not existing – to be corrected, Para *2, first indent* *Para 2, second indent* - There are no regional emergency committees – to be corrected; - i.e. there are no regional administrative bodies, regional authorities – to be corrected; - Plans for protecting the public (these are external emergency plans or some other plans) are not approved by the head of regional authority and are not agreed by UJD – to be corrected; *Para 3* - Official abbreviation of the organization of emergency response is not ERO – to be corrected; *Para 4* - The main roles of the organization of emergency response are not in compliance with the legislation – to be corrected;	C.IV.4.2 *Measures in case of accidents – Emergency Plan*
2.2.8	To evaluate the impacts of the future operation of NPP EMO 3&4 on the surrounding environment in a complex manner focusing primarily on the assessment of increase of the risk for the inhabitants living in the vicinity resulting from commissioning of MO3&4, in the risk, which the population is facing due to the existence of nuclear installations, which are already in operation in the given location - NPP EMO 1&2 (including the operation of the final processing of liquid radwaste (FS KRAO) and the National Repository of Radwaste (RU RAO). So to prove that the expected impact relating to the proposed activity is negligible and with this rationale to defend the request of the Proponent to abandon the alternative solution for the "Nuclear Power Plant Mochovce VVER4x440 MW 3rd project".	C.III.1 *Impacts on population* A.II.9 *Alternatives of the proposed activity*
2.2.9	Chap. *V. Comparison of alternatives for the proposed activity and the proposal of an optimal alternative, part: Protection from ionizing radiation, physical protection and emergency planning*, p. 108 – the second paragraph mentions national regulatory authority – to give the name of this authority.	II.2.10.3 *Release of liquid effluents in normal operation - Permit to discharge liquid radioactive substances into the environment*

SoA chapter	Requirements' description	EIA Report chapter
2.2.10	Chap. *V. Comparison of alternatives for proposed activity and the proposal of the optimal alternative, part Protection against ionizing radiation, physical protection and emergency planning*, p. 109 – the last indent, if there is an agreement on mutual cooperation, it should state a concrete number of such agreement, the title and the date from when it is effective (or will be effective).	C.V *Comparison of alternatives of proposed activity and the proposal for optimal alternative*
2.2.11	Chap. *V. Comparison of alternatives of proposed activity and the proposal for optimal alternative, part Conclusion,* p. 111 – The text below this title is too brief and unclear. For example, it includes a very non specific reference to part IV of the Intent, which however has 41 pages. The conclusion should be formulated in a clear and unambiguous way, comprehensibly and if necessary, it should be supported by concrete references to the preceding text.	C.V *Comparison of alternatives of proposed activity and the proposal for optimal alternative*
2.2.12	**To state the list of authors of the assessment report (the responsible researcher, project manager, research team) by names and not to present the authors of the Intent only in a form of illegible signatures.**	C.XIII *Date and confirmation of correctness and completeness of data by signature (Stamp) of authorized representative of elaborator of assessment report and the proponent*
2.2.13	To state the latest possible information about the current status of the environment. To complement up-to-date data on average monthly air temperatures, to evaluate the air stability. To complement the temperatures of the Hron stream before the discharge and after the discharge of cooling water from the power plant. To give an overview of radioactive burden of measured values from 24 monitoring stations - TDS, which monitor the environmental burden. To complement the results from the monitoring stations monitoring the seismology values of the affected area.)	Annex 4.2 *The Report on Monitoring of Radioactivity in the SE – EMO Environment for the years 2005, 2006, 2007 and 2008*
2.2.14	To incorporate the balance review of the Hron river from the profile of the planned water works Slatinka until the estuary while taking into consideration the existing permitted offtakes of surface water and the expected demands for offtake of water relating to the planned activities in the area of interest with the aim to preserve the minimal ecological flows below the water works Kozmálovce while having required offtake after commissioning of NPP MO34.	C.II:6.1 *Water conditions - Surface water*

SoA chapter	Requirements' description	EIA Report chapter
2.2.15	To review whether the operation of the nuclear power plant NPP MO 3&4 would have a negative impact on the flow and the quality of water in the Hron river below the VN Veľké Kozmálovce or not. If the assessment procedure demonstrates negative impact of operation of the proposed activity on the ecosystem of Hron as a result of low residual flow rates caused by the water offtake, the measures for elimination of such negative impacts must be defined as forced investments relating to implementation of NPP MO34.	C.II:6.1 *Water conditions - Surface water*
2.2.16	To complement information relating to historical records of more significant floods on the Hron river. The last year recorded as having floods was year 1981. To complement assessment of occurrence of floods currently, potentially for the past period.	C.II:6.1 *Water conditions - Surface water*
2.2.17	To make an assessment how the situation would be resolved if the Slovak Water Management Company, state enterprise, the branch office Banská Bystrica, as the administrator of water structure Veľké Kozmálovce would be unable to secure supply of surface water necessary for after-cooling of reactors of EMO 1,2,3,4, due to decline in the usable reservoir storage VS Veľké Kozmálovce down to 50% and in case of longer-term deficit inflows below Q_{364} = 9,233 $m^3.s^{-1}$. Because the administrator of VS must secure objective need in this section representing minimal flow in the profile VS Veľké Kozmálovce in the amount of cca 11 $m^3.s^{-1}$ corresponding to Q_{355} of the daily water (currently there is a temporary decision and due to construction of EMO there is a minimal flow rate set at the profile of VS Veľké Kozmálovce at 6.6 $m^3.s^{-1}$) so it is necessary to review this situation and to suggest relevant measures due to increased offtake of cooling water expected for NPP MO 3&4, in order to prevent increase in the balance tension in relation to the minimal residual flows, which would be environmentally not sustainable. During the period of minimal flows on the Hron river this may cause inability to cover the water needs for other users and their regulation and also to tension with respect to the quality of surface water in the problematic indicators, such as $N\text{-}N0_3^-$, $N\text{-}NH_4^+$, or the water temperature. To propose other alternative for cool down of reactors of EMO 1,2,3,4 for example system of air cooling.	C.II:6.1 *Water conditions - Surface water*
2.2.18	To complement the part *Basic data on the proposed activity* - data on sources of pollution. It should include date on the expected activity of discharges into the atmosphere and to surface water during normal operation, including operational conditions on the level of operational limits (in particular limits for leakages in the tightness of fuel cover, leakages in the primary and the secondary circuits).	II.2.9 *Release of airborne effluents in normal conditions* II.2.10 *Release of liquid effluents in normal operation*

SoA chapter	Requirements' description	EIA Report chapter
2.2.19	To respect that the annual balance limit for waste water discharged to surface waters for the tritium activity has already been drawn by the operation of NPP EMO12 on the level of 60-80 % and for operation of four units it would be necessary to adjust the limit. The tritium in waste water represents a dominant path for exposure of a critical group of the population living in the vicinity.	B.II.2 *Wastewater*
2.2.20	To complement also more details on the systems of cleaning of gaseous and liquid waste before they are discharged, more details on the monitoring systems monitoring their activity and on the possibilities of controlling discharges and coordination of discharges with the first dual unit of MO.	II.2.6.2 *Ventilation system and treatment of gaseous and airborne wastes* II.2.6.3 *Basic principles of liquid RAW processing and treatment*
2.2.21	In *part C, chapter III, item 1. – Impact on the population* – to complement results of model evaluation of impacts of discharges to the dosage load on the population in the vicinity. The models should evaluate not only discharges on the level of current values of discharges (according to Units 1 and 2 of NPP EMO12), but also discharges on the level of expected limits for units 3 and 4 - NPP MO34, potentially location limits.	C.III.1 *Impacts on population*
2.2.22	In the analyses to state also partial contributions of individual paths of radiation and to take in regard also the radionuclide, for which there are no limits set, for example C -14 in air pollutants.	Annex 4.1 *The Assessment of the Radiological Impact of the Radioactive Discharges from Operation of 4 Reactors NPP Mochovce*
2.2.23	Within assessment of impacts with trans-boundary effect to assess at least the burden on the critical group of the population abroad. Although it is expected that the radiation exposure would be very low, it is still necessary to prove it with a model calculation, the statement that the impact of the proposed activity abroad would be negligible is perceived as insufficient in this case. In connection with this it can be expected that according to article 37 of the EURATOM Treaty the European Commission would require relatively detailed information on trans-boundary influences of the proposed activity.	C.III.1.5.3 *Impacts on population - Radiation doses to members of the public - Conclusions*

SoA chapter	Requirements' description	EIA Report chapter
2.2.24	In *part C, chapter III, items 4 to 6* – to assess and elaborate in more details influences on water ratios, soil and air, so that the proposed activity could be sufficiently reviewed.	C.III *Evaluation of anticipated impacts of the proposed activity on the environment, including health*
2.2.25	In *part C, chapter III, item 19* – to complement operational risks with the analysis of operational risks and a model evaluation of the influence of selected extraordinary events – accidents – on the environment and radiation exposure of the population. To state the measures for prevention and for potential consequences in case of an accident including leakage of radioactivity.	II.2.4.8 *MO34 Safety improvements*
2.2.26	In part *C, chapter IV. – Measures* - to analyze in more details in particular technical, technological and operational measures for prevention, elimination, minimization and compensation of impacts on the environment, compared to the existing units of NPP EMO12 also in connection with the original design of NPP MO34. To also state all modifications on structural and technology parts compared to the originally approved design (for example, measures to strengthen the main supporting civil structures and technology should respect latest available information on seismic characteristics NPP Unit 3 and 4 removal of structural parts containing asbestos, etc.) and to assess the condition of the existing engineering structures and technology equipment from the time of their conservation until the present time.	II.2.4.8 *MO34 Safety improvements* II.2.2 *Project description*
2.2.27	To complement the list of individual types of waste, which are created during the construction of NPP MO34 itself together with the estimation of their quantity and the method of handling, including waste, which is suitable for repeated discharge into the environment – to waste dumps, etc. (In compliance with the Decision of the Nuclear Regulatory Authority of SR No. 246/2008, which states the building, demolition and reconstruction works, during which replacement of several equipment and materials is going to take place according to the relevant consent from the District Environmental Office Levice).	A.II.2 *Basic data on proposed activity - Purpose*
2.2.28	To state the quantitative and qualitative data on inputs and outputs of realized activity and to propose monitoring of pollutants together with measures for elimination of their negative impact.	B.I *Requirements on inputs* B.II *Data on outputs*

SoA chapter	Requirements' description	EIA Report chapter
2.2.29	To assess impacts on the environment and the health of people and to suggest measures for their elimination not only during the phase of construction and operation, but also in the phase of decommissioning and liquidation of these units, also these influences to be reviewed in a complex manner from the view of their significance and the time development of the review. (Austria, as the affected party, requests in its position to review and to establish the ratio of diseases, such as thyroid diseases and leukemia, which could be provably caused by radioactivity while securing possibility to establish consequences of operation on the health of population in the affected area).	A.II.2 *Basic data on proposed activity – Purpose* C.III *Evaluation of anticipated environmental impacts of proposed activity, including health*
2.2.30	To state what method would be used to address safety issues in replacing the spent fuel, to state the method of its transportation to the interim storage, to the repository, as well as the method of its disposal from the material and timing point of view. To complement data on storage of spent nuclear fuel. (To finalize the part on radioactive waste management originating from NPP MO34. To complement data on handling high radioactive nuclear fuel, the data on the quality and the capacity of the interim storage of spent nuclear fuel; to specify solutions necessary for securing storage of this high radioactive hazardous material.)	II.2.5 *Fuel*
2.2.31	To describe the method of sludge disposal, this is produced when disposing with the waste water as part of the activity; to state the method of sludge storage, as well as data on its quantity and quality.	II.2.6.3 *Basic principles of liquid RAW processing and treatment* II.2.6.6 *Disposal from radioactive waste installations* II.2.10.4 *Radioactive liquid effluents*
2.2.32	To assess influences of the activity on the health of people according to selected demographical and health indicators of the population living in the vicinity of the Nuclear Source Mochovce, including social and economic consequences and the context, disturbing relax and quality of life and acceptability of the activity for the affected inhabitants while using results from the current evaluation of the health condition of the population living in the vicinity of NPP Mochovce prior commissioning and during operation of Units 1&2 and expected development after commissioning of Units 3&4.	C.III.1.6 Impacts on population - Assessment of impacts on human health

SoA chapter	Requirements' description	EIA Report chapter
2.2.33	In connection with assessment of the impact of activity on the environment and the health of people to propose measures for their elimination not only during the phase of construction and operation, but also during the phase of decommissioning and liquidation of these units, and these influences to be reviewed in a complex manner from the view of their significance and the time development of the assessment.	A.II.2 *Basic data on proposed activity – Purpose* C.III *Evaluation of anticipated environmental impacts of proposed activity, including health*
Requests of the Republic of Poland as the affected party in the trans-boundary assessment		
2.2.34	To take in regard aspects of nuclear safety for the proposed activity, this is related to provision of detailed data relating to the method and procedure for intervention and information in case of severe accident (Accident Response).	II.2.4.8 *MO34 Safety improvements*
Requests of the Republic of Hungary as the affected party in the trans-boundary assessment		
2.2.35	To complement data documenting how Units 3&4 of nuclear power plant Mochovce would meet maximal standard of nuclear safety valid at present	II.2.4.8 *MO34 Safety improvements*
2.2.36	To complement information about how the requirements for design-base a beyond design-base accidents have been addressed. To set the limits for leakage from hermetic areas (design tightness) as well as what other safety measures are available (for example the system of localization of the accident, the spraying system, system of burning hydrogen) and what preventive effects these measures may have in case of leakage from the primary circuit.	II.2.4.8 *MO34 Safety improvements*
2.2.37	To prove how the power plant is prepared for an earthquake, this may occur in the area with respect to the seismic sensitivity of the area.	C.II.2.3 *The probability calculation of seismic risk at the Mochovce NPP*

SoA chapter	Requirements' description	EIA Report chapter
2.2.38	To complement information about discharges, as well as about their characteristics and distribution possibilities and on the basis of meteorological information from the location to define the territory of influence of the proposed activity.	II.2.9 *Release of airborne effluents in normal conditions* II.2.10 *Release of liquid effluents in normal operation* C.III.1.5 *Impacts on population - Radiation doses to members of the publics*
2.2.39	To state how the spent fuel would be handled and what would be the influence of spent fuel on the environment during the entire life cycle of the fuel.	II.2.5 *Fuel*
2.2.40	To prove safety of operation of the nuclear power plant also by how the spent fuel is being handled and what would be the influence of the spent fuel on the environment during the entire life cycle of the fuel.	II.2.5 *Fuel*
2.2.41	To describe in details a well functioning monitoring network. To consider possibility of access by official Hungarian authorities responsible for prevention of damages to the on-line system of measuring radioactivity in the vicinity of the nuclear power plant Mochovce in Slovakia.	C.II.17.1 *Monitoring of Radioactivity in the Environment*
	Requirements of Austria as the affected party in the trans-boundary assessment	
2.2.42	To describe in significantly greater detail the equipment and the conditions of its operation.	II.2.1 *Overview of EMO12 operational background* II.2.2 *Project description* II.2.3 *Description of the process* II.2.4 *Description of the main systems*

SoA chapter	Requirements' description	EIA Report chapter
2.2.43	To complement information on nuclear fuel and on conditions of its use (the type, enrichment, the quantity, number and condition of fuel elements), as well as conditions for operation and the period of employment in the reactor (fuel burn-up time).	II.2.5 *Fuel*
2.2.44	To describe radwaste management and discharges and their impact on the environment.	II.2.6 *Radioactive and non radioactive waste management* II.2.9 *Release of airborne effluents in normal conditions* II.2.10 *Release of liquid effluents in normal operation*
2.2.45	**To confirm or to defeat the consideration in the Intent to increase the output by nearly 22%. (While the thermal output of the reactor (primary circuit) is stated the same as in the original design on the level of 1,375 MW, the electric output is reported as 535 MW gross.)**	II.2.3 *Description of the process*
2.2.46	To specify the detailed technical descriptions of planned changes in the primary and secondary circuits. To describe in details significant changes compared to the originally approved design with the emphasis on the safety aspect, as stated by Golder (2008, page 100 of the Intent). To analyze improvements in the realized activity, this should be documented with appropriate results from the safety analysis. To pay special attention to the following topics in particular, as these have extraordinary importance from the safety aspect, not only in connection with potential trans-boundary impacts (BT 2008): ✓ Severe accidents (to state the measures for preventing and mitigation of consequences); ✓ Improved tightness of Hermetic zones and realization of systems for locating design accidents – bubbler tower system (Confinement and the bubbler tower system); ✓ Potential seismic threat on the location; ✓ Integrity of the reactor pressure vessel; ✓ Reliability according to the control system (I&C criteria).	II.2.4.8 *MO34 Safety improvements*

SoA chapter	Requirements' description	EIA Report chapter
2.2.47	To explain, why the maximal horizontal acceleration was increased to 0.15 g in connection with the fact that the activity is realized in a seismic area.	C.II.2.3 *The probability calculation of seismic risk at the Mochovce NPP*
2.2.48	To assess resistance of nuclear installation against external events, such as malice aircraft collision.	I.1.6.4 *Duties towards the European Commission under the Euratom Treaty*
2.2.49	To assess solution of the realized activity in the area of fire protection compared to the original design and to describe how the deficits conditioned by the original design of the proposed activity have been resolved (recommendations of the IAEA 1999).	II.2.13 *Non nuclear malfunctions and accidents*
2.2.50	To describe the permitting procedure and expected periods in the next step according to Act No. 24/2006 Coll. l. on environmental impact assessment and the Act No. 541/2004 Coll. l. on peaceful use of nuclear energy (Atomic Act).	I.1.4 *Permits related to the Act on EIA* I.1.5.4 *Commissioning of the nuclear installation and its operation*
2.2.51	To describe the status of insurance for the case of accident (financial coverage for nuclear damage in Slovakia) ✓ DBA - design-base accidents ✓ BDBA - beyond design-base accidents	I.1.6.1 *International treaties and obligations – Nuclear Third Party Liability*
2.2.52	To add other relevant comments and recommendations from the position of Austria.	
2.2.53	To perform thorough analysis of all other comments resulting from the positions of the parties to the assessment procedure by the party of origin, and also the affected parties submitted on the Intent according to the national law, the Espoo Convention and the Bilateral Agreement between Austria and the Slovak Republic. Justified comments from the positions to be incorporated in the assessment report.	

1.0 PROGRAMMATIC FRAMEWORK

1.1 Slovak Electricity Market and Regulatory Environment

The specification and operation on the Slovak electricity market is regulated in particular by the Act No. 656/2004 Coll. on Power Industry (Energy Act) and the Decree No. 317/2007 Coll. issued by the Government, which defines the rules for operation of the electricity market (Market rules).

In the mid of 2007 the distribution companies unbundled the trading from the distribution in line with the EP and EC Directive No. 2003/54/ES and at the same time in July 1, 2007 the households have become eligible customers on the market. After these steps the electricity market in Slovakia has become liberalized.

Major market players influencing the electricity market are:

- **Slovenská elektrizačná prenosová sústava (SEPS)** – the transmission system operator (TSO) and deviation clearing agent. SEPS ensures reliable operation of the transmission system and cross-border interconnection. SEPS is a state owned company;

- **Západoslovenská energetika (ZSE), Stredoslovenská energetika (SSE), Východoslovenská energetika (VSE)** - the unbundled regional distribution companies perform the function of system operators and also as electricity traders; and

- **Slovenské Elektrárne** – major producer of electricity and provider of ancillary services on the market.

Major state authorities responsible for the regulation of the electricity market in Slovakia are Ministry of Economy and Regulatory Office for Network Industries (URSO).

Ministry of Economy is responsible for formulation of Energy policy, issuing of authorisation for building up new power plants, approval of Regulatory policy and implementation of EU legal provisions concerning energy market into the national legal framework.

URSO defines regulatory framework and policy in power industry, heating industry, gas industry and water supply industry. The aims of regulation policy are reflected in the Decrees which lay down the extent of price regulation, scope and structure of eligible costs, execution methodology and determination of reasonable profit.

The electricity market is divided in non regulated and regulated activities. The non regulated activities include the purchase and sale of electricity. The distribution companies and eligible customers usually purchase the electricity from producers and electricity traders through auctions and on the basis of bilateral relations.

The major regulated activities include electricity transmission, distribution and provision of system and ancillary services. The way of regulation is defined by the Act No. 276/2001 Coll. on Regulation of network industries amended by later provisions (Regulation Act) and amendments (Act No. 397/2002 Coll., Act No. 442/2002 Coll. and Act No. 658/2004 Coll.).

1.2 Development of power system in Slovakia

1.2.1 Demand - Development of Electricity Consumption

Electricity consumption forecast is based on analysis of macroeconomic indicators characterized by development and structure of Gross Domestic Product (GDP), development of energy intensity in individual economic sectors as well as demographic changes in the country.

Since 1990´s, electricity consumption has been characterized by the stagnation or a slight decline despite of the fast growth of the country economy. In the 2000-2008 period there was a moderate continuous increase in total electricity consumption with an average annual growth of 0.9% while an average growth of GDP was 6.2% in the same period.

Aforementioned correlation between the development of electricity consumption and GDP growth in Slovakia does not correspond to the relation that is characteristic for developed EU countries with a stable economy where the average growth of electricity consumption roughly corresponds to GDP growth. The reason of this inconformity in Slovakia was mainly restructuralization of the national economy and reduction of its energy intensity.

In 2006 gross consumption in the Slovak Republic reached the level of 29,625 GWh, that compared with 2005 brings an annual growth of 3.7%, almost half of the GDP growth.

In the year 2007 the gross consumption did not change in comparison with the year 2006 and was at the level of 29,632 GWh. Nevertheless the net consumption in 2007 increased by 1.0% and reached 27,446 GWh. This discrepancy was caused by reduction of the system own consumption due to shut down of 440 MW in EBO V1 (relatively large source with substantial self consumption). In 2008 the gross consumption represented 29,830 GWh that shows 0.7% increase in comparison with previous year. The stagnation in 2007 and slight growth in 2008 could be explained by GDP growth driven by less energy intensive sectors, restructuring of electricity production portfolio, and spread of financial and budding economic crisis at the end of year 2008.

In the short-mid term period the escalation of world wide economic crisis, negatively affecting the demand expectations, is envisioned.

With respect to what mentioned above, the resulting long term **Reference scenario** shows modest growth of electricity consumption that corresponds to an average annual increase of **1.28%** during 2008-2020 period.

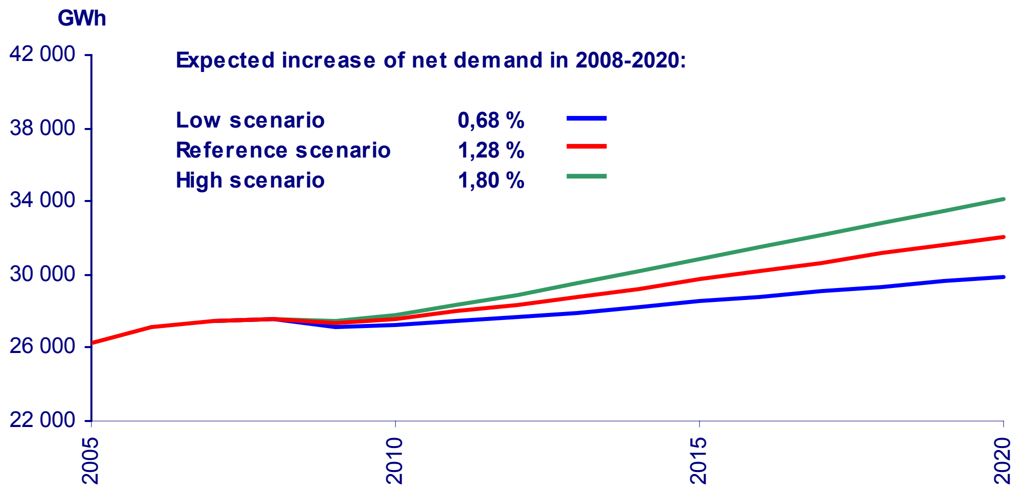


Figure 2 - Net Electricity Demand Forecast in Slovakia
(Source: SEPS, SE analyses)

1.2.2 Supply - Development of Installed Capacities

Production sources of the Slovak electricity system with total installed capacity of **7,453 MW** in 2008 can be divided according to producers into three basic categories: Slovenské elektrárne, **JAVYS**, Vodohospodárska Výstavba (**VV**) and independent producers.

Slovenské elektrárne is the largest electricity producer with an installed capacity of 4,811 MW in 2008 with a share of 64.6% of the total capacity of the Slovak Republic.

Second category, **JAVYS** and **VV**, represents state owned companies created by carve-out process, which after shut down of first unit of EBO V1 (440 MW), have installed capacity of 1,186 MW and 15.9% share (as the second unit of EBO V1 was shut down on December 31, 2008, recent contribution of state owned companies represents 746 MW, 11% share).

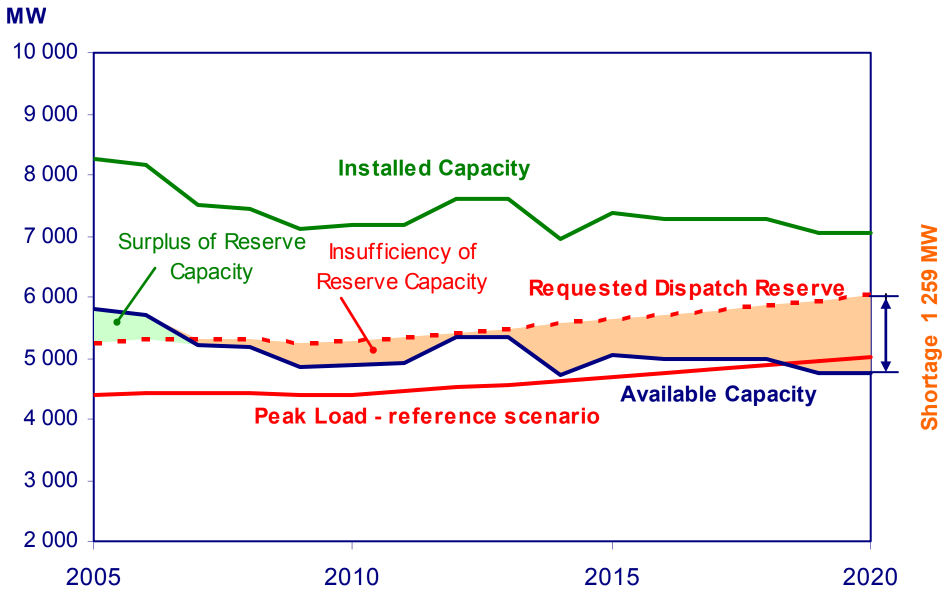
Third category, **independent producers**, is represented by heating plants, industrial plants and co-generation plants with a combined electricity and heat generation as well as other independent producers (hydro power plants, renewable resources) with a total installed capacity of 1,456 MW. The contribution of independent producers to the total volume of installed capacity of the Slovak Republic represents 19.5%.

1.2.3 Reliability of Electrical System

Scenario without MO34

The development of installed and available capacity and the development of maximum system load, in line with the SE reference scenario of electricity consumption in the Slovak Republic, are shown in Figure 3.

The analysis shows that, without putting new considerable production sources as MO34 into operation, after 2007 it has been difficult (and it will be always more difficult) to ensure a sufficient capacity reserve necessary for safe operation of electricity network.

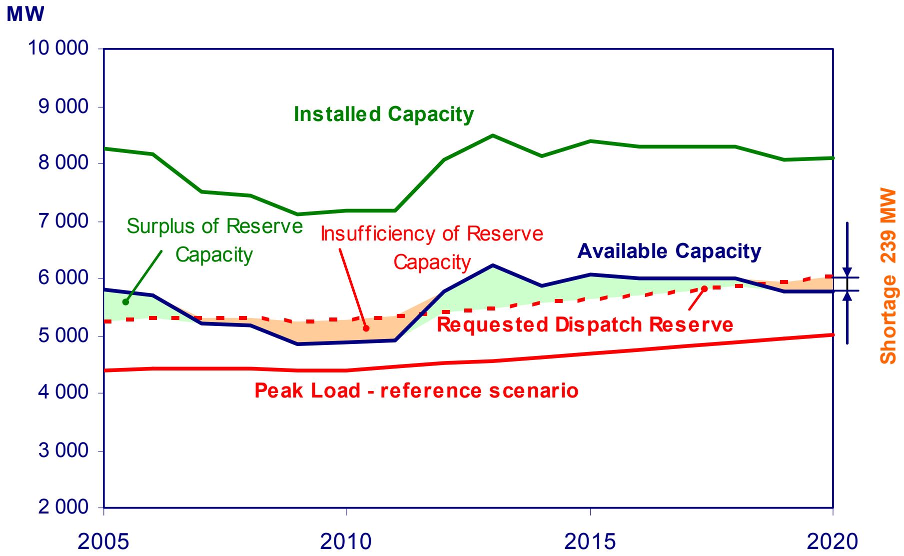


Note: Available Capacity includes EMO12 and EBO Uprates and construction of new sources in 2013 and 2015 reaching some 830 MW in total

Figure 3 - Reliability of Electrical System in Slovakia without MO34
(Source: SE analyses)

Scenario with MO34 completion

The effect of MO34 completion on Slovak electricity system is illustrated in Figure 4. The analysis of available power in the period of annual maximum system load shows that the MO34 has substantial positive effect to the system stability in comparison to scenario without MO34 where electricity imports would have to be significantly higher.



Note: Available Capacity includes MO34, plus EMO and EBO Uprates and construction of new sources in 2013 and 2015 reaching some 830 MW in total

Figure 4 - Reliability of Electrical System in Slovakia with MO34
(Source: SE analyses)

1.2.4 Evaluation of Electricity Market in Slovakia

In 2008 Slovakia generated 29,309 GWh of electric energy while the import represented 521 GWh. The net production in the same year was 27,018 GWh.

The outlook of net electricity generation from 2009 to 2020 is based on forecasted development of installed capacity in the Slovak Republic. According to structure of sources the resulting forecast till 2020 is reported in Figure 5.

After the shutdown of two old nuclear units in Bohunice (V1) Slovak Republic has become an importer of electricity. The shutdown of Bohunice Nuclear Power Station V1 is a consequence of the political decision taken during the negotiation of the Preaccession Treaty with the EU. The Slovak Republic committed to shutting down two units of the Nuclear Plant V1 Bohunice, in the period 2006-2008. With the shutdown of these two units, the total capacity of NPPs has been reduced by 880 MW.

In 2007 Slovakia ceased to be an exporter and became an importer; such condition will continue until putting appropriate capacity substitution into operation. Taking into account current status and viability of new potential investments, MO34 will be probably the only equivalent substitution for closed power plants. Based on current schedule of MO34 construction, Slovakia will be dependent on electricity import at least until 2013.

Figure 5 shows that the electricity supplies from completed MO34 would be sufficient to make the SR a minor exporter during the 2013-2019 period.

In addition to this investment, it is also expected that some new projects with capacity in the vicinity of 400 MW will arrive in the medium-term horizon.

Consequently the export capacity of Slovakia will increase in dependence on these expected potential projects.

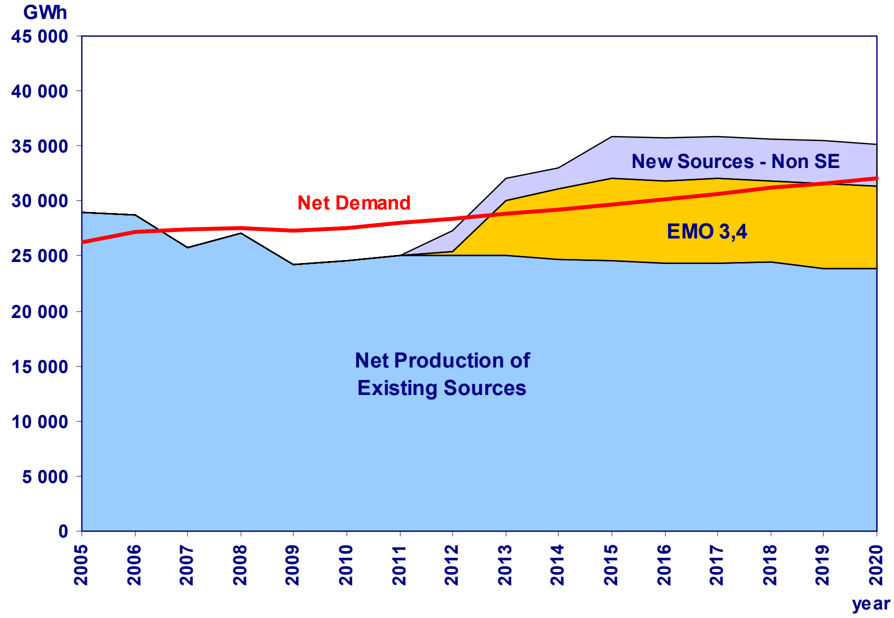


Figure 5 - Net Demand and Net Production Forecast in Slovakia
(Source: SE analyses)

1.3 EIA law framework

The EIA Directive (85/337/EEC) on Environmental Impact Assessment of the effects of projects on the environment was introduced in 1985 and was amended in 1997 (97/11/EC). Member States had to transpose the amended EIA Directive into their own legislation by 14 March 1999 at the latest.

The primary purpose of the EIA Directive was to introduce general principles for the assessment of environmental effects, with a view to supplementing and coordinating development consent procedures governing public and private projects likely to have a major effect on the environment. As Member States at that time generally had a national EIA regime, the EIA Directive also undertook to harmonize and to set common standards for the principles of EIA, for the main obligations of the developers and for the content and scope of the assessment of these projects throughout the EU. The key principle of the EIA Directive is that development consents for public and private projects, which are likely to have significant effects on the environment, should be granted only after a prior assessment of the likely significant environmental effects of these projects has been carried out.

This assessment must be conducted on the basis of the appropriate information supplied by the developer, which may be supplemented by the authorities and by people who may be concerned about the project in question.

The history of EIA in the SR dates back to 1992, when the Environment Act was adopted (effective as of 16 February 1992). This contained very general rules for the assessment of environmental impacts of certain projects. The federal Environment Act contained only a very brief framework and it relied on the adoption of future implementing legislation at the national levels of the Czech Republic and the SR as provided for the Environment Act (the National Implementing Legislation). The National Implementing Legislation was expected to regulate the EIA process, and to provide further details and time periods within which EIA compliance should be secured. However, for various reasons (one of which may be the division of Czechoslovakia) the National Implementing Legislation has never been adopted. With effect from 1 September 1994, a new legislation regulating EIA applied with the Old EIA Act, which repealed all provisions of the Environment Act regarding EIA. Act No. 127/1994 on EIA was published in April 1994 and came into force in September 1994. The Slovak Ministry of the Environment has confirmed that this Act does not apply to projects for which the licensing process began prior to its entry into force.

With effect from 1 February 2006, the EIA Act was adopted, fully repealing and replacing the Old EIA Act. As stated in the governmental justification report for the new legislation, the primary cause for its adoption was significant changes in the requirement for strategic environmental assessment (SEA) of programme or activities of strategic importance. The EIA for projects is very similar to the procedure under the Old EIA Act, but with certain deadlines being shortened. There are no major deviations from the principles regarding EIA for individual projects as set out in the Old EIA Act.

In Figures 6 and 7 are schematically illustrated respectively the main players and the likely planning of the EIA process for the Project.

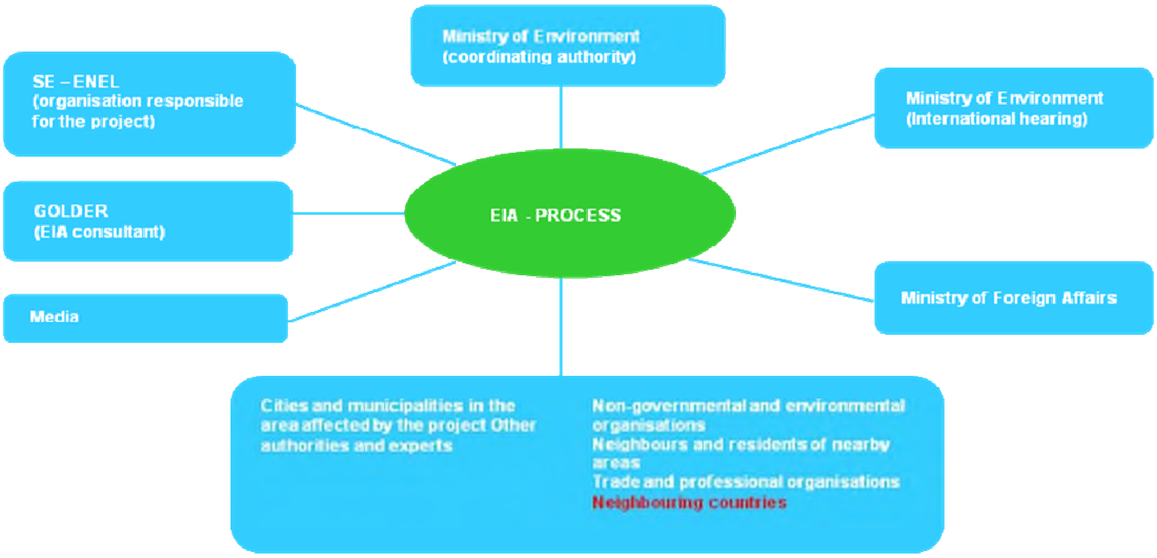


Figure 6- Main players of Mochovce NPP EIA

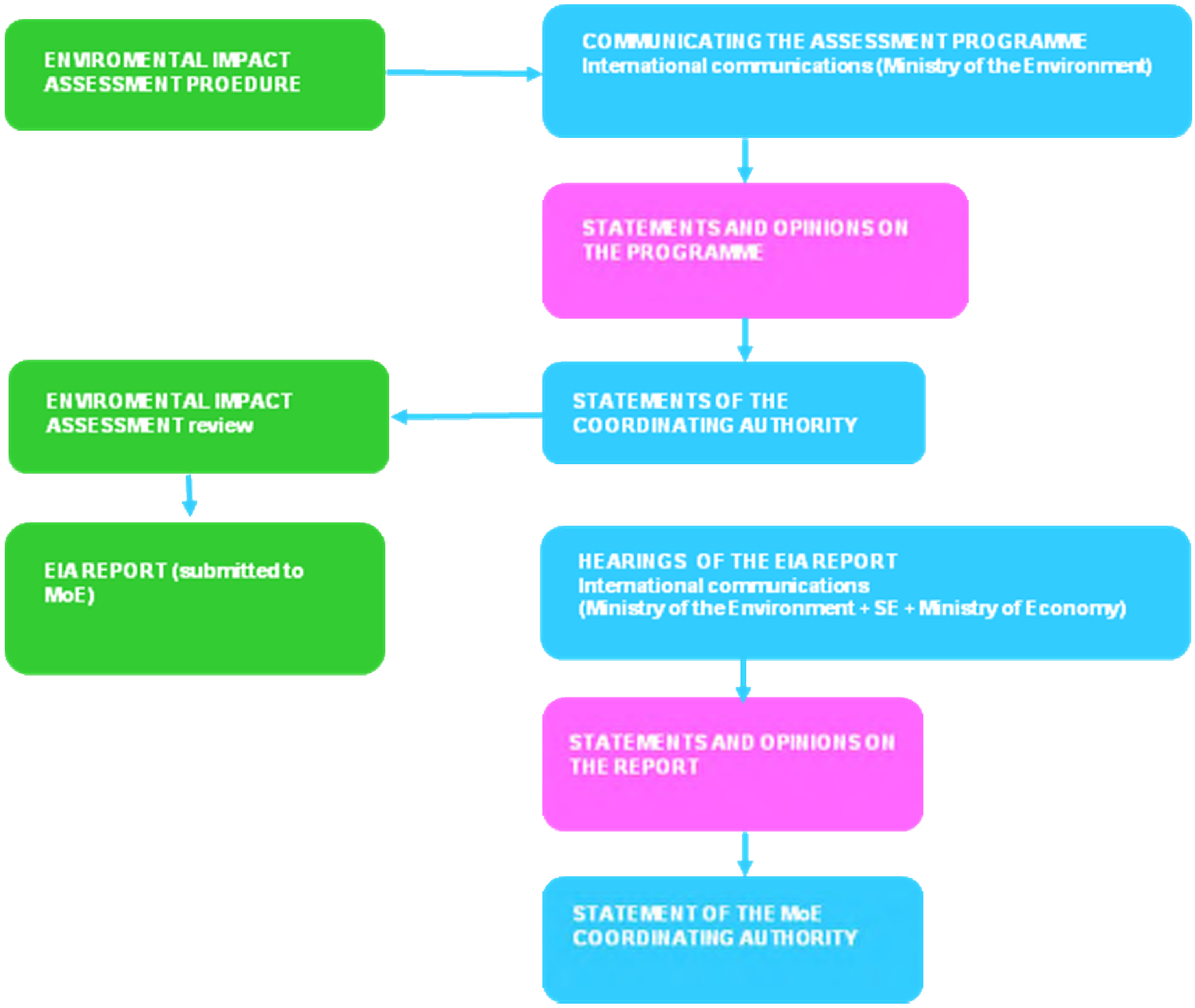


Figure 7- Likely planning of Mochovce NPP EIA process

1.4 Assesment process in accordance with the Act on EIA

SE, a.s. as the „Proponent“ in accordance with Section 31 of the Act NR SR No. 24/2006 Coll. on the environmental impact assessment will submit EIA Report to the Ministry of Environment and consequently, in collaboration with the concerned municipality (Kalná ^{n}/ Hronom) will arrange the public hearing and consultation day. Commenting process of the EIA Report for departmental authority, authority concerned and permitting authority takes 30 days in accordance with the Act NR SR No. 24/2006 Coll. from the day of delivery of the EIA Report and similarly, the public can make comments within 30 days from the day of submission of the Non-technical Summary. The development process of expert opinion on the proposed activity continues consequently and it takes 60 days. The expert opinion shall always include a proposal of the final statement arising from the assessment of the proposed activity. Ministry of Environment as competent authority conjointly with Public Health Authority shall elaborate and submit the final statement on the activity within 20 days from the day of delivery of the expert opinion. After elaborating the final statement for the proposed activity, this shall be delivered to the departmental authority, permitting authority, authority concerned, concerned municipality and concerned public, and it will be valid for 3 years.

The final statement will be attached to the letter of application for authorisation for commissioning by the „Proponent“ in compliance with the Atomic Act.

1.5 Decisions and authorisations pursuant to particular regulations

Land use planning methodically and comprehensively solves the functional use of land. It specifies principles of its organization and material and temporal coordination of construction and other activities that affect the development of the land.

Land use planning implies the safeguarding of the long-term harmony of the natural and cultural value of the land. In particular regarding environmental care and protection of its main components - land, water and air:

- it specifies land use areas;
- it regulates the functional and spatial disposition of the land;
- it specifies necessary remediation, reconstruction or recultivation of the land and the method of its further utilization;
- it defines protected land, buildings, tranquil areas and protection zones, should it not be determined pursuant to special legislation otherwise, and ensures the protection of all protected land, buildings, tranquil areas and protection zones;
- it specifies principles and conditions of material and temporal coordination, localization of the construction of one or more buildings;

- it assesses and evaluates the territorial engineering consequences of the planned construction and other land measures and proposes the basic scale of the construction and measures that provide its full utilization;
- location of the construction, it specifies territorial engineering, urban and architectonic principles of the planned solution and performance;
- it proposes the use of sources and reserves of land incorporating the most effective urban development;
- it creates a background for the creation of the concept of the construction and technical lay-out of the land;
- it proposes the sequence of the construction and use of the land; and
- it proposes the territorial engineering and organizational measures leading to the achievement of the optimal use and layout of the land.

Key phases for the operation of Mochovce NPP are:

- land use procedures and land use decision; and
- operational authorization.

1.5.1 Land Planning

According to the provisions of the Building act, land use planning documents are required for all new or substantially modified constructions. This documentation provides a description of the planned development for the relevant land. Relevant land use planning documents for Mochovce NPP were approved in Levice by the district planning office prior to the construction work decision being made.

Land use planning documents are binding as soon as they are approved by the competent authority. All significant alterations to the binding document on land use planning must be ratified by the body that originally approved this document. It is not assumed that alterations at the Mochovce NPP relating to safety upgrades would require amendments to the existing approved planning documents. The construction of a new facility will be liable to the approval requirements of the land use planning process.

On the basis of the approved land use planning documents, a land use decision must be issued prior to starting the construction work.

This phase in the planning process was carried out in various land use decisions issued between October 1980 and January 1982. The initial safety report was also approved.

1.5.2 Land Planning Decisions

The Land Planning Decisions for the entire Mochovce NPP were issued in the early 1980s by the District National Committee (okresný národný výbor) in Levice as follows:

a) Land Planning Decision No. Výst. 3865/1980 dated 22 October 1980, final and conclusive as of 7 November 1980;

b) Land Planning Decision No. Výst. 2044/1981 dated 10 July 1981, final and conclusive as of 24 July 1981;

c) Land Planning Decision No. Výst. 3818/81 dated 28 January 1982, final and conclusive as of February 1982.

The above Land Planning Decisions approve the construction of the Mochovce NPP within the specified territory, and are referred to in the Construction Authorization. The Land Planning Decisions are still valid.

1.5.3 Construction Authorizations

Authorizations for the launching of the construction were issued by Levice environmental office between March 1983 and November 1986 based on the various phases of the overall construction design. These permits were issued with the approval of the former Czechoslovakian atomic energy commission on the basis of an initial safety report. The issued construction license requires written approval of other state bodies.

Construction and operational authorizations were granted with the approval of the offices of regional hygiene, occupational health and safety inspectorate, district fire protection office, the telecommunication directorate and the civil protection body.

Construction Permit No. Výst. 2010/86 for MO34 was issued by the District National Committee in Levice on the basis of the Land Planning Decisions on 12 November 1986, and it became final and conclusive on 28 January 1987. The deadline for completion of MO34, as an individual condition, set out in the original Construction Permit has been extended as follows:

a) initially, until 31 December 2005 by the Regional Authority in Nitra No. 97/02276-004 dated 5 May 1997; and

b) finally, until 31 December 2011 by a Decision of the Regional Construction Authority in Nitra No. 2004/00402-007 dated 15 July 2004, becoming final and conclusive as of 3 August 2004.

Recently, the Nuclear Regulatory Authority (ÚJD SR, which, according to the Atomic Act 541/2004, is also the Building Authority for Nuclear Installations), by means of its Decision No. 246/2008 dated 14th August 2008, has set as a binding condition for the proposed activity, to complete the construction by 31st December 2013 (thus extending the validity of the Construction Permit for Completion of MO34).

Construction and operation permits for railway branch

MO34 is connected to a railway branch. The construction of the railway branch to serve MO34 is covered by the railway construction permit No. 1987/08_ŠSU/J-Vg issued by the Railway Administration Authority in Bratislava on 16 June 2008.

Construction and use permits for electrical interconnection

On 27 June 2005 ÚJD issued the permit No. 189/2005 for the construction of electrical interconnection with the operational site. The construction was completed and the use permit was issued by the ÚJD on 17 February 2006 under No. 48/2006, becoming final and conclusive as of 10 March 2006.

1.5.4 Commissioning of the nuclear installation and its operation

Commissioning process of a nuclear installation is divided into different phases and the operation of nuclear installation is divided into trial operation and operation. The commencement of the commissioning and operation of nuclear installation requires separate permission by NRA in accordance with Section 5, item 3, letter b) and c) and in accordance with Section 19 of Act No. 541/2004.

The application process, as in case of building permission, combines the supervision regime of Atomic Act and Building Act. Application of Building Act for commissioning of nuclear installations is caused by the fact, that the Building Act regulates not just the equipment construction, but also approval process for use of construction for assumed activities.

Commissioning according to Section 19 of the Atomic Act

The commencement of the commissioning of a nuclear installation shall mean loading of the first fuel assembly into the nuclear reactor. Authorisation for commencement of the commissioning of a nuclear installation is deemed to be an authorisation limited in time which will be superseded by the permission for the trial operation (and permission for temporary use of construction for the trial operation purposes) and consequently the house inspection for construction.

The application for commencement of the commissioning must be submitted to NRA and contains the following information:

a. information set forth in Section 6 and 7(4-6, 8-9, 11, 12, 13, 14) of the Atomic Act;

b. information set forth in Appendix 1, point C, of the Atomic Act;

c. information set forth in the legally binding Regulations (of the NRA Regulation);

d. information required under Section 83 of the Construction Act and Section 17 of the Ministry of Environment Regulation No. 453/2000 Coll. ; and

e. final statement of Ministry of Environment, The NRA shall issue the authorisation for commencement of the commissioning within six months from submission of a complete application (Section 8(6)(c) of the Atomic Act). Before the commencement of commissioning, SE would be required to submit to the NRA an on-site emergency plan for its approval (Section 28(8) of the Atomic Act). The on-site emergency plan deals with protection arrangements inside and outside of the nuclear installation in order to minimise and mitigate negative effects in case of a potential nuclear accident. The requirements for content and structure of the on-site emergency plan are set forth in the NRA Regulation No. 55/2006 Coll. on emergency planning. The plan has to be assessed by the Ministry of Health which may submit its comments. The comments, if any, have to be incorporated into the on-site emergency plan and then submitted to the NRA together with the assessment of the Ministry of Health. The plan must be submitted to the NRA no later than eight months before the intended commencement of the commissioning.

Trial operation according to Section 19 of the Atomic act

The permission for trial operation in compliance with the Atomic Act shall be granted together with the issue of permission for the temporary use of construction for trial operation in compliance with Section 19 (6) of Atomic Act and Section 84 of Building Act. Trial operation shall enable the NRA to assess the competence of nuclear installation to operate for intended purpose. The NRA as well as other relevant bodies (municipalities) may set forth conditions of trial operation.

The NRA issues trial operation permission for nuclear installation based on application containing the following:

a. report on evaluating the commencement of commissioning of nuclear installation, which shall be prepared in accordance with the legally binding Regulations (NRA Regulations); and

b. information required pursuant to Section 84 of the Construction Act and Section 17 of the Ministry of Environment Regulation No. 453/2000 Coll.

After successful completion of the testing phase, SE may apply for the authorisation to operate the nuclear installation.

Operation according to Section 19 of the Atomic act

Authorisation for operation of nuclear installation allows to use the nuclear installation for intended purpose (House Inspection under Section 19(7) of the Atomic act and 84(3) of the Construction act). Application for authorisation to operate the nuclear installation must contain the following information:

a. information required by Section 6 and 7 (4-6, 8, 9, 11, 12, 14) of the Atomic Act;

b. report evaluating the trial operation prepared pursuant to the legally binding Regulations (of the NRA Regulation);

c. information required by legally binding NRA regulations;

d. information required by Section 84 (3) of the Construction Act and Section 17 of the MoE Regulation No. 453/2000 Coll.

Other authorisations

The following authorisations cover some activities related to the actual commissioning of the nuclear installation:

- Nuclear materials treatment inside and outside the nuclear installation pursuant to Section 12 of the Atomic act;
- Import and export of nuclear and special materials and installations pursuant to Section 14 of the Atomic act;
- Shipment of radioactive materials pursuant to Section 15 of the Atomic act;
- Shipment of radioactive waste pursuant to Section 16 of the Atomic act;
- Professional competency of employees pursuant to Section 24 of the Atomic act.

1.5.5 Authorization for operation

According to the Slovak Atomic Act No. 541 of 9 September 2004, the authorization for operation shall be issued by the ÚJD. In order to be authorised to use (operate) the facility MO34, an operational authorization would have to be issued in accordance with the relevant provisions of the Atomic Act.

Before the start of the commissioning, an authorization holder would be required to submit to the ÚJD an on-site emergency plan for its approval (Section 28(8) of the Nuclear Act). The prerequisites of the on-site emergency plan are set forth in the Regulation of the ÚJD No. 55/2006 Coll. on details in an emergency planning for the event of an incident or an accident. The Plan has to be assessed by the Ministry of Health which may submit its comments. The comments, if any, have to be incorporated into the on-site emergency plan and then submitted to the ÚJD together with the assessment of the Ministry of Health.

The permission for trial operation in compliance with the Atomic Act shall be granted together with the issue of permission for the temporary use of construction for trial operation in compliance with Section 19 (6) of Atomic Act and Section 84 of Building Act. Trial operation shall enable the NRA to assess the competence of nuclear installation to operate for intended purpose. The NRA as well as other relevant bodies (municipalities) may set forth conditions of trial operation.

The NRA issues trial operation permission for nuclear installation based on application containing following:

(a) report on evaluating the commencement of commissioning of nuclear installation, which shall prepared in accordance with the legally binding Regulations (NRA Regulations); and

(b) information required pursuant to Section 84 of the Construction Act and Section 17 of the Ministry of Environment Regulation No. 453/2000 Coll.

After successful completion of the testing phase, SE may apply for the authorisation to operate the nuclear installation.

First authorization for operation is valid for 8 years and after its termination can be renewed, after the submission of “Periodic safety evaluation” to NRA. Consequently the renewed authorization for operation is valid for the period of 10 years.

Besides the abovementioned documents required by the ÚJD, there are other documents that have to be provided. The Slovak Public Healthcare Authority issues a list of "decisions" and “permits” in the field of protection against ionizing radiation, pursuant to the Public Healthcare Act. These “decisions” and “permits” are independent of the authorisations issued under the Nuclear Act, but it will be required to obtain them in addition to any authorisation issued under the Nuclear Act. The permits are issued for a period of five years, and may be extended for another period of equal length.

In Table 2 a list of Slovak regulatory framework is reported.

Detailed lists of Basic Nuclear laws and Basic Energy Laws are reported in Annex 0.7 and Annex 0.8 respectively.

Table 2 - List of regulatory framework

Year	*No. Coll.*	*Title*	*Amendment*	*Repeals*	*Implemented EU legal text*
1998	**109/1998**	**Consolidated text of the Act** of the National Council of the Slovak Republic No. 50/1976 Coll. on landscape planning and on building code (the Building Act)	175/1999 237/2000 416/2001 553/2001 217/2002 103/2003 245/2003 417/2003 608/2003 541/2004 290/2005 479/2005 24/2006		
1998	**262/1998**	**Consolidated text of the Act** of the National Council of the Slovak Republic No. 145/1995 Coll. on administration fees	232/1999 3/2000 142/2000 211/2000 468/2000 553/2001 96/2002 118/2002 215/2002 237/2002 418/2002 457/2002 465/2002 477/2002 480/2002 553/2002 217/2003 245/2003 469/2003 450/2003 583/2003 5/2004 199/2004 204/2004 347/2004 382/2004	• **320/1992** in the wording of 181/1993; 58/1995 • **321/1993**	

Year	No. Coll.	Title	Amendment	Repeals	Implemented EU legal text
			434/2004 533/2004 541/2004 572/2004 633/2004 653/2004 656/2004 725/2004 5/2005 8/2005 15/2005 93/2005 171/2005 308/2005 331/2005 341/2005 342/2005 473/2005 491/2005 538/2005 558/2005 572/2005 573/2005 610/2005 14/2006 15/2006 24/2006 117/2006 124/2006 126/2006 224/2006 342/2006 672/2006 693/2006 21/2007 43/2007		

Year	*No. Coll.*	*Title*	*Amendment*	*Repeals*	*Implemented EU legal text*
2000	**453/2000**	Decree of the Ministry of Environment of the Slovak Republic implementing certain provisions of the Building Act No. 50/1976 Coll.			
2001	**575/2001**	Act on organization of the Governmental activities and on organization of the central state administration	143/2002 411/2002 465/2002 139/2003 453/2003 523/2003 215/2004 351/2004 405/2004 585/2004 654/2004 78/2005 172/2005 474/2005 231/2006 678/2006	• **347/1990** in the wording of 197/1991, 298/1991; 494/1991 294/1992 322/1992 453/1992 2/1993; 61/1993 83/1994; 293/1999. 195/2000; 329/2000; 338/2000; 417/2000; 136/2001; 241/2001	
2004	**302/2001**	Act on the Self-Government of higher territorial units (Self-Governing Regions Act)			
2004	**215/2004**	Act on protection of secret information and on amendments of certain acts	638/2005 255/2006	• **241/2001** • **432/2001** • **455/2001** • **2/2002** • **28/2002** • **88/2002** • **89/2002** • **90/2002** • **91/2002 Coll.**	

1.5.6 SR Public Health Authority condition for operation

According to the Decision No. 000ZPZ/6274/2006 of Public Health Authority of the Slovak Republic, starting from 2 November 2006 the conditions for operation of EMO12 foresee the observance of the following limits:

- yearly limit activity of radionuclide in emissions:

a) radionuclide of noble gases (random mixture): 4.1×10^{15} Bq;

b) iodine radioisotope ^{131}I (total gaseous and aerosol forms): 6.7×10^{10} Bq;

c) radionuclide mixture (except ^{131}I) in aerosol (with half-life of 8 days): 1.7×10^{11} Bq;

- yearly and volume activity limits of radionuclide activity in wastewater:

a) tritium 1.2×10^{13} Bq;

b) other radionuclides (except tritium) 1.1×10^{9} Bq;

- reference levels:

a) investigation level for releases to atmosphere:

   i) radionuclide of noble gases (random mixture) 1.1×10^{13} Bq/day;

   ii) iodine radioisotope - ^{131}I (gaseous form) 1.8×10^{8} Bq/day;

   iii) radionuclide mixture in aerosol 0.5×10^{9} Bq/day;

b) interference level for release to atmosphere:

   i) radionuclide of noble gases (random mixture) 5.5×10^{13} Bq/day;

   ii) iodine radioisotope - ^{131}I (gaseous form) 9.0×10^{8} Bq/day;

   iii) radionuclide mixture in aerosol 2.5×10^{9} Bq/day;

c) investigation level for releases to wastewater:

   i) tritium volume activity 3.0×10^{4} Bq/l;

   ii) volume activity of other radionuclides (except tritium) 40 Bq/l;

d) interference level for release to wastewater:

   i) tritium volume activity 1.0×10^{5} Bq/l;

   ii) volume activity of other radionuclides (except tritium) 40 Bq/l;

other requirements are:

- continual monitoring:

a) total bulk activity of noble gas radionuclides, total bulk activity of aerosol and bulk activity of iodine radioisotopes ^{131}I in gaseous form, in gas emissions;

b) total bulk activity of gamma radionuclides in wastewater;

- dose loads for balancing and evaluation:

a) activity to be monitored in gaseous emissions:

   i) noble gas radioisotopes ^{41}Ar, ^{85}Kr, ^{85m}Kr, ^{87}Kr, ^{88}Kr, ^{133}Xe, ^{133m}Xe and ^{135}Xe;

   ii) radioisotopes in aerosol ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{57}Co, ^{58}Co, ^{60}Co, ^{65}Zn, ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{106}Rh, ^{100m}Ag, ^{124}Sb, ^{134}Cs, ^{137}Cs, ^{141}Ce and ^{144}Ce, ^{238}Pu, $^{239+240}Pu$, ^{241}Am;

   iii) iodine radioisotope ^{131}I (total gaseous and aerosol forms);

   iv) tritium;

   v) carbon radioisotope ^{14}C in organic and inorganic form;

b) activity to be monitored in wastewater:

   i) radionuclides ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{57}Co, ^{58}Co, ^{60}Co, ^{65}Zn, ^{89}Sr, ^{90}Sr, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{106}Rh, ^{100m}Ag, ^{124}Sb, ^{134}Cs, ^{137}Cs, ^{141}Ce and ^{144}Ce, ^{238}Pu, $^{239+240}Pu$, ^{241}Am;

   ii) tritium.

The permit is valid until 1 November 2011 and similar permission will be necessary also for the operation of units 3 and 4.

1.5.7 Terrestrial system of ecological stability

The terrestrial system of ecological stability (TSES) legally categorizes the evaluation of the state of the landscape (in particular their biotic formation). The basic TSES documents are the **General supraregional TSES for Slovakia** (1992), regional TSES documentation for the former Slovak districts (1993-1995) and the National Ecological Network of Slovakia (1996).

In the Slovak Republic several methods are used for evaluation of environmental (ecological) quality of the territory and their positive and negative factors. All of these methods have markedly regional dimensions and differentiate the territory of the Slovak Republic from the point of view of various criteria. As yet there is still the lack of an integrated viewpoint on the issue which would evaluate the following three basic approaches together - evaluation of negative factors (terrestrial system of stress factors), evaluation of positive factors (TSES framework) and a broad evaluation of the impacts of the positive and negative factors (environmental regionalization, level of ecological stability used in the TSES.

The territorial system of environmental stability (TSES) is embedded in Act 543/2003 Coll. on nature and landscape protection in a purely declarative form.

It means that if there is any ecologically valuable countryside segment included as the major element of a TSES document, the above mentioned legislation does not define any thresholds nor does it set and duties to perform any action.

A large territorial unit plan for the Nitra region was approved in a governmental decree of the Slovak Republic issued in 1998, as a regional TSES.

The following significant regional bio-centres were defined: Stiavnicke vrchy, NPR Horsianska dolina and the oak tree forests including NPR Patianska cerina. Regionally significant bio-corridors include the Hron, Podluzianka and Sikenica.

Recently local TSES projects were conducted within the framework of the land planning documentation conducted for some of the cities situated in this area. These include suggestions for the measured needed to be taken to maintain and increase the ecological qualities of major TSES elements.

These cities and towns are: Pohranice, Ladice, Dolne Obdokovce, Velka Lapas, Maly Lapas, Vrable, Zlate Moravce, Topolcianky, Tesarske Mlynany, Kozarovce, Rybnik, Cajkov, Nova Dedina, Zemberovce, Brhlovce, Levice, Hronske Kosihy, Hronske Klacany, Novy Tekov, Maly Cetin, Cechynce, Travnica, Bardonovo, Podhajska, and Horna Sec.

1.6 International treaties and obligations

1.6.1 Nuclear Third Party Liability

There are two basic international regimes for nuclear third party liability in force: the Convention on Third Party Liability in the Field of Nuclear Energy ("the Paris Convention") was established on 29 July 1960 under the auspices of the NEA and covers most West European countries, while the Convention on Civil Liability for Nuclear Damage ("the Vienna Convention") was established on 21 May 1963 under the auspices of the International Atomic Energy Agency (IAEA) and is worldwide in character.

In September 1997, government took a significant step forward in improving the liability regime for nuclear damage. At a Diplomatic Conference at IAEA Headquarters in Vienna, 8-12 September 1997, delegates from over 80 States adopted a Protocol to amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage and also adopted a Convention on Supplementary Compensation for Nuclear Damage. The Protocol sets the possible limit of the operator's liability at not less than 300 million Special Drawing Rights (SDRs) (roughly equivalent to 400 million US dollars).

The Convention on Supplementary Compensation defines additional amounts to be provided through contributions by States Parties on the basis of installed nuclear capacity and UN rate of assessment.

The Convention is an instrument to which all States may adhere regardless of whether they are parties to any existing nuclear liability conventions or have nuclear installations on their territories. The Protocol contains inter alia a better definition of nuclear damage (now also addressing the concept of environmental damage and preventive measures), extends the geographical scope of the Vienna Convention, and extends the period during which claims may be brought for loss of life and personal injury. It also provides for jurisdiction of coastal states over actions incurring nuclear damage during transport. Taken together, the two instruments should substantially enhance the global framework for compensation well beyond that foreseen by existing Conventions.

Slovak National Council expressed agreement with joining the Vienna Convention on civil liability concerning damages caused by nuclear event by its resolution No. 71 dated January 25, 1995 and the president of the Slovak Republic approved it on February 23, 1995.

Before the action in September 1997, the international liability regime was embodied primarily in two instruments, i.e. the Vienna Convention on Civil Liability for Nuclear Damage of 1963 and the Paris Convention on Third Party Liability in the Field of Nuclear Energy of 1960 linked by the Joint Protocol adopted in 1988. The Paris Convention was later built up by the 1963 Brussels Supplementary Convention. As reported in IAEA's documents International Conventions & Agreements, the Conventions are based on the civil law concept and share the following main principles:

- Liability is channelled exclusively to the operators of the nuclear installations;

- Liability of the operator is absolute, i.e. the operator is held liable irrespective of fault;
- Liability is limited in amount;
- Liability is limited in time. Compensation rights are extinguished under both Conventions if an action is not brought within ten years from the date of the nuclear incident. Longer periods are permissible if, under the law of the installation state, the liability of the operator is covered by financial security. National law may establish a shorter time limit, but not less than two years (the Paris Convention) or three years(the Vienna Convention) from the date the claimant knew or ought to have known of the damage and the operator liable;
- The operator must maintain insurance of other financial security for an amount corresponding to his liability; if such security is insufficient, the installation State is obliged to make up the difference up to the limit of the operator's liability;
- Jurisdiction over actions lies exclusively with the courts of the Contracting Party in whose territory the nuclear incident occurred; and
- Non-discrimination of victims on the grounds of nationality, domicile or residence.

In Slovak Republic compensation for nuclear damage is covered by general regulations on liability for damage, e.g. Sections 415 to 450 of the Civil Code [Act No. 40/1964 Zb., as amended], except as otherwise stipulated in the act or an international agreement to which the Slovak Republic is bound [Section 26(2)]. In fact, the Act contains very detailed provisions on third party liability for nuclear damage, which largely reflect the provisions of the 1963 Vienna Convention on Civil Liability for Nuclear Damage. The Slovak Republic acceded to the Vienna Convention and the 1988 Joint Protocol on the Application of the Vienna Convention and the Paris Convention on 7 March 1995 (OECD, 2001).

Recently NRA of the SR based on the Governmental Resolution No. 880/2008 submitted to Slovak Governmental Legislative Committee draft proposal of new act on civil liability of nuclear damage and its financial coverage. Draft proposal of a new Act is in full compliance with Slovak Constitution, constitutional laws, international conventions and other international documents that are binding for Slovak Republic.

1.6.2 The Comprehensive Nuclear-Test-Ban Treaty (CTBT)

The Slovak Republic signed the Comprehensive Nuclear-Test-Ban Treaty on September 30, 1996 and ratified the treaty on March 3, 1998. The Government of Slovakia authorised the chairman of UJD to guarantee, according to Art. III of the Treaty, performance of the function of the National Authority. In co-operation with the Ministry of Foreign Affairs, Ministry of Defence and the Slovak Academy of Sciences objectives resulting mainly from the plenary sessions of the Preparatory Commission for the Treaty Organisation and from the meetings of their working groups were provided. UJD actively contributed to the On-Site International Inspection Operational Manual

1.6.3 Convention on Nuclear Safety

The Convention on Nuclear Safety was adopted on 17 June 1994 by a Diplomatic Conference convened by the International Atomic Energy Agency at its Headquarters from 14 to 17 June 1994.

The Convention was drawn up during a series of expert level meetings from 1992 to 1994 and was the result of considerable work by Governments, national nuclear safety authorities and the Agency's Secretariat. Its aim is to legally commit participating States operating land-based nuclear power plants to maintain a high level of safety by setting international benchmarks to which States would subscribe.

Slovakia has been the first state in the world with nuclear power plant in its territory to ratify the Convention on Nuclear Safety.

The obligations of the Parties are based to a large extent on the principles contained in the IAEA Safety Fundamentals document "The Safety of Nuclear Installations". These obligations cover for instance, siting, design, construction, operation, the availability of adequate financial and human resources, the assessment and verification of safety, quality assurance and emergency preparedness.

The Convention is an incentive instrument. It is not designed to ensure fulfilment of obligations by Parties through control and sanction but it is based on their common interest in achieving higher levels of safety which will be developed and promoted through regular meetings of the Parties. The Convention obliges Parties to submit reports on the implementation of their obligations for "peer review" at meetings of the Parties to be held at the IAEA. This mechanism is the main innovative and dynamic element of the Convention.

Up to now three review meetings on the Convention on Nuclear Safety have taken place.

International (Multilateral and Bilateral) Agreements on Nuclear Power, affecting the SR, updated on November 2005, are listed by IAEA in the technical publication of Country Nuclear Power Profile (CNPP).

The preparation of CNPP was initiated within the framework of the IAEA's programme on assessment and feedback of NPP performance. It responded to a need for a database and a technical publication containing a description of the energy and economic situation, the energy and the electricity sector, and the primary organizations involved in nuclear power in IAEA Member States. The CNPP covers background information on the status and development of nuclear power programmes in countries having nuclear plants in operation and/or plants under construction. It reviews the organizational and industrial aspects of nuclear power programmes in participating countries and provides information about the relevant legislative, regulatory and international frameworks in each country.

Slovakia is also party to Convention on radioactive Waste and Spent Fuel.

1.6.4 Duties towards the European Commission under the Euratom Treaty

Under EU laws, some activities pertaining to nuclear facilities have to be communicated to the European Commission of the Directorate-General Energy and Transport (DG-TREN). According to Article 41 of the Euratom Treaty, entities have to communicate investment projects relating to new installations and also to replacements or conversions which fulfil the criteria as to type specified in Annex II of the Euratom Treaty.

As far as concerns MO34, the communication has been transmitted to the Commission on July the 16th 2007, and the main stages of the process can be summarized as follows:

- First Communication as per Art. 41 from Slovenské Elektrárne (SE) to European Commission (DGTREN General Director): Communication on Completion of Unit 3 and 4 Mochovce NPP, Slovak Republic (16/7/2007);
- Feedback from EC through the Acknowledgment of Communication on Completion of Unit 3 and 4 Mochovce NPP, Slovak Republic (1/8/2007);
- Requests for supplementary information by EC and replies by SE (21/9/2007 - 8/2/2008);
- DGTREN site visit (10/3/2008);
- Further information provided by SE after requests raised during the site visit (9/4/2008);
- DGTREN communicates to SE the conclusion of information acquisition process and the start of the evaluation process for the European Commission Opinion issue (28/4/2008); and
- European Opinion and Recommendation issue. Viewpoint of EC in accordance with Art. 43 ET) (15/7/2008).

On July 15, 2008, in accordance with Article 43 of the Euratom Treaty, the European Commission of the Directorate-General Energy and Transport (DG-TREN) issued its positive viewpoint on the completion of MO34 after debating it within an internal Commission working group which has discussed all the aspects of the Mochovce 3&4 Investment Project which relate to the objectives of the Euratom Treaty.

The positive viewpoint about the completion of the Units 3 and 4 of the Mochovce NPP has been then transmitted to the concerned Member States and stakeholders.

In its viewpoint, the Commission acknowledges that the Project aims at meeting future additional national and regional demand for low-carbon electricity and that the new Units will help to ensure a stable supply of electricity at predictable prices for consumers, thus contributing to develop a diverse energy mix in the whole region.

As far as the completion activities are concerned, the Commission also notes that for the equipment already on-site, Slovenské Elektrárne has implemented the strategy on preservation and protective works in compliance with IAEA guideline "Management of delayed NPP projects" (TECDOC 1110), with the relevant Slovak regulations and under the supervision of the Slovak National Regulator UJD. This comprehensive strategy for reuse of existing components allows for their appropriate safe storage and conservation. Moreover the equipment has been subjected to a deep assessment consisting of a multi-stage process of inspections and/or examinations aimed at verifying its compliance with the new basic design requirements.

For the brand-new equipment, suppliers will be carefully selected according to the construction time schedule.

The Commission stresses the importance of diversification of supply sources into the aspect of secure supply of nuclear fuel for the whole EU nuclear industry as well as a correct management of decommissioning funds, and is informed that the fuel supply will be diversified to the extent technically achievable and that Slovenské Elektrárne already adheres to the State Fund for the decommissioning of the Nuclear Power Plants that has been established in 1995 and amended in 2006 in Slovakia; thus guarantying, at the end of the Plant's life, availability of adequate financial resources for the decommissioning of the nuclear installation along with the spent fuel and the radioactive waste.

The Commission remarks that Slovenské Elektrárne duly and effectively applies both national regulations as well as recognised international best practice when dealing with nuclear safety issues, nonetheless, the viewpoint includes also recommendations for the next stages of the project, pointing out that the "Investor, in close collaboration with the National Authorities", should:

- *"develop a reference scenario including a deterministic impact from an external source (e.g. an impact of a small aircraft) in agreement with international best practice;*
- *evaluate and implement on this basis appropriate additional features, functional capabilities and management strategies to withstand a potential deterministic impact from an external source (e.g. a small malevolent aircraft impact) into the design basis of the proposed investment, bringing the design in line with the existing best practices."*

In August 2008 the above recommendations were converted by the Nuclear Regulatory Authority of Slovakia (UJD) as binding conditions for the MO34 licensing process.

It has to be pointed out that the original design of the plant already shows a high level of resistance against aircraft impact, mainly because of the structural features of the most important buildings of the plant. In fact, many systems primarily important for nuclear safety are located in a containment featuring reinforced-concrete walls up to 1.5m thick, for which a remarkable resistance against external and internal events can be expected. In addition, the containment is housed in a building which is further shielded by surrounding civil structures less important from a nuclear-safety point of view.

However, in order to comply with the UJD requirement, additional, in-depth analyses of the actual plant resistance against the crash of a small aircraft had to be done. For this purpose, a general methodology has been developed by Slovenské Elektrárne and preliminary concurred with UJD.

According to this general methodology, the following main activities had to be performed:

- postulation of the reference small aircraft;
- **specification of the plant "external-event safety functions" which have to be ensured after a crash;**
- **identification of the plant systems** available for the fulfilment of such safety functions;
- **identification of the bounding impact scenarios** (taking into account the whole plant site);
- **definition of the acceptance criteria/assumptions** for the safety analyses;
- execution of the safety analyses (structural, mechanical, thermo-hydraulic, radiological, etc.);
- **processing of results and identification of the areas for improvement** (i.e.: plant areas for which design modifications are necessary);
- **identification of the required design modifications**;
- demonstration of the adequacy of such modifications to comply with the UJD requirements.

In outlining the methodology and executing the activities presented above, the available international best practice has been considered by Slovenské Elektrárne (e.g., IAEA NS-G-1.5, NSS No. 4).

On the basis of the above methodology, the execution of the engineering activities is currently in an advanced stage: safety analyses are in progress and design modifications needed to comply with the UJD requirements have been identified.

Because of the already-high resistance of MO34 against external threats, it is expected that compliance with the UJD requirements concerning aircraft crash will require moderate modifications to the design of the plant.

The successful implementation of the above measure will bring the malevolent impact of a small aircraft within the design basis of the new Units 3&4, providing an equivalent level of protection as the one being implemented at present in the ongoing and planned constructions. This guarantees Mochovce 3&4 to be in line with the future state of the art design for all new Nuclear Power Plants in EU.

1.7 The coherence of the project with regional planning

The current state of the MO34 construction is:

- Civil part is complete up to 70%;
- Mechanical equipment supply is complete up to 30%;
- Electrical and I&C equipment supply is negligible.

1.7.1 Permitting

The original Construction Permit No. Výst. 2010/86 for MO34 was issued by the District National Committee in Levice on the basis of the Land Planning Decisions on 12 November 1986. The binding condition for completion has been renewed firstly on May the 5th 1997 by letter of the Regional Authority in Nitra No. 97/02276-004 and further by Decision of the Regional Construction Authority in Nitra No. 2004/00402-007 dated 15 July 2004.

Recently, the Nuclear Regulatory Authority (ÚJD SR, which, according to the Atomic Act 541/2004, is also the Building Authority for Nuclear Installations), by means of its Decision No. 246/2008 dated 14th August 2008, has set as a binding condition for the proposed activity, to complete the construction by 31st December 2013 (thus extending the validity of the Construction Permit for Completion of MO34).An authorisation for commissioning of Unit 3. a 4: requires completion of the assessment proces of proposed activity to environment.

1.7.2 Safety improvements

The existing valid Construction permit, and specifically the extension granted on July the 15th 2004 with the Decision No. 2004/00402-007, requires SE to perform some safety improvements to the original Basic Design with the scope to further increase the level of nuclear safety compared to Mochovce units 1 and 2.

The required safety improvements have been included in the project and are described in the Design Framework of the present EIA Report.

2.0 DESIGN FRAMEWORK

2.1 Overview of EMO12 operational background

The Mochovce project history started off as early as the 1970s when the then Czechoslovakia started to perform geological surveys for the identification of suitable sites to construct a new atomic power plant. The future power plant had to sit on seismically stable geological formations. An essential condition was the proximity to a source of water to cool the plant and replace the evaporated water. Neither large-scale industrial enterprises nor urban agglomerations were to be located nearby. Upon taking account of all the factors, a definitive decision was taken - the site in the municipality of Mochovce was chosen to construct the nuclear power plant. This area was best to meet all the siting conditions.

The preparation work was launched in June 1981 and the proper construction of the NPP in November 1982. The original construction plan envisaged for the utility to be commissioned in the late 1980's. As compared with other installations of a similar type, the NPP Mochovce design already involved several principal improvements such as a seismically resistant attachment of technologic equipment.

Nevertheless, the original technologic process control and management system was found under the final phase of the plant construction to fail to comply with the current stage of knowledge. It had to be replaced with a new system supplied by the German company Siemens, the reliability of which had already been verified in practice. At the time of its application it represented the world's top-class and had already been successfully installed at atomic power plants in Germany.

In the early 1990's lack of funds affected the completion. The search for financial resources abroad proved the only option to ensure further progress of works. Following demanding negotiation, the Slovak Government approved in September 1995 a model for completion and funding of Units 1 and 2. Under it, the completion is implemented to the extent of the original project and with the original contractors.

However the entry by foreign and high-profile companies such as Electricité de France, Siemens or Framatome was conditional on a complex assessment of both the project and overall status of the plant equipment. The Mochovce NPP had undertaken at the time a host of examinations and opened its gates to expert missions from the most reputable institutions worldwide. Experts analysed the principle of the technical equipment and its safety functions. The result of joint efforts by Slovak and foreign experts was a nuclear safety improvement programme and its implementation even prior to the plant start up.

Unit 1 has now supplied electricity to the network since the summer of 1998 and Unit 2 was finally put into operation in late 2000.

2.2 Project description

According to the original design, Mochovce NPP consists of 4 units of VVER 440 type (Vodo Vodni Energeticeskj Reaktor) pressurized water reactors of the Russian type V 213. MO34 follow directly the EMO12 units and will use the auxiliary systems already in operation which are common for all 4 units.

EMO12 have been commercially operated since 1999 and 2000 respectively.

Construction works for MO34 started in 1986 with the laying the foundations of the main buildings (reactor building, longitudinal electrical building, basement of transformers, cooling towers, vent stack) and continued up to 1992. In 1992 construction works were suspended. From 1992 to 2000 maintenance and conservation of suspended equipment and components and of civil structures were carried out by the original main suppliers and constructors. From 2000 to-date the preservation and protection works have been performed on the basis of programs approved by the NRA of the SR.

The current status of the MO34 construction is:

- Civil parts are up to 70% complete;
- Machinery is up to 30%;complete ; and
- Electrical and I&C equipment are up to complete (negligible).

The civil structures already constructed and the components already delivered to the Mochovce site have been subjected to a deep assessment consisting of a multi-stage process of inspections and/or examinations. This process has been started by checking the compliance with the new basic design requirements, and has then been followed by technical inspections and evaluations of the documentation completeness and of the original Manufacturer and/or Supplier certification.

The purpose of such process is to make sure that the achievement of a high level of safety for Mochovce 3&4 NPP, being the primary target for the project completion, will not be impaired by the use of existing/already-delivered components and/or civil structures.

For this purpose a tailored maintenance and preservation plan was developed and the IAEA recommendations ("Management of delayed NPP Projects", IAEA-TECDOC-1110, IAEA, Vienna, 1999) were fully adopted.

In this way, the compliance of the existing components/structures with demanding quality and functional requirements has been verified and the successfully-evaluated components/structures, after adequate refurbishment when needed, can be considered "as good as new" and in line with the expected lifetime of the plant.

The evaluation of the status of individual components/systems and parts of buildings was accomplished setting up a suitable methodology according to the requirements specified in to UJD Decision (Decision of ÙJD SR No. 188/2001 approval of the quality requirements for "Preservation and Conservation Programme for nuclear power plant Mochovce, 3rd and 4th unit) and international practices requirements.

Concerning the asbestos, in order to guarantee and preserve the health of workers, its removal has been planned since the very beginning of completion activities. In September 2008, the mapping of the asbestos in all the premises of MO34 has been carried out. According to the results of this activity, the asbestos has been divided into three categories:

1) Asbestos that can be easily removed before the beginning of completion activities;

2) Asbestos that has to be removed during the completion activities;

3) Asbestos that can be removed at the end of power plant's life.

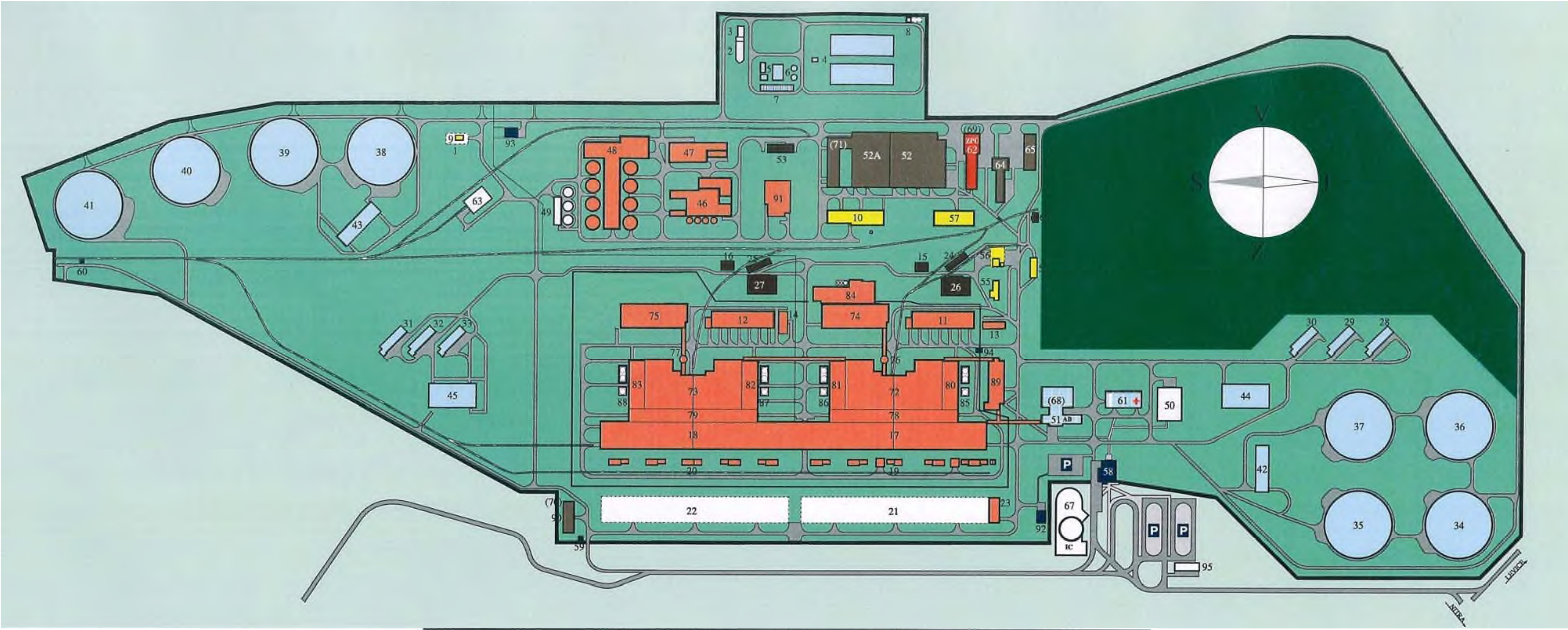
With regard to point 1., the removal activities have been completed in March 2009.

Concerning point 2., due to the peculiarity of the structures/components containing asbestos, the removal will be carried out in parallel with the completion/refurbishment activities.

Finally for the small amount of asbestos embedded in the structures and that cannot cause damage to the health of workers due to its encapsulation in the structures themselves, the removal will be performed at the end of the power plant's completion.

Figure 8 and Map 1 shows a layout of Mochovce NPP in which the following main building structures can be identified:

- 73: reactor building (72 for EMO12);
- 79: longitudinal compartment of electrical equipment (78 for EMO12);
- 17-18: turbine-generator hall;
- 38-41: cooling towers (34-37 for EMO12);
- 12: diesel generator building (11 for EMO12);
- 75: auxiliary operation building (74 for EMO12);
- 84: final processing of liquid radioactive waste building (for all four units).



Object	loc.	n. Name of object
320/1-01		1 Fence of regulation gas station
362/1-06		2 Storage reservoir of industrial sewerage
362/1-07		3 Oil separator on industrial sewerage
363/1-01		4 Safety reservoirs of storm sewer
366/1-01		5 Repumping station of sewage
367/1-01		6 Sewage disposal plant
367/1-02		7 Sludge bed
368/1-01		8 Associate object of waste water measuring
393/1-01		9 Regulation gas station
441/1-01		10 Auxiliary boiler house
442/1-01		11 Dieselgenerator set I (DGS)
442/1-02		12 Dieselgenerator set II
442/1-03		13 HP Compressor plant I
442/1-04		14 HP Compressor plant II
442/1-05		15 Oil management station 1st MPU (Main production unit)
442/1-06		16 Oil management station 2nd MPU
490/1-01		17 Machine room 1st MPU
490/1-02		18 Machine room 2nd MPU
510/1-01		19 Transformer ground 1st MPU
510/1-02		20 Transformer ground 2nd MPU
522/1-01		21 Outdoor distribution 100 and 400 kV 1st MPU
522/1-02		22 Outdoor distribution 100 and 400 kV 2nd MPU
529/1-01		23 Central electric survey
566/1-01		24 Petroleum DGS I and oil bottling house
566/1-02		25 Petroleum DGS II bottling house
568/1-01		26 Petroleum management of 1st MPU
568/1-02		27 Petroleum management of 2nd MPU
580/1-01		28 Cooling ventilation tower I/1
580/1-02		29 Cooling ventilation tower I/2
580/1-03		30 Cooling ventilation tower I/3
580/1-04		31 Cooling ventilation tower II/1
580/1-05		32 Cooling ventilation tower II/2
580/1-06		33 Cooling ventilation tower II/3
581/1-01		34 Cooling tower I/1
581/1-02		35 Cooling tower I/2
581/1-03		36 Cooling tower I/3
581/1-04		37 Cooling tower I/4
581/1-05		38 Cooling tower II/1
581/1-06		39 Cooling tower II/2
581/1-07		40 Cooling tower II/3
581/1-08		41 Cooling tower II/4
584/1-01		42 Central pump room of cooled water 1st MPU
584/1-02		43 Central pump room of cooled water 2nd MPU
584/1-03		44 Pump room of ITW (Important technical water) in the 1st MPU
584/1-04		45 Pump room of ITW in the 2nd MPU
590/1-01		46 Chemical water treatment (CHWT)
592/1-01		47 Store and bottling room of chemicals
593/1-01		48 Decarbonization
599/1-01		49 Sludge management of CHWT
630/1-01		50 Simulator building
631/1-01		51 Administrative building and canteen
640/1-01		52 Workroom (HND store)
641/1-01		53 Oil and combustible storehouse
642/1-01		54 Technical gas storehouse
643/1-01		55 Oxygen and nitrogen generation
643/1-02		56 Hydrogen storehouse
646/1-01		57 Outdoor store and scarp yard
650/1-01		58 Main lodge and police station
652/1-01		59 Subsidiary lodge by the secondary entry
652/1-02		60 Subsidiary lodge by the siding
653/1-01		61 Medical centre
656/1-01		62 Firehouse
700/1-01		63 Engine dock
701/1-01		64 Transport – garage, wash stand
701/1-02		65 Motor truck garage
703/1-01		66 Fuel store – petroleum pump
		67 Information bureau
780/1-01		68 Civil defence under administrative building
780/1-02		69 Civil defence under firehouse
780/1-03		70 Civil defence under metrological centre
780/1-04		71 Civil defence under workrooms and stores
800/1-01		72 Reactor building of 1st MPU
800/1-02		73 Reactor building of 2nd MPU
801/1-01		74 Auxiliary operation building of 1st MPU
801/1-02		75 Auxiliary operation building of 2nd MPU
803/1-01		76 Ventilation stack of 1st MPU
803/1-02		77 Ventilation stack of 2nd MPU
805/1-01		78 Electrical equipment rooms (EER) – lenghtwise1st MPU
805/1-02		79 EER – lenghtwise 2nd MPU
806/1-01		80 EER – crosswise 1. unit
806/1-02		81 EER – crosswise 2. unit
806/1-03		82 EER – crosswise 3. unit
806/1-04		83 EER – crosswise 4. unit
808/1-01		84 Processing and Ra waste disposal
810/1-01		85 Supercasualty charge 1. unit
810/1-02		86 Supercasualty charge 2. unit
810/1-03		87 Supercasualty charge 3. unit
810/1-04		88 Supercasualty charge 4. unit
840/1-01		89 Operational building
881/1-01		90 Metrological centre
882/1-01		91 Compressor plant
940/1-01		92 Guardhouse 1
940/1-02		93 Guardhouse 2
784/1-01		94 Small lodge
		95 INPAKO admin. building
		Railway

Figure 8 - Layout of Mochovce Nuclear Power Plant Units 1&2 and Units 3&4

2.3 Description of the process

MO34 will have two individual operational nuclear units, both containing separate nuclear and conventional parts. Both MO34 units will be directly linked to the first two operational units - EMO12. The operational auxiliary systems can be used in all four units of the complex.

The process for the production of electrical power in Mochovce NPP incorporates three principal heat transfer cycles:

1) in the first cycle, heat derived from the fuel is used to boil water to produce steam: the section of the plant that performs this function is known as the Nuclear Steam Supply System;

4) in the second cycle, the steam is used to drive turbines, which are connected to generators that produce electrical power: this section of the plant is known as the Power Conversion System;

5) in the third cycle, the remaining energy in the steam is rejected as heat: the section of the plant associated with this process is known as the Cooling Water (or Heat Rejection) System.

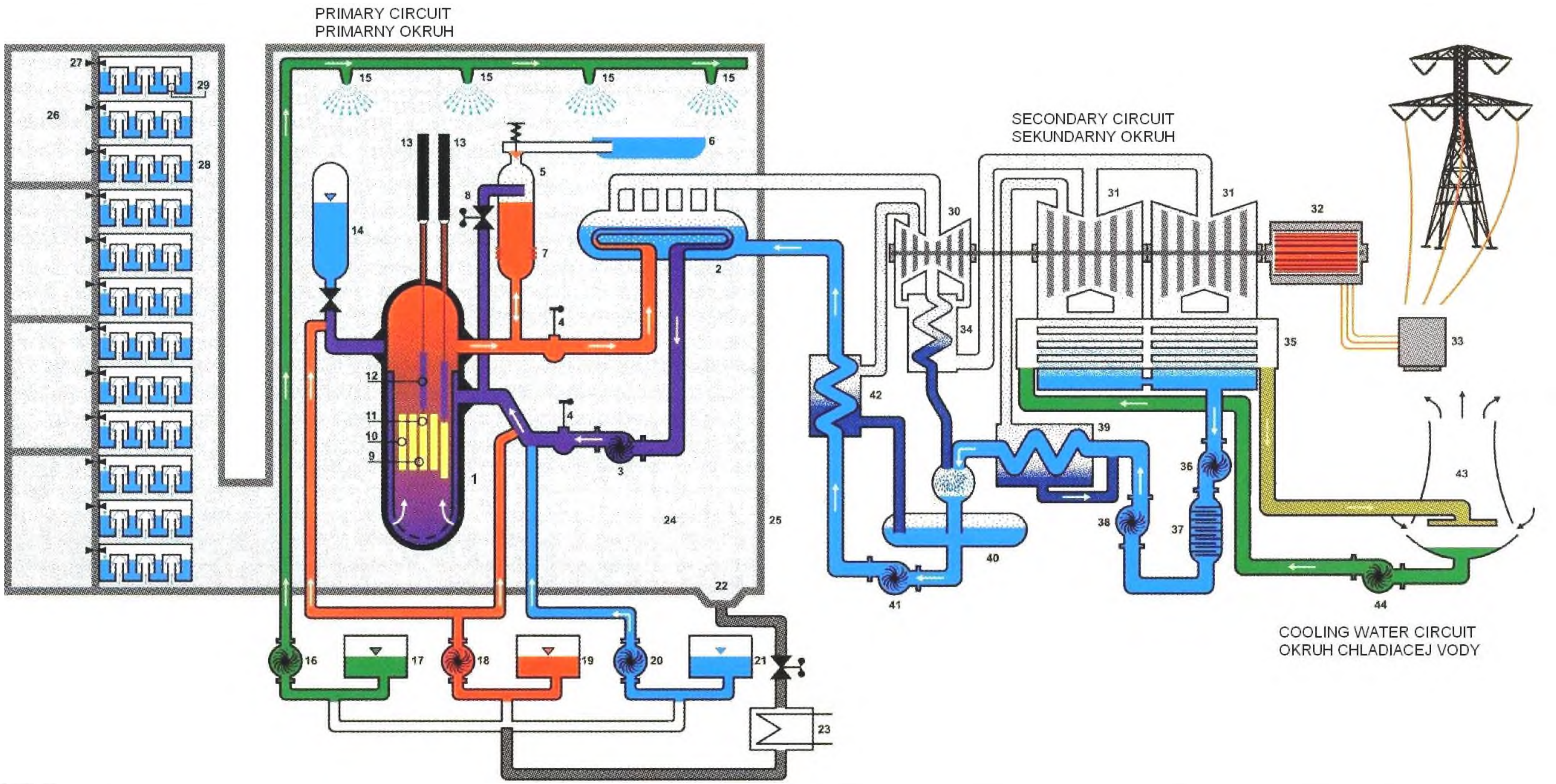
Figure 9 illustrates the general arrangement of the three heat transfer cycles for a nuclear power station based on the Russian VVER-440 Model V213 reactor unit. The two main circuits, the primary one and the secondary one, can be distinguished. Table 3 contains the basic technical data for a 440 MW unit.

The **primary circuit** of each unit is housed in the reactor building. The primary circuit is formed by the reactor and six coolant loops; each loop consists of a hot leg with an isolation valve, a steam generator (SG) and a cold leg with a reactor main circulation pump and an isolation valve (Figure 10). The reactor main circulation pumps recycle pressurized water to remove heat from the reactor core. The pressurizer establishes and maintains the reactor coolant system pressure within the operational conditions and allows compensation for reactor coolant volume changes during operation. SGs are the interface between the nuclear system (primary circuit) and the steam system (secondary circuit). Each SG is a tubular evaporator of horizontal design.

The fuel in fuel assemblies is placed in the reactor pressure vessel (RPV), where chemically treated water runs through channels in the fuel assemblies and removes the heat generated by the fission reaction. The water average temperature at the exit from t he reactor is about 297 °C (temperature increase through the reactor is about 29 °C).

The **secondary circuit** connects the nuclear steam supply system (NSSS) to the power conversion system. The steam generated in the six SGs is piped through 6 high pressure steam lines from the reactor building to the turbine hall. The turbine hall, shared by all four units, is oriented parallel to the reactor buildings. For each unit the hall houses two turbo-generator sets with one high-pressure and two low-pressure sections.

The exhausted steam condenses in the turbine's main condenser, which is cooled by the circulating **cooling water** system. The condensate is then sent back to the SGs.



Legend

1 - Reactor - Reaktor
2 - Steam generator - Parogenerátor
3 - Reactor coolant pump - Hlavné cirkulačné čerpadlo
4 - Main isolating valve - Hlavná uzatváracia atmatúra
5 - Pressurizer (steam section) - Kompenzátor objemu (KO) (parná časť)
6 - Pressurizer relief tank - Barbotážna nádrž
7 - Pressurizer (electric heaters) - Kompenzátor objemu (elektroohrieváky)
8 - Pressurizer injection - Vstreky KO
9 - Reactor core - Aktívna zóna
10 - Fuel assembly - Palivová kazeta
11 - Automatic control rod (ACR) (fuel section) - Automatická regulačná kazeta (ARK) (palivová časť)
12 - ACR (absorber section) - Automatická regulačná kazeta (ARK) (absorpčná časť)
13 - ACR drives - Pohony ARK
14 - Hydroaccumulators - Hydroakumulátory
15 - Spray system - Sprchový systém
16 - Spray pump - Sprchové čerpadlo
17 - Spray system tank - Zásobná nádrž sprchového systému
18 - Low-pressure (LP) emergency pump - Nízkotlakové havarijné čerpadlo
19 - LP emergency system tank - Zásobná nádrž nízkotlakového havarijného systému
20 - High-pressure (HP) emergency pump - Vysokotlakové havarijné čerpadlo
21 - HP emergency system tank - Zásobná nádrž VT havarijného systému
22 - Containment suction sump - Sanie z hermetickej zóny
23 - Spray system cooler - Chladič sprchového systému
24 - Containment - Hermetická zóna
25 - Reinforced concrete containment wall - Ochranná obálka
26 - Bubble-condenser tower air trap - Záchytná komora barbotážnej veže
27 - Check-valve - Spätná klapka
28 - Bubble-condenser tower - Barbotážna veža
29 - Bubble-condenser tower flumes - Žlaby barbotáznej veze
30 - HP stage of steam turbine - VT diel parnej turbíny
31 - LP stage of steam turbine - NT diel parnej turbíny
32 - Electrical generator - Elektrický generátor
33 - Unit transformer - Blokový transformátor
34 - Steam separator and re-heater - Separátor a priehrievač pary
35 - Condenser - Kondenzátor
36 - Condensate pump (stage 1) - Kondenzátne čerpadlo 1°
37 - Condensate treatment - Bloková úprava kondenzátu
38 - Condensate pump (stage 2) - Kondenzátne čerpadlo 2°
39 - LP regeneration - Nízkotlaková regenerácia
40 - Feedwater tank - Napájacia nádrž
41 - Main electric feedwater pump - Hlavné elektronapájacie čerpadlo
42 - HP regeneration - Vysokotlaková regenerácia
43 - Cooling tower of circulating water - Chladiaca veža cirkulačnej vody
44 - Circulating water pump - Čerpadlá cirkulaènej vody

Figure 9 - Principle of electrical production in a NPP (VVER type)

Table 3 - Basic technical data of 1 unit of reactor type VVER 440/213

GENERAL	
Number of operation units: 2 Type of reactor: VVER 440/V-213 (pressurised water) Reactor thermal power: 1,375 MWt	Rated unit power: 440 MWe Inherent consumption: 35 MW (8% of rated power) Unit efficiency: 29.5%
Reactor Pressure Vessel	**Steam Generator**
Inner diameter: 3,542 mm Wall thickness: 140 + 9 mm Height: 11,805 mm Weight (internals excluded): 215,150 kg Material: alloyed steel Cr-Mo-V	6 per Unit Type: PGV-213 Amount of generated steam: 450 t/h Outlet steam pressure: 4.64 MPa Outlet steam temperature: 267 °C Feedwater temperature: 158÷223 °C
Reactor Core	**Turbogenerator**
Fuel operating assemblies: 312 Number of control assemblies: 37 Total weight of fuel (UO_2) in core: 42 t Enrichment for standard type fuel (1st core as for EMO12): 3.6%, 2.4% and 1.6% depending on position in the core Advanced type of Gadolinium doped fuel radially profiled with an average enrichment of 4.87% is considered from the 2 nd campaign of MO34.	2 per Unit Type: 220 MWe Stages: 1 high pressure, 2 low pressure Rated speed: 3,000 rpm Terminal voltage: 15.75 kV
Primary Circuit	**Condenser**
Number of cooling loops: 6 Coolant flow rate: 42,600 m^3/h Nominal pressure: 12.26 MPa_{rel} Coolant temperature at the reactor outlet: 297.3 °C Coolant temperature at the reactor inlet: 267.9 °C Total volume: 250 m^3	Circulating water flow rate: 35,000 m^3/h Maximum temperature of coolant water: 33 °C
EMERGENCY SYSTEMS	
PASSIVE	**ACTIVE**
Hydroaccumulators (4x)	**High pressure system (3x)**
Total volume: 60 m^3 Volume of water: 40 m^3 Volume of nitrogen: 20 m^3	Pump flow rate: 65 m^3/h Pump discharge pressure: 13.5 MPa
Bubbler-condenser tower	**Low pressure system (3x)**
Total volume of bubbler-condenser well: 13,800 m^3 Volume of 4 gas traps: 16,140 m^3 Volume of 12 bubbler-condenser tanks: 1,380 m^3	Pump capacity: 800 m^3/h Pump discharge pressure: 0.72 MPa
	Spray system (3x)
	Pump capacity: 380-520 m^3/h

Efficiency improvements of MO34 Units

Due to higher performance reached by new components (turbogenerators and other technological parts) that will be installed in MO34 secondary circuit, for each unit, the efficiency will be increased up to 31,7%, without any change in the primary circuit.

The reactor rated thermal power (1375 MWt) being equal, the electric gross power output will be 471 MWe (corresponding to 436 MWe net power output).

The most important improvements and their environmental benefits consist of:

- New turbines of higher efficiency and other optimizations in the secondary thermal cycle (leading to a decrease of the thermal discharge to the environment as a consequence of the decrease of the thermal power dissipated in the condenser);
- New titanium tubes in condensers (leading to higher performances of the component and hence to a lower steam pressure for the inlet water to condensers);
- New natural draft cooling tower package (leading to higher thermal performances of the component and hence to a lower inlet water temperature to condensers);
- New natural cooling tower drop retainers (leading to a decrease of the water consumption).

The general reduction of the thermal discharges (about 7%) into the environment can be estimated as the percent increase of the original efficiency (29,5%).

Moreover, the increase of the NPP efficiency (the electric generated energy being equal) will allow:

- an extension of the nuclear fuel life;
- a decrease of the production of radioactive waste;
- a decrease of the radioactive discharges.

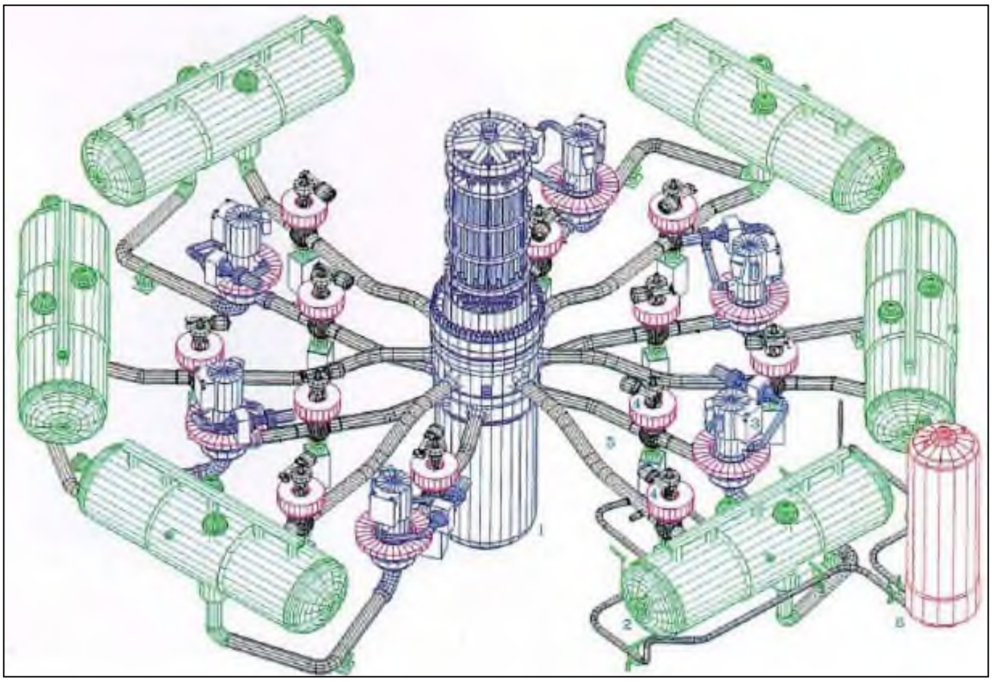


Figure 10 - Primary circuit representation with the six coolant loops

2.4 Description of the main systems

2.4.1 Nuclear Steam Supply System (NSSS)

The NSSS consists of the reactor, the reactor coolant system, and a number of auxiliary and safety systems.

The reactors in Mochovce NPP are VVER 440 type. The VVER 440 type uses nuclear fuel to produce the heat used to generate the steam that drives the turbines. Heat is generated by the process of nuclear fission with the uranium dioxide fuel. The neutron moderator for the fission process is demineralised borated water; this also acts as the primary coolant.

The fuel is placed in an assembly known as the reactor core, which is housed in the reactor vessel. The coolant water passes up through the core, removing heat from the surface of the tubes and thereby maintaining the temperature at the centre of the fuel (at full power) at approximately 1,200 °C.

Control of the nuclear chain reaction is achieved by movement of CFAs and by varying the concentration of boric acid in the reactor coolant.

In order to remove the heat from the core the reactor is equipped with a coolant system. The reactor core is housed in a steel pressure vessel with a stainless steel internal lining. Reactor coolant passes through the core, removing heat from the fuel, and then enters one of six main coolant loops (the primary circuit). The temperature of the reactor coolant is about 297 °C and, to prevent it boiling, it is maintained at a pressure of 12.26 MPa (around 125 atmospheres) by means of a pressurizer connected to one of the coolant loops.

The heated primary coolant enters the SG heat exchanging pipes. These pipes are surrounded by water which is itself heated and produces steam. In this way heat is transferred from the reactor coolant water (the primary circuit) to the power conversion system (the secondary circuit), without mixing of the two fluids. The primary coolant then returns to the core via the main coolant pumps.

The Auxiliary and Safety Systems of the NSSS are provided in order to ensure that the reactor can be safely shut down and kept shut down whenever required and to have the ability to keep the fuel elements cool, and thereby intact, under all circumstances. The Auxiliary and Safety Systems includes: Chemical and Volume Control System, RHR System, ECCS, Equipment Confinement, Auxiliary Feed-Water System and Component cooling systems.

2.4.2 Power Conversion System

The power conversion system consists of various water and steam systems and two steam turbines for each reactor unit. Demineralised water (secondary circuit water) is pumped from the turbine condensers to the SGs, where it passes over tubes containing reactor coolant water. Heat transferred through the walls of the tubes causes the secondary system water to boil, producing steam at a temperature of approximately 260 °C and pressure of about 4.6 MPa. This steam is collected in a common main steam header.

Steam from the main header passes via pipelines into the turbines, where it gives up approximately one third of its acquired energy in rotating the turbines and the connected electrical generators. The steam is then condensed in turbine condensers by passing it over tubes containing circulating water, to which it gives up the remaining two-thirds of its acquired heat energy.

2.4.3 Electrical systems

Each generator of the steam turbine generator set produces electric power at a voltage of 15.75 kV. A segregated bus bar connects each generator to a main transformer (15.75/420 kV). The generated electric power of each Unit of MO34 is transmitted through a separate single outer 400 kV line to Velký Ďur substation.

Power for internal uses of each unit is normally supplied by 2 auxiliary transformers (15.75/6.3 kV) which are connected higher voltage side to the segregated bus bar and lower voltage side to the 6.3 kV bus bars of the unit power distribution system.

If the 400 kV network fails and the switching to house load operation cannot be achieved, the power supply is taken from a 110 kV transmission auxiliary source. Two 110 kV lines connect the power plant to the Velky Dur switchyard. For each unit there is one auxiliary transformer 110 kV/6.3 kV/6.3 kV with two secondary windings connected to the 6 kV bus bars of the unit power distribution system.

The 6 kV bus bars are interconnected so that auxiliaries of one unit can be supplied in emergency conditions from other units of the NPP.

Some of the 6 kV bus bars are dedicated to essential and safety systems. These essential bus bars can furthermore be supplied by onsite power sources composed of 3.5 MVA standby emergency diesel generators.

To assure power supply to 1st category systems (essential systems), batteries and inverters are employed.

2.4.4 Instrumentation and Control (I&C)

MO34 will use the latest commercially available digital technology. Digital electronics technology is characterized by its vastly increased functionality, improved reliability and reduced maintenance requirements.

The best practices deriving from operational experiences of Slovakian NPPs and International NPPs will be used for MO34.

The modern Human Machine Interface (HMI) will enhance operator response in any plant condition. Also expert systems shall be used to diagnose plant conditions and to advise operators.

The Safety Parameter Display System (SPDS) will be a dedicated interface for the operator, to provide all essential information for the most effective management of the plant, even in the most unlikely accident conditions.

2.4.5 Cooling Systems

In order to minimize the thermal heat dissipation to the river Hron, a closed-loop circulating water-cooling system is used, where heat exchange is performed in wet natural draft cooling towers (Main cooling system). Heated water from the condenser heat exchangers is directed to natural-draught cooling towers. There are four wet natural draft cooling towers for each of the twin reactor units. All the condensers cooling water pumps for two reactor units are located in a common pump station. The steam condenser system in the secondary circuit is cooled by the heat rejection circuit, which contains treated water. Water will be extracted from a reservoir on the river Hron at Veľké Kozmálovce, approximately 5 km from Mochovce.

Fresh water, to replace that possibly lost from the cooling water circuit by evaporation and the smaller volume of blowdown water purged from the circuit, will be taken from the reservoir on the river Hron via a pumping station to twin storage tanks, each with a volume of 6,000 m^3. From the tanks water flows under gravity via two pipelines for treatment and then is fed into the cooling water circuit.

An essential water cooling system is also present and it is used as ultimate heat sink to remove the reactor core residual heat and is cooled by wet forced draft cooling towers. There are 3 independent and 200% redundant essential water cooling systems.

2.4.6 Seismic resistance

The Mochovce plant is built to an anti-seismic design, which means that the most important buildings and process equipment are seismically resistant up to the level of the Design Basis Earthquake for the site (site design basis earthquake ZPA - Zero Period Acceleration - is equal to 0.15 g). By seismic resistance is understood the assurance of reactor coolant system integrity, including safe reactor shutdown and its continuous cool-down during and after earthquake.

2.4.7 Safety systems

To maintain a reactor in a safe shut-down condition and prevent any uncontrolled release of radioactive materials into the environment, the following critical safety functions will be fulfilled:

- sub criticality;
- core cooling;
- heat removal by the ultimate heat sink;
- reactor cooling system integrity,
- confinement integrity; and
- coolant inventory.

The fulfilment of these safety functions is ensured by safety systems, which have to perform the required function even in the case of loss of off-site power and following a seismic event. In case of loss of the external electricity source, the emergency diesel generation station (containing six 3.5 MVA diesel generators, i.e. 3 per each unit) ensures the electricity supply to the safety systems.

The safety systems provide even in critical situations protection of plant personnel, and of the population around the plant, against the effects of ionizing radiation from the plant.

For this purpose, the electric equipment of safety systems is supplied by power from Category I (vital power) or Category II (essential power) sources and is seismically qualified. The safety systems have 200% back-up, i.e. each system consists of three identical independent systems of which one alone is sufficient to perform the intended safety function.

The main systems relevant for the safety of the plant in different operating conditions can be summed up as follows (Figure 11):

- High pressure and low pressure injection systems including a passive injection system (boric acid accumulators): these systems belong to the Emergency Core Cooling System (ECCS) which assures core cooling and negative reactivity injection in the case of primary circuit rupture;
- Containment Pressure Suppression System (Bubble condenser and spray system): this system performs the fundamental function of controlling the pressure after an accident in the containment, guaranteeing its integrity;
- Emergency residual heat removal system: it has to ensure the core residual heat and primary circuit accumulated heat removal during the unit cool-down at the normal, transient and accident conditions;
- SG emergency feed water system: this system supplies the steam generators with feed water in the case of low water inventory in the secondary side;
- Essential service water system: is classified as safety system. System provide persistent cooling water supply for cooling equipment which ensure

NPP safety during each unit modes, including quick unit shut-down process (DSG cooling, cooling of containment equipments, in reactor hall, equipments in turbine hall). System is back-up to 200 %, i.e. including 3 equivalent;

- Boron make-up and control system: it controls the inventory of coolant and it is used to maintain the optimal chemical characteristics of the reactor coolant; in particular it ensures:
  - coolant supply to reactor coolant pump seals;
  - reactor coolant system make-up to compensate non-organized leaks from reactor coolant system (RCS) and return of organized leaks into RCS;
  - correction of reactor coolant chemistry, change (increase/decrease) of H_3BO_3 concentration during normal operation and under accident situations;
- Hydrogen autocatalytic recombiner and igniters system: this system controls the hydrogen concentration in the containment as an additional measure for severe accident management (hydrogen may be produced during an accident by the reaction of water with metals at high temperature);
- Reactor cavity flooding system: this system ensures external Reactor Pressure Vessel cool-down in case of severe accidents;
- Fire protection system.

Legend

1 Reactor
2 Steam generator
3 Reactor coolant pump
4 Main isolating valve a1 hot leg
5 Main isolating valve a1 cold leg
6 Pressurizer
7 Pressurizer relief valve tank
8 Hydroaccumulators
9 HP safety injection pump
10 LP safety injection pump
11 Spray pump
12 Boric acid solution storage tanks
13 Hydrazine hydrate tank
14 Boric acid solution storage tanks
15 Water-jet pump
16 Heat exchanger
17 Sprays
18 Containment
19 Corridor between containment and bubble-condenser tower
20 Bubble-condenser tower
21 Air traps
22 Steam entrance to the bubble-condenser channel
23 Bubble-condenser channel area
24 Bubble-condenser channel
25 Check-valve
26 Check-valve

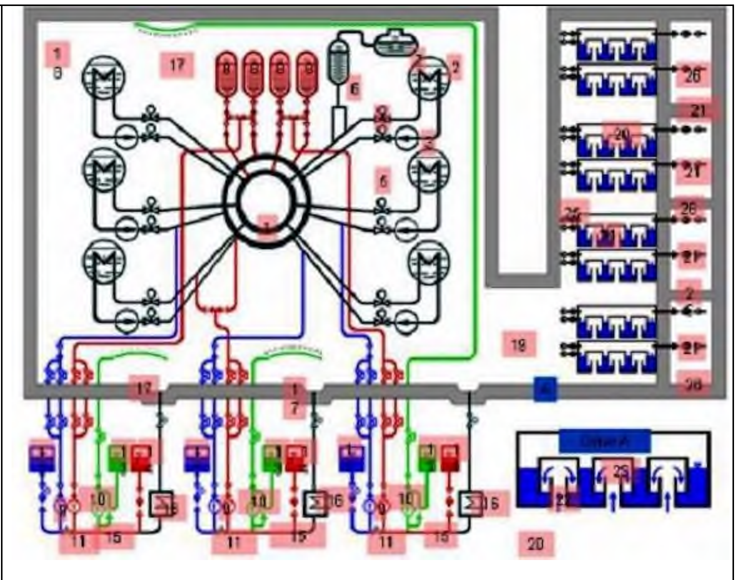


Figure 11 - Safety system scheme

The emergency reactor protections are important protections and control safety systems which assure the function of the reactor trip (*reactor trip system* and *diverse reactor trip system*).

The task of the reactor trip function is to achieve the set conditions, to automatically insert control rods in the reactor core and thus to assure the reactor trip.

The Units of Mochovce 3 & 4 are equipped with reactor limitation system. The reactor limitation system activates protection of an automatic reactor protection system to decrease the reactor thermal power depending on the achieving of set conditions.

The concept of twin reactor units allows for very efficient handling of fuel and radioactive waste. The plant safety features and the fire protection are improved as well. To maintain unit operation the auxiliary systems are installed close to the units. Additional facilities such as the nuclear auxiliary building, the diesel generator station, the compressor building, the service water and the fire fighting pump station also play a relevant role in ensuring a high level of safety of the NPP.

2.4.8 MO34 safety improvements

General overview

The safety improvements of MO34 have been conceived mainly on the basis of the IAEA document "IAEA-EBP-VVER-03, Safety issues and their ranking for VVER-440 model 213 Nuclear Power Plants", and taking EMO12 as the starting point for their further improvement.

Two important aspects need to be pointed out when considering the MO34 safety improvements:

- the main purpose of the IAEA document was to provide "a reference for the development of plant specific safety improvements and for the evaluation of measures proposed and/or implemented": hence, the document was mainly intended to be used as a support in the safety upgrade of operating plants;
- EMO12 is already 100% compliant with the IAEA recommendations.

For these reasons, within the framework of MO34 project, all the IAEA recommendations will be followed and exceeded, as specific design changes have been implemented for the completion of the construction works.

In particular, the most important modifications concerning nuclear safety can be summed up as below described.

- **Design measures for Severe Accident Management**: within MO34 project, not only the IAEA recommendations have been fully met, but additional measures have also been considered, as severe accidents are dealt with at the design level. In fact, specific design modifications have been identified on the basis of a large amount of analyses, in order to:
  - ensure the integrity of the RPV through external cooling;
  - avoid high-pressure core melt scenarios;
  - ensure containment integrity, through long-term cooling and management of the burnable gases in the containment atmosphere; and
  - improve the Post-Accident Monitoring System.
- **Improvements of I&C and electrical equipment**: state-of-the-art I&C will be installed in MO34. In particular, an advanced digital together with a analogical control system will be used, with an increase of control and monitoring capacity of the NPP. The human-machine interface will also be improved, for a more efficient monitoring and control of the plant safety status. Concerning electrical equipment, the use of solid-state technology for electric systems will improve the overall reliability of the plant: in addition, electrical interconnections between the different units and improved connections to the HV grid will reduce the impact on safety of the loss of offsite power.
- **Seismic upgrade**: following the requirements of the Slovak NRA, the MO34 design will be improved in order to achieve a higher seismic resistance of the plant. Seismic design zpa is 0.15 g.

- **<u>Design measures for the reduction of internal hazards</u>**: the MO34 design will address all the IAEA issues concerning internal hazards, including those deriving from:
  - fires;
  - internal flooding;
  - turbine missiles; and
  - high-energy pipe break.
- **<u>Improved design of safety systems and safety-related equipment:</u>** several design improvements have been considered for some safety systems (e.g., ECCS, EFWS) and for components of primary relevance for safety (e.g., Steam Generators, pressurizer safety valves, etc), as a result of the operational feedback of EMO12 and on the basis of the IAEA recommendations, in order to:
  - increase the reliability and separation of safety systems; and
  - increase the lifetime of components important for safety.

Description of the improvements in respect to the original design

In line with the IAEA well-know Defense-In-Depth principle, the safety-improvement program performed during the revision of the Basic Design of MO34 has been aimed at enhancing the plant safety features both in terms of accident prevention and mitigation.

Mochovce 3-4 NPP is an "evolutionary design" (as defined by IAEA-TECDOC 936), like all the so-called Generation III reactors, since it is firmly based on proven and well-consolidated technology of currently-operating NPPs and, as appropriate, introduces significant safety and performance upgrades, implementing lessons learned from operating experience in order to ensure compliance with the latest international safety requirements and practices while putting a strong emphasis on maintaining proven design to minimize technological risks.

Mochovce 3-4 is a new design, substantially improved over and above the reference plant Mochovce 1-2 (VVER 440/V213) upon which it is based, as well as other VVER 440 nuclear power plants currently in operation in EU. It addresses all internationally recognized safety issues, it meets or exceeds all current relevant international safety requirements (IAEA, WENRA) and is comparable with NPPs currently under construction elsewhere today.

As the EMO12 design, the MO34 design encompasses all the IAEA recommendations highlighted in the document IAEA-EBP-WWER-03 "*Safety issues and their ranking for WWER-440 model 213 Nuclear Power Plants*". This set of measures covers the issues of RPV integrity and of the effectiveness of the pressure-suppression passive mechanism of the Mochovce containment ("bubbler condenser") for LOCA-type design-basis accidents.

In addition, the already-high safety level of the EMO12 design (taken as starting point for the safety-improvement program) has been further increased through additional design measures identified in order to increase the plant performances both in terms of accident prevention and mitigation.

In addition, further safety improvements have been defined for MO34 in order to enhance the plant performance in terms of:

- accident prevention;
- accident mitigation.

As for accident prevention, the following major improvements can be highlighted:

1) adoption of the state-of-the-art, commercially-available I&C and, in particular, of the latest-available solutions in terms of human-machine interface. These advanced solutions, along with the enlargement of the plant monitoring capabilities, ensure a quick and efficient comprehension of the plant actual status by the Main Control Room operator. In this way, in an abnormal/accident state, the operator will be able to promptly counter-act, bringing the plant in safe conditions (for this purpose, ad-hoc procedures will be available and adequate training programs will be set up);
2) modifications of the electric design of the Units, to take advantage of the fact that four Units are available on the same site: in this way, the management of Station-Blackout scenarios will be possible also through manual interconnection of each Unit to the others, hence relying on a source of power which is independent from external-grid perturbations (which, in fact, may have been the primary cause of the black-out);
3) modifications of the design of safety and safety-related systems (e.g., Emergency Core Cooling System, Emergency Feedwater System) to improve the system overall reliability (evaluated in parallel through fault-tree analyses);
4) improvement of the plant fire design (new solutions adopted for fire detection and fixed fire-fighting systems, adoption of fire resistant cables for safety systems);
5) increase of the Design-Basis Earthquake and, consequently, of the plant seismic resistance, following the requirement of the Nuclear Regulatory Authority and on the basis of the Probabilistic Seismic Hazard Study for the Mochovce site (performed in 2003 following the recommendations of IAEA).

As for accident mitigation, MO34 design includes a set of measures not yet implemented on most of the units in operation nowadays, aimed at preserving the containment function and hence ensuring the minimization of the off-site consequences of a severe accident, in full compliance with the most recent safety requirements and in line with the most modern reactor designs. These measures include:

1) measures for prevention of high-pressure core-melt scenarios;
2) adoption of in-vessel retention strategy for the cooling of the molten corium;
3) passive measures for hydrogen management during a severe accident;
4) an additional power source dedicated for severe-accident scenarios;

5) enlarged plant monitoring capacity during a severe accident;

6) an additional source of water dedicated for the management of containment pressure and temperature in the early phase of a severe accident (during which it is postulated that the normal ultimate heat sink is not available).

It is important to remark that such measures are fully in line with the most recent international safety requirements (e.g., IAEA, WENRA) and with the technical solutions adopted in the most recent NPP designs.

The validity of the design modifications described above has been confirmed by both probabilistic and deterministic safety analyses presented to the Nuclear Regulatory Authority of Slovakia as a part the MO34 licensing process: in particular, radiological analyses have been performed for the most challenging design-basis and severe-accident scenarios, to assess the possible impacts of such scenarios on the surrounding environment and populations.

The results of the analyses have been checked against the requirements of the Nuclear Regulatory Authority of Slovakia, finding in all the cases a full compliance.

In particular, due to newly-introduced severe-accident mitigation design measures, the probability of large releases will be reduced with respect to operating reactors (in line with the IAEA recommendations for new reactors) and the releases, even in the case of highly-unlikely severe accident scenarios, will be so reduced that the need for emergency measures in the plant vicinity (i.e., at the boundary of the plant exclusion area - minimum distance from the plant equal to 2 km) will be practically eliminated.

The increase of the Design-Basis Earthquake (DBE) for the plant has lead to the following main consequences on the MO34 design:

- recalculation of the seismic resistance of seismically-qualified civil structures, with the subsequent identification of the need for minor structural reinforcements of steel structures (no modifications have been found necessary for the reinforced-concrete structures, due to the significant margins considered for these structures in the original design);

- recalculation of input data for the seismic design of technological equipment (e.g., seismic floor response spectra);

- verification of the adequacy of the originally-supplied equipment to the increased design requirements for seismic resistance.

In general, the analyses performed on the existing civil structures have shown that the increase of the DBE will not require major reconstruction works because of the large margins considered in the original design.

All the applicable national and international safety requirements concerning design-basis and beyond-design-basis accidents have been properly addressed in the MO34 design.

The full compliance with all the international requirements for design-basis accidents has been already thoroughly demonstrated for the operating units of EMO12 (and hence, due to the similarity of the design, also for EMO34). In particular, several experiments have been conducted to test the effectiveness of the containment pressure-suppression system ("bubbler-condenser") in quickly reducing the containment pressure following a large-LOCA accident. These experiments have finally demonstrated that, following a large-LOCA accident, the Mochovce containment pressure is brought back to sub-atmospheric values in only a few tens of minutes, thus stopping the releases to environment.

The compliance of the Mochovce design with the applicable requirements concerning design-basis accidents is due to the fact that the Units of Mochovce NPP are equipped with a containment system and with safety systems, including:

1) emergency core cooling (active high/low pressure injection, passive low-pressure injection);
2) residual-heat removal system;
3) containment spray;
4) emergency feedwater;
5) emergency power supply;

which are designed fully in line with the Western standards (e.g., in accordance with IAEA principles of diversity, redundancy and independence, seismically-qualified, etc.).

The adequacy of these safety features of EMO12 has been assessed also by several international organizations (including IAEA, WENRA, WANO, Riskaudit) which, after leading missions to EMO12, have concluded that the safety level of these two units is comparable to that of nuclear power plants being operated in Western Europe.

On the other hand, it has also to be recalled that beyond-design-basis scenarios like ATWS (Anticipated Transients Without Scram) were already considered in the Final Safety Analysis Report of EMO12 and the existence of adequate safety margins was demonstrated also for those scenarios.

The basic features relevant from the point of view of nuclear safety of the reactors currently under construction (referred to as "evolutionary designs" in the IAEA TECDOC "Terms for describing new, advanced nuclear power plants", 1997) complying with the most recent safety standards can be summarized as follows:

1) Simpler design for easier operation and lower vulnerability to operational deviations, with broader use of passive and inherent safety features;
2) Reduced possibility of core melt accidents (enhanced effectiveness of design in the prevention of core melt scenarios);
3) Minimal effect on the environment, practically eliminating the need for emergency measures in the plant vicinity (enhanced effectiveness of design in the mitigation of highly-unlikely core melt scenarios);
4) Incorporation of the most recent operational experience of similar, operating NPPs.

With reference to point 1, it has to be pointed out that the design of VVER 440 reactors in general shows specific features which are inherently positive for nuclear safety, such as low power, small active core, large volume of coolant both in the primary as well as in the secondary circuit.

Focusing on the points 2-4, the following issues have to be pointed out:

2) in comparison to the existing reactors, the frequency of core melt accidents for MO34 will be reduced by a factor of about 10 and will be aligned with the recommendations of IAEA for new reactors;

3) due to newly-introduced severe-accident mitigation design measures, not only will the probability of large releases be further reduced (again, in line with the IAEA recommendations for new reactors) but such releases, even in the case of these unlikely events, will be so reduced that the need for emergency measures in the plant vicinity will be practically eliminated;

4) MO34 will be fine-tuned to fully incorporate the operational experience coming from other similar NPPs (in particular, EMO12).

Finally, the state-of-the-art I&C commercially available will be adopted for MO34.

For this reason, with respect to the existing NPPs, the MO34 design reflects an increased ability of the plant both to prevent severe accident scenarios and to cope effectively with them, in order to limit strongly the impact of the plant on the surrounding environment in any scenario, in line with the most recent safety standards.

2.4.9 Containment

MO34 is equipped with a containment system of pressure-suppression type, which relies on a large amount of cold water to condense steam released from the Reactor Coolant System as a consequence of an accident. A similar technology is widely used by other reactors, such as General Electric, Siemens and ASEA Atom (now ABB) BWR's.

The VVER-440/213 containment system is intended to prevent the escape of steam and fission products and to facilitate steam condensation, thereby reducing the pressure after the break of any single primary system pipeline, including the double-ended rupture of 500 mm inner diameter pipes.

The containment system is composed of (Figure 12, Figure 13):

- reinforced concrete accident localization structure, providing confinement function of the system;
- bubbler condenser, providing passive pressure-suppression function; and
- water droplet spray system, providing active pressure-suppression function and radioactivity removal function.

The accident localization compartments include a sealed set of interconnected compartments surrounding selected primary system components (steam generators, inlet and outlet piping, pumps, isolation valves, pressurizer and the major portion of the reactor vessel) and additional compartments containing bubbler condenser.

Compartments housing technological systems constitute a part of the reactor building.

Bubbler condenser rooms are located in an additional building (bubbler condenser tower), connected to the reactor building by a rectangular tunnel.

The reinforced concrete walls of the VVER-440/213 are approximately 1.5 m thick. All walls and roofs of the localization compartments have internal steel lining. Reinforced concrete structures, the airtight entrance doors and penetrations are designed for the 0.15 MPa overpressure.

The bubbler condenser comprises twelve levels of trays filled with Boric acid solution. Each level contains 116 m^3. The trays hold borated water with a minimum concentration of 12 g/l. Total water inventory inside the bubbler condenser amounts to 1,387 m^3. Outer surfaces of adjacent trays form vertical weirs that are capped by a downward facing trough submerged in water. The inside walls of the trays and troughs form water-filled vertical channels, approximately 50 cm long.

The reactor building spray system (RBS) provides a water spray to the reactor compartment following a LOCA or steam line break, to limit containment pressure and to minimize the release of radioactive iodine and particulates to the environment. The RBS is composed of three identical and completely independent trains, each of them with a capacity of approximately 400 m^3/h.

The efficiency of the containment system in rapidly reducing the accident pressure by combination of pressure suppression system and containment spray allows termination of releases to the environment in a very short time, as fully demonstrated by Research programs sponsored by IAEA, OECD and European Commission through Phare programs, while other containment designs have to cope with overpressurization for days and weeks after an accident. MO34 containment will be equipped with safety systems, so that the integrity of the containment will be ensured during and after an accident. In addition, the MO34 project includes several design improvements, in compliance with the most recent and demanding international safety requirements, which are specifically aimed at preserving the structural integrity of the containment even for extremely-unlikely accident scenarios ("Severe Accidents") which, nonetheless, are the most critical and challenging for the containment.

In particular, the design measures defined for MO34 will:

- avoid the uncontrolled burning of the hydrogen which is generated during a Severe Accident (by using hydrogen recombiners/igniters);
- avoid high-pressure core-melt scenarios (through a dedicated line for fast depressurization of the primary circuit);
- avoid RPV failure (through the in-vessel retention of the molten core by reactor-cavity flooding and external core cooling);

thus practically eliminating the accident sequences which could seriously jeopardize the containment structural integrity.

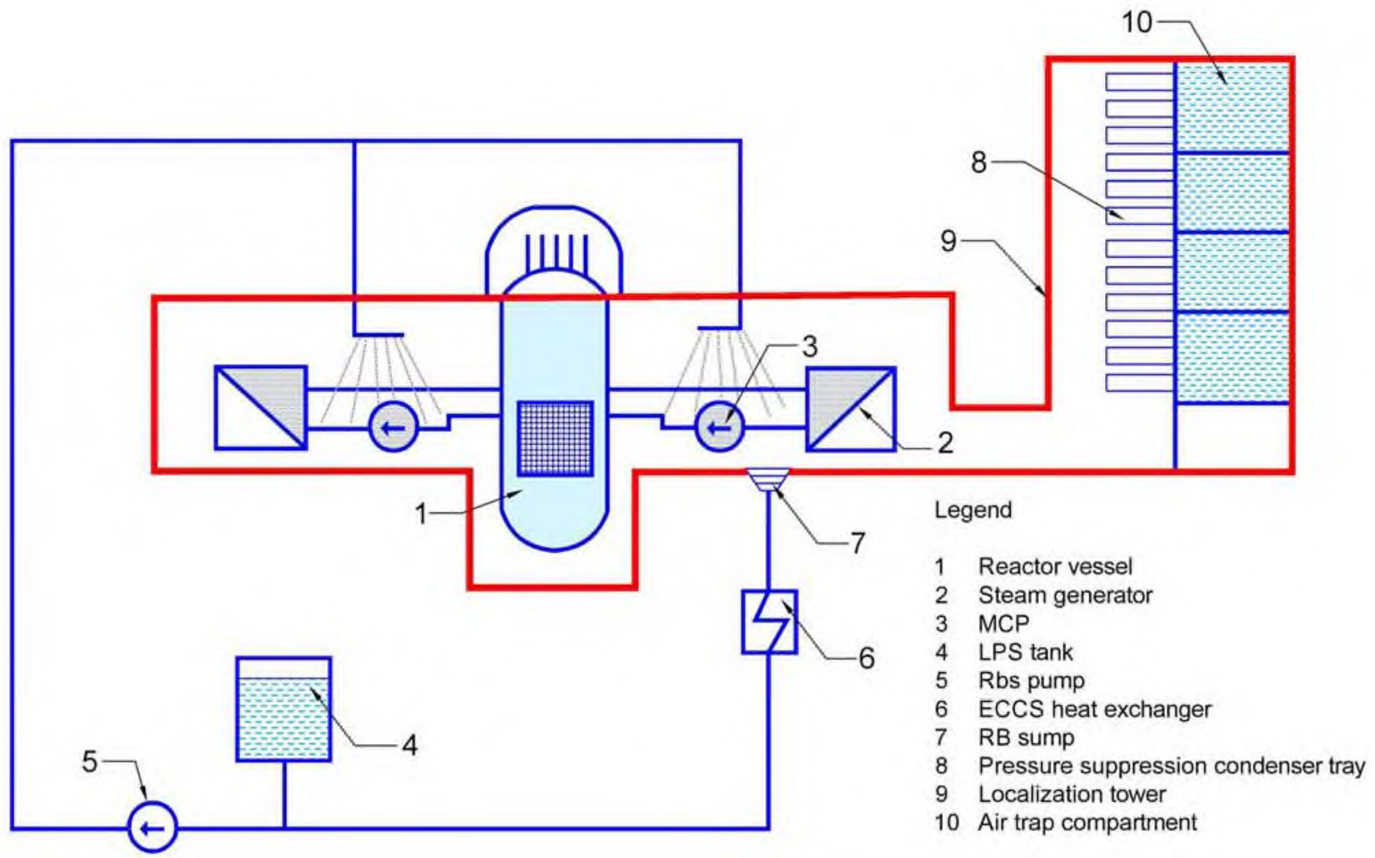


Figure 12 - Schematic diagram of VVER-440/213 containment system

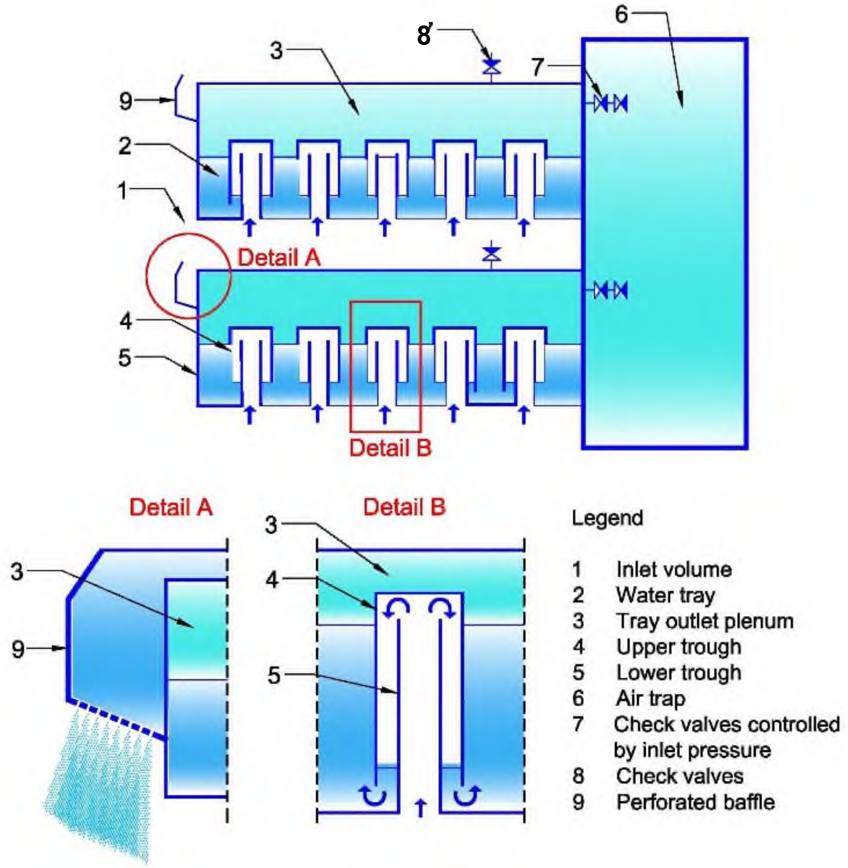


Figure 13 - Details of bubbler condenser's trays and air trap compartment of VVER-440/213 containment system

2.5 Fuel

The fuel in form of fuel assemblies is placed in the RPV, where chemically treated water runs through channels in fuel assemblies and removes the heat generated by the fission reaction. The water exits the reactor at the temperature of about 297 °C. The used fuel is uranium dioxide (UO_2). Nuclear units operate in campaigns and periodically the reactor is shut down for refuelling.

SE nuclear reactors at NPP Bohunice, both VVER 440/213 type, started their operation with fuel of Russian fabrication and construction. For the first core of MO34 the same configuration as at Bohunice Unit 3. will be used in order to have an optimal power distribution. In accordance with original design nuclear fuel as the initial cores of Bohunice and EMO12, as well as fuel produced for the refuelling in approximately 12 month cycles, consisted of fuel assemblies with enriched uranium 1.6%, 2.4% and 3.6%. Such fuel was used in 3-4 year cycles and the maximum burn-up of discharged fuel assemblies reached approximately 40 MWday/kgU. From 1999 all units started progressively to use a radial profiled fuel with an average enrichment of 3.82% ^{235}U. From 2006 EBO V2 and EMO12 started to use second generation fuel with 3.84% ^{235}U and 4.25% of average enrichment with burnable gadolinium absorber (burnable absorber of thermal neutrons). In addition to the above types of fuel, starting with the second campaign it will be used an advanced type of Gadolinium doped fuel with an enrichment of 4.87% ^{235}U. The use of gadolinium allows to smooth the growth of energy in the reactor core from the beginning of campaign where too many neutrons are emitted to the end of the campaign where more neutrons are needed to allow the use of less fissionable products. With such a fuel it is possible to operate with a 5÷6 year cycle and the fuel burn-up should reach values of 48÷52.6 MWday/kgU.

The adoption of Gadolinium in nuclear fuel elements allows, therefore, reducing tritium production and consequently tritium discharges in wastewater streams.

In the VVER 440, Model V213, the reactor core is composed by:

- 312 Independent Fuel Assemblies (IFA);
- 37 Control Assemblies (30 Absorber Assemblies and 7 Regulation Assemblies).

The 37 Control Assemblies (or Fuel Follower) are divided in 6 groups, five with six assemblies for group and the 6th with the 7 regulation assemblies.

Figure 14 shows the layout of the first core for MO34.

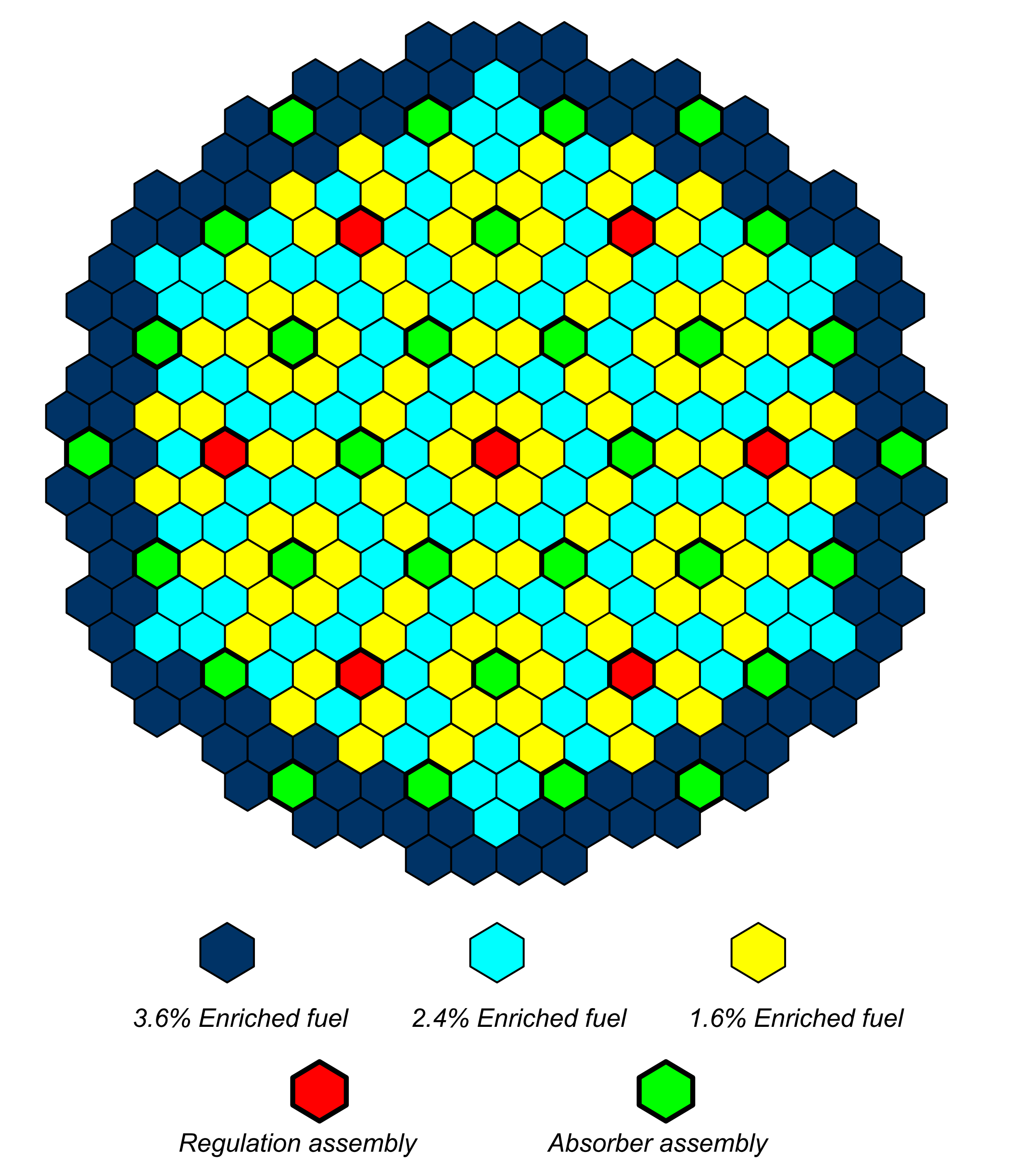


Figure 14 - Layout of the first core for MO34

Control Fuel Assembly (CFA) is composed by two parts – fuel (lower part) and absorber (upper part). Fuel part is located in the core and absorb part (contain Boron to absorb neutrons) is located over the core. To reduce the power of reactor is shift down in to the core.

Each fuel assembly is made up of 126 fuel rods and a central channel for the instrumentation. Ten spacer grids are used in order to assure the position of each rod. Inside each fuel rod there are annular pellets of enriched uranium dioxide, to produce power by fission. The space between the inner surface of the tube rod and the pellets is filled with helium to compensate for the external pressure.

Each fuel assembly is covered by a shroud, as shown in Figure 15.

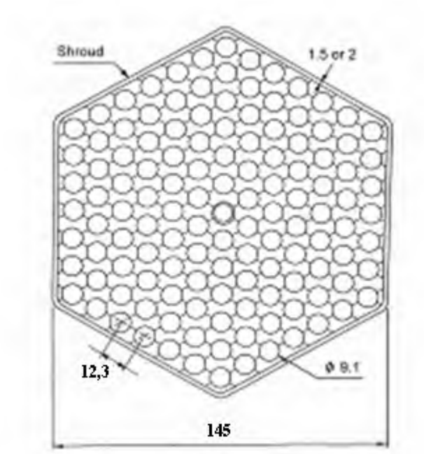


Figure 15 - Fuel assembly cross section

The fuel follower of hexagonal shape is made of boron-steel.

2.5.1 Fresh fuel transport and handling

Presently a special railway train serves to transport fresh fuel. Each wagon carries eight containers, each of which holds four fuel assemblies/fuel followers. Upon arrival at the power plant the fuel is transferred into fresh fuel storage where it is checked (visually, geometrically), and either put into temporary storage racks, transport containers or into cylindrical magazines in preparation for refuelling. These magazines each hold 30 assemblies. During refuelling, the magazines are transported by crane to the receiving part of the fuel storage pool. The fresh fuel is transferred from the magazine to the core by a refuelling machine.

When the fuel is ready for discharge, it is transferred from the core to the storage pool using the refuelling machine.

2.5.2 Spent fuel management

Spent fuel treatment conception is set in accordance with Final part of nuclear power industry strategy on its long term storage (cca 50 years) and on its consequent disposal in a deep underground disposal site.

Nuclear power plants in the Slovak Republic are operated in the so-called open fuel cycle. At present it is not possible to apply the closed fuel cycle, as VVER-440 reactors operated in the Slovak Republic are not licensed for the use of MOX fuel (mixture of Uranium and Plutonium oxide). This means that the spent fuel is not reprocessed (Figure 16).

Under the assumption of the shutdown of EBO V1 and the 40 year EBO V2 operation period, EMO12 and MO34 will produce 24,698 spent fuel assemblies which correspond to approximately 2,960 tonnes of spent fuel converted into the heavy metal contents. Out of that number, the EBO V1 and V2 productions will be 12,384 pieces of spent fuel assemblies and the EMO12 and MO34 productions will be 13,104 pieces of spent fuel assemblies.

The spent fuel storage in an interim storage facility is an inevitable technological stage whose aim is to reduce the amount of heat and activity produced by spent fuel assembles prior to their reprocessing or prior to their conditioning and insertion in disposal containers and the carriage to the deep underground disposal site. The Interim Spent Fuel Storage Facility in Jaslovské Bohunice is used for that purpose for the EBO V1 and V2 spent fuel and for a part of the Mochovce NPP spent fuel at present. The first spent fuel carriage from Mochovce NPP to the JAVYS Interim Spent Fuel Storage Facility was made in April 2006.

A dry storage facility construction is assumed for the spent fuel storage at Mochovce NPP, based on the principle of two-purpose transport-storage containers. The original assumed commissioning date was the year 2009. The intention to build the Mochovce NPP dry storage facility assumed spent fuel transports (approximately 2 year spent fuel production) to another site (to the JAVYS Interim Spent Fuel Storage Facility). The Mochovce NPP Interim Spent Fuel Storage Facility environmental impact assessment (EIA) process was successfully completed in 2004 resulting in a positive final position issued by the Ministry of Environment of the Slovak Republic. In 2003, however, SE, a.s., decided to make use of the free capacity in the JAVYS Interim Spent Fuel Storage Facility in Jaslovské Bohunice that will remain free after the premature shutdown of NPP V1 reactor units in 2006 and 2008 and to postpone the beginning of the construction to 2017. The capacity in question is approximately 1,500 fuel assemblies which is sufficient for about 10 years of Mochovce NPP operation (under the assumption that 75 spent fuel assemblies will be removed from the reactor core on an average yearly and the spent fuel assemblies will be stored in KZ-48 compact containers in the Interim Spent Fuel Storage Facility).

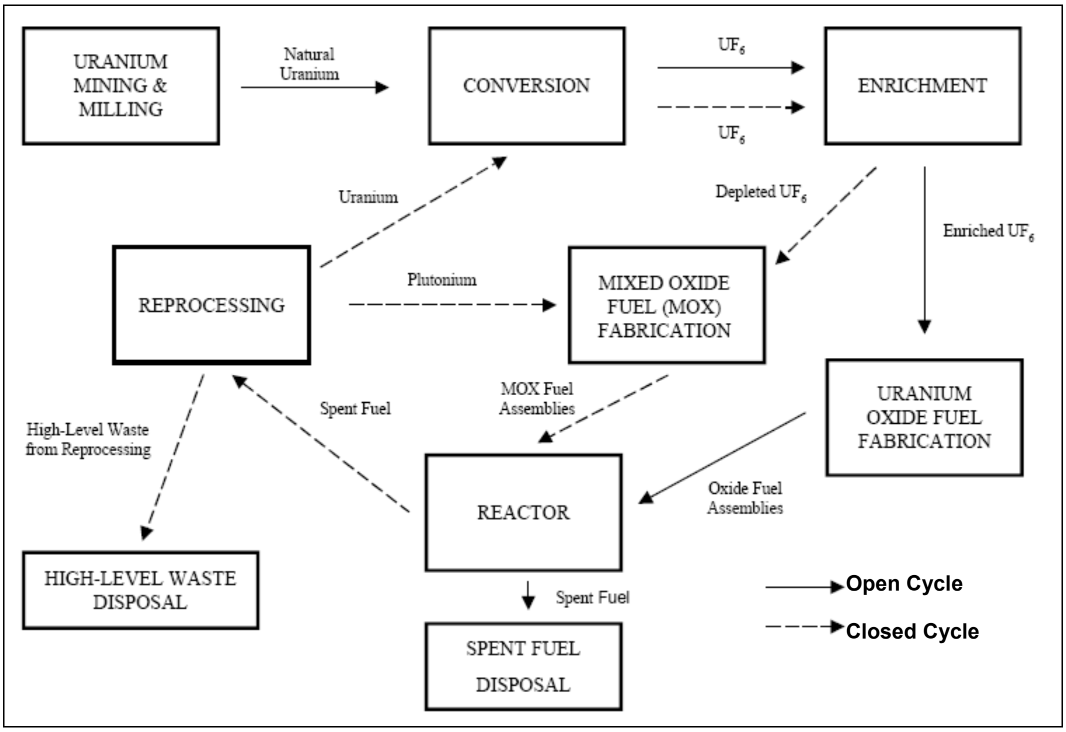


Figure 16 - Open and closed fuel cycle

2.5.3 Spent fuel storage in main reactor building hall

Yearly, after termination of planned campaign, a part of spent fuel is removed from the reactor and placed to the spent fuel pit situated in the reactor vicinity. The need for the spent fuel storage in the spent fuel pit results from the residual heat production in the fuel that continues even after its removal from the reactor core. The spent fuel stays in the spent fuel pit approximately 6 to 7 years. The Mochovce NPP spent fuel is stored in a compact storage lattice in vertical positions enabling a good cooling by the circulation of the cooling medium, i.e., the aqueous solution of boric acid with the concentration of 12 g/kg at least. The solution temperature is maintained on values up to 50 °C. The compact storage lattice capacity is 640 positions/storage places for each pit. The base of the storage lattice is formed by hexagonal absorption tubes manufactured with addition of stainless steel with up to 2% of Boron in which spent fuel assemblies and hermetic enclosures are inserted. There are positions dedicated for placement of the round hermetical capsules on the compact storage lattice edge.

Spent fuel assemblies for which a cladding damage was detected are stored in hermetic capsules. The hermetic enclosure structure ensures the following:

- a reliable isolation of gaseous fission products leaking through the damaged fuel assembly cladding;
- the residual heat removal;
- a safe transport and handling of a fuel assembly; and
- the long-term storage of the spent fuel with a damaged fuel cladding.

A further storage space for spent fuel (reserve storage lattice) is used in case of a short-term storage of fuel assemblies removed from the reactor core during revisions or repairs of internal reactor parts. The reserve storage lattice for spent fuel is manufactured with stainless steel and it is positioned above the compact lattice and its capacity is 296 fuel assemblies and 54 hermetic capsules.

The above described elements of the spent fuel storage system in the spent fuel pools are made of stainless steel. The Mochovce NPP storage pits are covered with one stainless steel liner with the thickness of 3 mm.

The heat is removed from the space when the spent fuel is stored by means of two separated cooling circuits that are equivalent as for their power outputs. Each of them alone is able to remove efficiently the heat produced by spent fuel assemblies found in the storage lattice and the maximum heat load during the operative fuel transfer from the reactor vessel to the reserve lattice.

The water warmed up by spent fuel assemblies is removed from the pit water level and from container shaft to the heat exchanger and after cooling down it is pumped by a pump back to the pit and container shaft. The maximum pit water temperature must not exceed 50 °C.

The pit, the reactor shaft and the container space are interconnected during refueling of the active core and filled completely with a boric acid solution of the concentration of 12 g H_3BO_3/kg H_2O at least, up to the highest level +21.0 m. High level of the boric acid solution ensures core subcriticality, reliable heat sink during refueling and creates adequate shielding to avoid external personnel's irradiation at the same time.

2.5.4 Anticipated Mochovce interim spent fuel storage facility

The construction of a dry storage facility (Figure 17) is assumed for NPP Mochovce based on the principle of two-purpose transport-storage containers. The assumed commissioning date is 2017. The Mochovce NPP Interim Spent Fuel Storage Facility environmental impact assessment in compliance with Act No. 127/1994 Coll. was successfully completed in 2004.

The subsequent stages are as follows: the design preparations, the technology selection, the land-use proceeding and, subsequently, the implementation.

By that time the free capacity in the JAVYS, a.s. Interim Spent Fuel Storage Facility will be used assuming the gradual spent fuel carriage from NPP Mochovce by three KZ-48 annually, alternately from Units 1 and 2.

Ease of implementation is the major advantage of the dry interim storage facility, especially if using containers. The dry interim storage facility can be operated in a simple way, while only a few or no active systems are necessary. Its capacity can be easily modified, if needed (the so-called modular storage systems).

Dry spent fuel storage is usually chosen where spent fuel reprocessing is not considered. In addition to favourable economic aspects that can be proved, the method is recommended, in comparison with wet storage facilities, especially for the following reasons:

- no active systems are required (or a minimum number - e.g., the pressure monitoring system);
- low maintenance requirements;
- a simple operation and the possibility to adapt to modified Customer's requirements;
- less secondary wastes; and
- low inherent accident risk resulting for the storage principle.

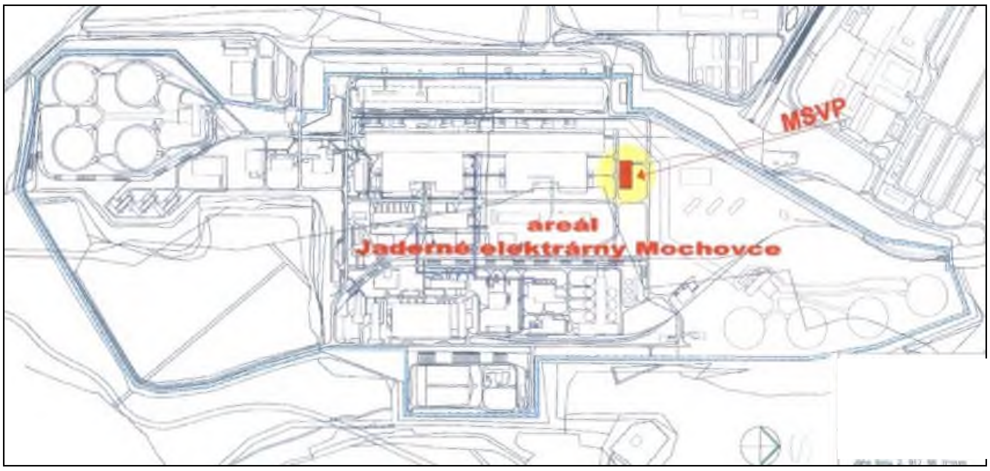


Figure 17 - Location of the anticipated Interim Spent Fuel Storage (MSVP in figure)

Civil structure

Spent fuel containers will be stored in a building whose primary function is to ensure the cooling of the containers and their protection against climatic influences. The additional biological shielding is the secondary, however not necessary, function. The interim storage facility building will be equipped with necessary handling means.

The heat that is produced by the stored spent fuel will be removed from the containers by natural ventilation. The interim storage facility building will be interconnected with other facilities on the site by roads and a railway siding. The electric power supply will be provided from the existing power plant equipment. The building will also be connected to fire water pipeline circuits on the Mochovce NPP site.

The storage facility building consists of the technical zone, receipt area and the storage space itself. The technical zone consists of the access hall, changing and sanitary rooms, electric switch room and a store room. The building will also include a storage room for transport means.

The receipt area consists of an empty container storage zone and a container preparation and inspection zone. The receipt area is sized to hold a truck with a semi-trailer or a railway wagon capable of carrying a container. The crane parking position is situated in the receipt area.

Spent fuel container

The Mochovce NPP Interim Spent Fuel Storage Facility will be built on the basis of two-purpose containers enabling both the spent fuel transport and storage. Fuel assemblies are stored in a dry inert atmosphere. The containers must ensure the following major functions:

- a safe confinement of radioactive substances;
- the provision of the spent fuel subcriticality;
- the provision of the fuel cooling and residual heat removal;
- the provision of shielding; and
- the protection of spent fuel assemblies against external impacts and risks.

In addition to the fuel assembly cladding, the container body equipped with a double closing system also prevents radioactive substances from leaking into the environment. The subcriticality of stored spent fuel assemblies is ensured by the layout of the assemblies in the container and is calculated conservatively for the fresh fuel. The heat produced during the storage is usually removed by a passive air flow. The reference two-purpose transport-storage container for the dry interim spent fuel storage facility consists of the following parts:

- the metallic monolithic container body providing the biological shielding and structural integrity of assemblies during:
  - the whole storage period;
  - the on-site transport;
  - potential transport to the reprocessing plant or to the spent fuel disposal site;
- the storage basket (receiver) where fuel assemblies are placed in the defined position;
- the closing system (consisting of two screwed-on lids) including doubled seals;
- the container leakage monitoring system.

Neutron absorbers made of plastics are also inserted in the container body and lids.

Monitoring system

The storage rooms will be monitored for gamma and neutron radiation. The monitoring system will be equipped with lamp and acoustic alarm signals that will be activated in case of exceeding the permissible levels for normal operation. The storage containers will be equipped with the tightness monitoring system that ensures the internal space tightness inspection and early indication of possible loss of tightness.

Auxiliary systems

- Container Repair and Maintenance System

During the normal operation of the interim storage facility, maintenance actions will only be taken to a limited extent. They will especially consist in visual inspections and filling the helium receiver of the pressure monitoring system, or in the removal of deposited dust from the surface of containers. After some storage period it may be necessary to restore the container coatings.

The visual inspections can also be ensured by means of cameras installed in the storage hall and on the crane. The filling of the pressure monitoring system receiver with helium can be performed in the preparatory zone of the receipt area.

It will be possible to remove the secondary upper lid leakage in the Interim Spent Fuel Storage Facility. Activities for which it is necessary to open the primary container lid will be performed outside the interim storage facility building (in the Reactor Hall).

- *Ventilation system*

The task of the interim storage facility building ventilation system is to remove the residual heat produced by spent fuel assemblies in containers and to ensure that the maximum design values will not be exceeded. The ventilation is ensured by the natural air flow and circulation (a passive system). The air enters through shutters at the bottom part of the perimeter wall and gets out through holes in the ceiling structure of the interim storage facility.

- *Drainage system*

The function of the drainage system is to lead the potential liquid radioactive waste to the collection tank. Following the dosimetrical control, the waste will be either discharged to the sewer system or carried and processed by the liquid radioactive waste processing system.

- *Fire protection System*

The dry interim storage facility will make use of the NPP Mochovce site fire protection system.

- *On-Site container handling*

After the termination of the storage in the spent fuel pool, the spent nuclear fuel will be carried to the Interim Spent Fuel Storage Facility. All handling actions related to spent fuel preparations for the placement in the Interim Spent Fuel Storage Facility will be taken in the NPP Mochovce Reactor Building. Spent fuel assemblies will be inserted in containers in the transport container shaft. They will be carried in the containers to the Interim Spent Fuel Storage Facility and stored there in the containers. The spent fuel is inserted in containers in the water environment whose parameters are identical to those of the cooling water in the spent fuel pit. The following actions will be taken after the spent fuel is inserted in the containers and the containers are closed and transferred to the service point:

- the cooling medium will be pumped out from the containers,
- the containers will be dried out, and
- the container tightness test will be performed.

Those actions are aimed to fill the container and prepare it for the carriage to the Interim Spent Fuel Storage Facility.

Both the insertion and removal of the fuel to and from the containers will only be performed by means of the refuelling machine at the spent fuel pit in the Reactor Building of the relevant reactor unit. The container decontamination will also be performed in those rooms.

The containers will be carried from the Reactor Building to the Interim Spent Fuel Storage Facility by a truck with a semi-trailer or by a railway wagon in the horizontal position. The container will be lifted by a crane from the transport means in the receipt area and placed in the vertical position to the preparatory zone. After the required inspections and handling are performed, the container will be transported to its storage position in the storage space and connected to the system monitoring the gas pressure in the container (container tightness inspection).

2.5.5 Deep underground geological disposal site for spent fuel

The spent fuel disposal, following the relevant preparations (the transfer to the storage container, welding up, etc.), in a disposal site built in deep underground geological formations of appropriate properties (or the carriage abroad, if enabled by legislative and economic conditions) will be the final phase of the spent fuel management in the open cycle.

The deep underground geological disposal principle consists in, after a storage period, placing the spent fuel and high-activity radioactive waste in an engineering construction in a big depth in a stable geological environment in order to ensure a permanent isolation of stored materials from the environment without any intention to retrieve the materials in the future. In principle, it is possible to design the disposal site so that the stored waste is retrievable prior to the closing of the disposal site or for some time after the closing.

A system of multiple engineering and natural barriers (the multi-barrier principle) in the deep underground geological disposal site ensures the isolation of wastes from the biosphere and a high degree of safety.

Regarding the research-development activities related to the deep underground disposal in the Slovak Republic, the following objectives can be highlighted:

1) a detailed geological exploration of sites with crystalline rock and clay environments that were identified during preceding programme stages

based on results obtained by means of light geological methods, but also deep bores;

2) the draft concept of the deep underground disposal respecting the spent fuel and radioactive waste parameters after the storage, rock environment properties in the given sites, the long-term safety of the disposal site after the termination of its operation and closing based on a combination of storage container properties, engineering barriers and geological environment and the minimalisation of impacts on the environment;

3) safety analyses for the draft concept of the deep underground disposal;

4) the reduction in number of exploration sites and the selection of candidate site and stand-by sites.

The development programme for deep geological disposal was launched 1996. It came from federal programme that has been modified for condition within Slovak territory. Programme was covered by SE Headquarter and later on the responsibility came to company GovCo (Governmental Company) respectively JAVYS. It is expected that the main responsibility will be taken by a new established state agency for disposal of RW.

2.6 Radioactive and non radioactive waste management

2.6.1 Waste inventory

As for their origin, radioactive wastes can be produced either during the NPP operation or during its decommissioning period. As for the state of matter, radioactive wastes are divided into the following:

- gaseous;
- liquid; and
- solid.

Each form of the radioactive waste state of matter requires a specific approach to be taken by the Operator during its collection, sorting, pre-treatment, temporary storage, final processing, conditioning and final disposal or release to the environment.

It is problematic to catch radioactive gases and they are mostly released into the air on the basis of a limit specified for each radionuclide. In case that they cannot be released at the time of their production, they are stored for the necessary time period in so-called ‘die-out’ gas holders and they are released into the air after having achieved the release limit values.

In Slovakia, operational radioactive waste is characterized by activity as follows:

- transient RAW; and
- radioactive waste.

A: Transient (temporary) radioactive waste, activity of which falls during storage under the limit value for their release into environment.

B: Low and medium active waste, activity of which is higher than the limit value for their release into environment and which produce residual heat less than $2kW/m^3$.

C: High active waste, which produce residual heat equal to or higher than $2 kW/m^3$ and which are not storable in the above-ground storage – the National Radioactive Waste Repository.

Liquid radioactive wastes produced during the NPP operation can be further divided into the following:

- inorganic;
- organic; and

- ionizes.

Inorganic liquid radioactive wastes can be further processed by means of cementation, bituminisation and vitrification in compliance with the way of their subsequent conditioning. Organic liquid radioactive wastes can be further processed by means of combustion, chemical (acid) decomposition or in compliance with the way of their subsequent conditioning. Ionizes waste is a group of liquid radioactive waste, because they are in solid state, but they are transported in the same way as liquids. Their further division in compliance with the way of their subsequent conditioning is the same as of organic and inorganic liquid radioactive wastes.

Liquid radioactive wastes originating from the NPP Mochovce Units 3 and 4 operations, as well as from the decommissioning process, will have the following forms:

- liquid waste produced by means of waste water thickening (radioactive concentrates);
- mixtures of saturated sorbents (low- and medium-active wastes);
- radioactive oils and oil products;
- diluting agents; and
- radioactive sludges and deposits.

Liquid radioactive waste sources are as follows:

- boric acid (H_3BO_3) solutions:
- decontamination solutions;
- regeneration solutions; and
- purification and detergent solutions.

Solid non-conditioned radioactive wastes can be further divided into the following:

- metallic radioactive wastes that can be either meltable of unmeltable; and
- non-metallic radioactive wastes that can be compactable, combustible, non-compactable or non-combustible.

Solid wastes can be transformed by means of a treatment into a form appropriate for the conditioning and storage. From the point of view of the conditioning to a matrix appropriate for the final storage, solid radioactive wastes can be:

- cemented;
- bituminised;
- vitrified; and
- stored in a high-integrity containers.

Wastes originating from the operation of nuclear power plants are mostly of low-activity with a short half-time and they are disposable in the National Radioactive Waste Repository, located near the Mochovce NPP, after having been conditioned by means of established technological procedures and after having been stored in a certified package set.

Radioactive wastes produced during the NPP decommissioning are sorted on the basis of the same classification procedure as radioactive wastes produced during the operation. Compared with radioactive wastes produced during the operation, there are differences in their severity and total quantities. From the disposability point of view, there can be produced also radioactive waste that is not disposable in the above-ground storage. Moreover, this includes also solid waste of such type that is not produced during the NPP operation at all, e. g. contaminated or activated concrete, activated soils, etc..

The high-active radioactive waste is a specific group of radioactive waste defined in Slovakia as waste which produces residual heat equal to or higher than 2 kW/m^3.

Handling with high-active waste includes a set of measures to reduce the effective dose received by the workers and specific personnel protection measures. The main components of high-active radioactive waste include:

- in-core parts;
- tie rods;
- absorption sections of control assemblies; and
- high-active sludges resulting from the reactor vessel bottom cleaning.

The high-active in-core parts are not processed during power plant, but stored in the Active Service Building. That waste is not included in the operational waste group, because it will be disposed during the decommissioning stage together with the reactor vessel and other primary circuit parts. Parts that must be replaced during the operation period are included in the operational waste group, e.g., absorption sections of control assemblies. Those control assembly sections are removed from the reactor core and transported in a fuel assembly container to the transport container pit. Absorption sections of control assemblies are stored in the ‘die-out’ pit in tubes sealed with plugs. Worn-out tie rods, MNT sensors, etc. are stored in a similar way. Presently, for this type of RAW it is not available any processing technology in Slovakia. However, method of high-active radioactive waste management must be resolved in the last phase of NPP decommissioning.

The following institutional radioactive waste is collected and stored in special shielded containers and disposed in premises reserved for those actions:

- emitters;
- fire detectors; and
- measuring probes.

2.6.2 Ventilation system and treatment of gaseous and airborne wastes

The ventilation system of the Mochovce NPP is made up of several technological parts, which are constructed and designed based on the task which they serve, e.g. so that the required conditions in the relevant civil object are met.

Environmental parameters are provided in three ways:

- heating and natural ventilation;
- air-conditioning system (ventilation and air-conditioning) with heating; and
- only air-conditioning providing heating, ventilation, and cooling.

These systems are important from the point of view of effect on the environment, ensuring environmental parameters of technological operations. Generally, these systems provide the following functions:

- maintenance of good working environment for service personnel;
- maintenance of good working environment for the correct function of the technology; and
- safety of service personnel.

These functions are provided by the air-conditioning system separately for non-active operations, and for active operations.

Extra attention is given to active operations where the aim of the air-conditioning is:

- creation of a good working environment for service personnel;
- contribution to internal and external safety from the point of view of facility operation;
- limit the escape of radioactive material through the air-conditioning system to the air of the air-conditioning equipment;
- control temperature loss of the technological equipment;
- create advantageous environmental parameters for the safety and reliable operation of the technology; and
- aid to remove the consequences of accidents of technological equipment, including the most severe accidents.

Air-conditioning of active operations at the Mochovce NPP is also separated into:

- technology for containment (containment envelops areas and rooms to which air vapour mixtures can spread, which occur from the release of coolant from the primary circuit);
- technical environments for active areas where pressure must not increase (airtight zone). The airtight zones of VVER 440 unit are boxes, areas and

rooms located in the reactor and to which the worst possible accident cannot spread; and

- technology for other active areas.

Air-conditioning of active operations is made up of air supply, exhaust and circulation systems. The exhaust systems of the active operations discharge air to ventilation chambers and are equipped with a filtration system for:

- radioactive aerosols;
- radioactive aerosols and iodine isotopes.

From the safety point of view and potential impacts on the environment it is logical to concentrate attention on the containment.

In the containment is located the primary circuit, part of which is barbotage system. The containment is designed to prevent the release of activity to the external atmosphere, should there be damage (accident) to the technology. Air-conditioning equipment in the hermetic zone provides all of the requirements that are placed on the technical environment for the active operation. The operational documentation strictly defines parameters for the containment which are monitored.

If there is found presence of aerosol and iodine activity in the containment during operation, a circulation filter system is installed inside the containment which reduces the volume of aerosols. The surroundings of the Mochovce NPP are protected against aerosol and iodine isotopes by filtration of the air discharged from containment.

Limitation of release of radioactive material to the external atmosphere from the containment through the air-conditioning system is realized by the installation of a filtration system. The ventilation system is fitted with a set of aerosol and iodine filters through which the exhaust air is released to atmosphere in any operating mode, i.e. also during the most severe accidents.

The ventilation systems are, from the point of their functionality, supplemented with a system of technological protection so that they will run even if some parameters are exceeded (in particular temperature and heat load of the ventilation system when the exhaust of heat is provided by a separate system).

During normal or emergency operation the ventilation system is constantly monitored and the measurement results of individual qualitative and quantitative parameters are recorded in the information system.

Ventilation of the **airtight zone** of active operations is provided by an independent air-conditioning system working independently on NPP and reactor operating mode. Airtight zones in the unit are boxes, areas and rooms in the reactor and to which the most severe accident can not spread. The airtight areas are ventilated depending on presence (periodic, permanent) or absence of service personnel. The ventilation system is under pressure in rooms where personnel is absent or periodically present, with moderate circulation of air to the rooms where activity is potentially higher. In the rooms where personnel are permanently present, value of pressure difference is not guaranteed compared to the environment.

The overpressure system creates pressure in the ventilated rooms by air circulation from one room to another, in the direction of cumulative activity. There are filters to clean the air – aerosol as well as iodine isotopes filters. The air ventilated from controlled zone is discharged to the atmosphere through air-conditioning shaft.

The air-conditioning system of active operations at Mochovce NPP is an integral part of the safety system and lead to the ventilation stack. As the air enters the ventilation stack it goes through a final quality control of the air being discharged to the environment. There are continuous measurements of 10% air flow-rate. In addition to continuous measurements the system is fitted with air sampling for periodic analyses.

For MO34, the secondary containment function has been designed also to cope with severe accidents. This function further increases the external safety minimizing the consequences on the environment in case of such an extremely unlike accident. In fact, in case of a severe accident, the secondary containment function provide for the ventilation of the rooms of the airtight zone, with the exhausted air being filtered in a filtering station before being sent to the stack.

2.6.3 Basic principles of liquid RAW processing and treatment

In the purification process of liquid active operational media, in addition to the purified product which is returned back to technological process, there are produced also concentrated RAW - concentrates which are temporarily stored in ASB (Auxiliary Services Building) in DPS 3.54.01. Also spent low-active and medium-active ion exchangers are transported to ASB.

Using the mentioned procedures, mainly fission and activation products in soluble as well as insoluble form are removed from active media to the required extent. An exception is tritium which is not possible to remove by mentioned procedures from the purified products. To maintain the required tritium concentration it is necessary to release certain amounts of water containing tritium to industrial pipe (after reaching the required dilution and meeting all legislation requirements) and from there to environment.

All liquid wastes from operation are subjected to radiological and chemical testing and in case their quality meets the specified limits they can be released to environment.

A part of wastes are liquid wastes which must be refined and subsequently subjected to radiological and chemical testing before they are released.

A part of liquid wastes can be recirculated and returned back to be reused in technological loops using NPP treatment stations.

The last group are liquid wastes which are not utilizable and cannot be released to environment. Those are the wastes which will be stored in ASB (building 801/1-02). (Auxiliary Services Building).

Those wastes are the following:

- Radioactive concentrates;
- Low-active and medium-active sorbents;
- Radioactive oil products;
- Radioactive sludges and sediments.

The main sources of liquid radioactive waste waters produced during operation, processing product of which are radioactive concentrates, are the following:

a) washing of waters for deactivation of rooms and equipment,

b) non-controlled leakages of equipment and primary circuit pipes,

c) regenerating solutions and flush water from SWTS (special water treatment station) filters flushing,

d) waters from laundering and hydraulic emptying of filters,

e) overflows from boron concentrate tank, overflows from control tanks and overflows from pure condensate tank,

f) water from radiochemical laboratories,

g) water from washbasins and showers of access to controlled area,

h) recurrent waters (decantant) from unloading yard of liquid RAW,

i) water from steam generator, or treatment station LCQ32,32,33 if it does not meet radiation standards and cannot be returned to secondary circuit,

j) heating steam condensate of evaporators and additional evaporators in start-up mode or if radiation limits are exceeded,

k) a part of service water flowing into special canalization when deaerating, draining and repairing heat exchangers (it is not active water, but it is collected and treated together with radioactive waste water), and

l) air humidity condensated on cool surfaces of equipment and pipes.

The impurities will be continuously removed from the above mentioned collected radioactive waste waters using sedimentation and subsequent filtration. Then the water will be collected in waste water tanks where it will be homogenised and chemically conditioned prior to its processing in evaporators. Steam from evaporators, after it is condensed and purified in special water polishing system, will make so-called pure condensate. This can be recirculated. The residual waste from evaporators is the above mentioned radioactive concentrate – radioactive waste.

Various technological procedures are used for purification of radioactive operational media. The basic methods are: mechanical purification, purification using ion exchangers (called also sorbents), distillation and adsorption (for gaseous RAW). The most frequently used technology for purification of liquid operational media is purification using ion exchangers. This way waters with lower salts concentration can be purified. The waters being purified are pumped through ion exchange medium (cation or anion exchange resin, or their mixture). Ion exchangers filtration efficiency decreases during operation and cannot be renewed; ion exchangers must be replaced and stored up to the time of their final treatment.

They are stored in Auxiliary Services Building. Depending on technology, where the ion exchangers were used and on activity, which they received, we can divide them into low-active and medium-active sorbents. Saturated sorbents placed in filters of special water polishing system (ŠOV), which are part of primary circuit, and of water treatment stations, will be hydraulically flushed and transported to specified tanks in Auxiliary Services Building. Low-active and medium-active sorbents will be stored in a common tank.

Storing will be identical with concentrates storing. They will be processed using appropriate technology and after treatment they can be placed at the above-ground repository.

Some technological equipment getting in touch with active media or devices are the source of contaminated oils. Liquid radioactive organic wastes such as oils, hydraulic fluids, solvents, cooling media (diphenyloxide) and various dilution agents are normally produced in NPPs.

Active oils, lubricators and dilution agents will be collected according to the type to containers which can be handled manually (PE plastic cans, PE 50 l barrels up to 50 dm3). The containers will be put in standard steel 200 l barrels. The barrels will be put in standard steel 4-barrel pallet. The pallets will be put in the specified room No.108/6 in Auxiliary Services Building, which is fitted with steel cladding. The steel barrel will be the second and the steel cladding the third jacket, from conservative point of view. This type of waste will be processed in Bohunice Processing Centre. The transport will be made using a special transport container (PKIII/barrels) meeting requirements of transport by public roads (requirements of „ADR- European agreement on international road transport of dangerous subjects“).

During Mochovce NPP operation the liquid radioactive waste include radioactive sludges which will be gradually sedimented in collection and sedimentation tanks.

The sedimented sludge from sedimentation tank will be processed by sludge fixation in matrix in technological node of sludge fixation - „in-situ fixation“. This technology will be located in Auxiliary Services Building. The concentrated sludge will be transported to homogenization unit (200 l barrel). As fixation matrix there will be used cement which will be dosed to homogenization unit together with additives. The filled-up barrels, after hardening, will be closed and transported to room No. 305 in Auxiliary Services Building for temporary storage. The fixation product is in accordance with the requirements of the ´List of approved types of RAW packages ´. The list is Annex No.6 of Limits and Conditions for the National RAW Repository. The Limits and Conditions for the National RAW Repository – Annex No.6 - ´List of approved types of RAW packages´ was approved by UJD SR Decision No. 133/2005.

The sludge fixation line will be used also for processing sludges from tanks of used decontamination solutions. The used decontamination solutions will be collected separately from other sources of radioactive waste waters. The final fixation product must meet limits and conditions for acceptance of consolidated RAW stored in Fibre Concrete Container.

Liquid RAW will be transported from MO34 Auxiliary Services Building to FP LRAW for final processing by pipe bridge (SO 400/1-04 –External transport of liquid RAW) to storage tanks EMO12 Auxiliary Services Building, or immediately to FP LRAW. The transport bridge will be placed on brackets on external facade of both ASB buildings and there must be vertical clearance for track. There will be three lines on the bridge, two of them will be heated by heating cable. One of the heated lines is preferentially reserved for concentrate transport.

The other two lines are reserved for transport of ion exchangers (preferentially route without heating cable), and the second one for recurrence of transport water.

All pipe lines are mutually substitutable, so the second heated line is a reserve for concentrate transport.

The pipe lines on the bridge will be led in a closed compartment, under the pipeline will be a drainage channel to trap any leakage. The pipe bridge will be sloped to EMO12 Auxiliary Services Building -SO 801/1-01. Draining of lines and drainage channel will be led to drainage tank placed in EMO12 Auxiliary Services Building – Room No.102/6.

The concentrate can be pumped either to storage tanks PS 1.54.01 in EMO12 Auxiliary Services Building – “Storage of liquid RAW” or immediately to FP LRAW.

For pumping sorbents there is the transport node containing sorbent decantation tank, pump for sorbent transport and pump of transport water.

A similar technological node is designed for EMO12 Auxiliary Services Building as complementation of the existing technology.

Safety of LRAW processing systems under normal and abnormal operation
The LRAW collection and processing systems are a complex system of equipment ensuring reduction of radioactivity from individual NPP technological systems. For this purpose there are the individual treatment stations. It ensues that radiation impact of operation on environment is to large extent determined by condition and reliability of treatment stations and by way of their operation. They are designed so that each station has its components doubled from safety reasons (collection and storage tanks, pumps, filters, evaporators etc.) so that in case of an accident there can be used a backup system. In spite of that the EMO 34 Basic Design will include in comparison to EMO 12 many modifications in those systems. The modifications will contribute to enhanced operational reliability and safety, so that there cannot occur any leakages to environment even in abnormal operation. During LRAW processing the requirements of UJD regulation No.53/2006 § 7 are respected regarding minimizing of waste with the aim to enhance safety and economic efficiency of their management, with maximum utilization of ion exchangers and other filtration materials in their processing. A list of conceptual modifications and design revisions has been prepared and approved which includes also measures for minimizing of LRAW origination.

Taking into account that treatment stations work with radioactive medium, they are designed in such way as to minimize risks for operation personnel and environment as much as possible. The equipment is located in hermetically closed rooms, in which the air-conditioning system produces underpressure to serviced rooms, to which controls are led. The waste water tanks are fitted with hydraulic closures, which prevent leakage of active air substances and aerosols from tanks to rooms. Safety is ensured by doubling the important technological equipment. Maintenance of specified chemical regime and control of fluid outlets and exhalation gases of purification stations and ŠOV 3 evaporator station of waste waters as sources of prospective risk to environment is ensured by control of process nominal parameters and control of media.

The system of LRAW storage is designed so that if one of the tanks is damaged its content can be pumped to a reserve tank. The tanks are classified equipment as per the UJD SR Regulation No. 50/2006 and meet its requirements at all stages. With the aim to exclude any possibility of LRAW leakage to external environment all tanks are placed in concrete rooms (cubicles), covered with cladding of stainless steel up to the height of maximum flooding of the rooms.

The system of LRAW storage is able to meet its functions in all operational modes.

In accordance with the above mentioned, the equipment is ranked to classified equipment (safety class 3), LRAW storage tanks, decantation tank of sorbents and pipelines for LRAW transport by pipe bridge to seismic resistance category 1b. The structure of pipe bridge is ranked to seismic resistance category 2a.

2.6.4 Solid radioactive waste treatment

During technological equipment operation, during repairs or maintenance in controlled area or during the handling with emitters there are produced solid radioactive wastes.

Technical solution of solid RAW management is based on the fact that the produced waste is sorted according to activity to radioactive waste and waste which can be released to environment. Any further sorting depends on its further handling. All waste produced in controlled area is handled as potentially active waste.

The radioactive wastes produced are included in the activity material flow within the waste management process and they are stored temporarily in radioactive waste storerooms or storage spaces in the Auxiliary Services Building.

The solid radioactive waste collection and sorting systems consist of the following elements:

- the collection point – temporary, permanent; and
- solid radioactive waste transfer means from their production and sorting points to the temporary storage location.

The Mochovce NPP low- and medium-activity dry solid radioactive waste management process consists of the following phases:

1) the collection, sorting and fragmentation at collection points and the storage on the nuclear power plant site;
2) the combustible solid radioactive waste carriage to the Bohunice processing centre and, following the conditioning, the disposal in the National Radioactive Waste Repository;
3) the volumetric reduction (low-pressure compacting) of non-combustible solid radioactive waste, the carriage to the Bohunice Processing Centre and, following the conditioning, the disposal in the National Radioactive Waste Repository; and
4) the conditioning of other solid radioactive waste in the waste treatment centre (cementation) and, following the conditioning, the disposal in the National Radioactive Waste Repository.

Collection points

A collection point is equipped with designated package types intended to collect relevant solid radioactive waste types in compliance with dose rates and the disposal method. Temporary collection points are established purposefully for works performed. They can also be established during the performance of common repair or maintenance activities. The waste will be transported by using common traffic tools and means (low-lift trolley) along the corridors and heavy service lifts (heavy service lift in the ASB was extended for load capacity up to

1000 kg versus former design). Waste for treatment will be stored in metal locked boxes or metal locked trolleys in the room No. 216/1.

The solid radioactive waste storage location is found in the Active Service Building. The solid radioactive waste brought to the Active Service Building is handled in rooms No.215/1, 216/1, 216/2 217, 302, and 305. The solid radioactive waste in packages is inserted in storage packages there, i.e., barrels or pallets. The solid radioactive waste is transported for the storage in those packages.

Collection points for active underwear are established at radiation control area access points on the RCA side. Those points are only intended for the collection of protective clothes or footwear, they do not serve for the collection of waste produced during activities performed within the radiation control area.

There will be created a new transport route within the conceptual modifications of solid RAW management. The route will serve for transport of modified solid wastes determined for release to environment in barrels / containers to Auxiliary Services Building. The transport route is created by manipulation area on northern side of Auxiliary Services Building. The extension of manipulation area will serve as entry of transport means. The waste determined for release to environment will be until the time of its transport from Auxiliary Services Building stored on pallets in an organized way in a reserved storage cubicle. Before transportation (after measurement on gamma-spectrometric stand) the waste will be put in a container specified for this purpose (ca 2 m^3).

Waste sorting

The waste sorting is an important element of radioactive waste management. The sorting of solid radioactive wastes in compliance with the dose rate values is to help reduce the staff radiation load during handling operations and enables to make preparations for the introduction of non-active solid radioactive waste into the environment.

Solid RAW from MO34 are concentrated in Room No. 216/1 transported to Room No.216/2 to sorting carousel. There will be solid RAW sorted into 3 groups according to measured activity. The solid RAW will be there also sorted and packed into metal 200 l barrels according to type to compressible waste, non-compressible waste, combustible waste, cloths for laundry and drying. Large-dimension waste will be fragmented on hydraulic shears, saw for wood or disintegrator of polymer foils. The pre-treated and sorted solid waste will be transported by company vehicles to Room No. 305 where it will be measured in measurement chamber, temporarily stored and later sent to Auxiliary Services Building or released to environment.

The complete overview of solid RAW management is presented in the figure 18.

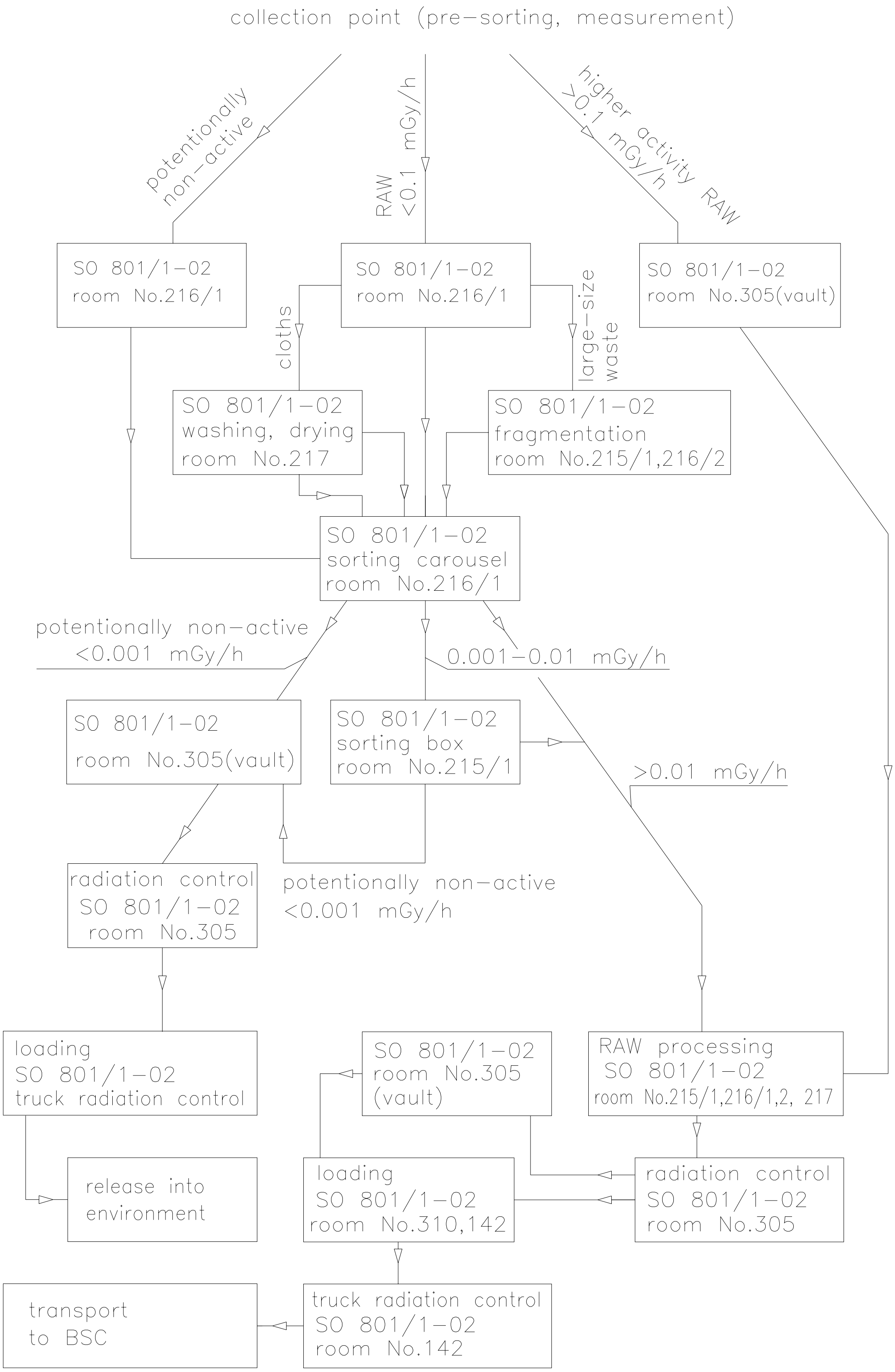


Figure 18 - Principle diagram of solid RAW management

Sorting of waste according to dose rate
According to dose rate the solid RAW are divided into the following groups:

- transient radioactive waste — Dose Rate (DR) < 1 µGy/hour
- low-active — DR 1 µGy/hour ÷ 2 mGy/hour
- medium-active — DR 2 ÷ 10 mGy/hour
- high-active — DR > 10 mGy/hour

From the disposal point of view, the solid radioactive waste originating from the NPP Mochovce operation is divided into the following two major groups:

1) combustible waste:
   - pulp - cardboard paper, wrapping paper, cotton-wool;
   - textiles - discarded working suits, textile working gloves, rags used during the decontamination;
   - plastics except for PVC - polyethylene foils and pantie-belts, polystyrene and polypropylene materials, acrylic glass shields, protective helmets, PE canisters and packages (exclusively empty);
   - protective leather footwear;
   - soft rubber material - gum-boots, rubber gloves, laboratory hoses, seals;
   - wood; and
   - adsorber fillings (active carbon);
2) non-combustible waste:
   - metallic parts of equipment (assemblies or individual parts);
   - small metallic parts (fragmentation and equipment repair remains), wires, welding electrodes, electrical wiring material, small tools, paint boxes, parts of scaffolding tubes, miscellaneous instruments);
   - asbestos;
   - PVC materials, floor coverings (concrete plastics);
   - teflon material;
   - hard rubber material (hoses, various support rubbers);
   - glass, insulation mineral wool;
   - building materials; and
   - filtration inserts.

The waste producer is obliged to sort the produced waste into the following categories:

- temporarily active waste whose surface contamination is lower than 0.3 Bq/cm^2 and the dose rate is on the background level or lower - is the “conditionally active waste” (water containing tritium is a typical example of the liquid radioactive waste, as for conditionally active solid radioactive waste, the metallic waste, combustible waste or building debris are included);
- combustible radioactive waste - textiles, working suits, protective means, pulp, paper, PE pantie-belts, foils, bags, respirators, etc.;
- non-combustible radioactive waste - small metallic waste, insulations, glass, electrical cables, seals, PVC foils;
- metallic radioactive waste - large steel pieces of technological equipment, pumps, valves, etc.;
- wet and damp radioactive waste - wet rags used during the decontamination, cleaning activities, etc.;
- HVAC filtration inserts and fillings.

Within the radioactive waste management system, the waste is sorted, measured, packed and identified in the storeroom in the following ways:

- combustible waste (except cloths) brought in PE bags is checked for the presence of metals using a light manual metal detector and visually inspected for presence of wet waste; (it is repacked to orange polyamide bags; this type of waste is sorted at collection points only if it is subsequently processed in BSC (Bohunice Processing Centre). It is processed as compressible waste; combustible waste brought directly in orange polyamide bags is checked for the presence of metals and visually inspected for the presence of wet waste;
- non-combustible waste is checked, packed in 200 l steel MEVA barrels and pre-pressed using a low-pressure press;
- cloths sorted at collection points; wet and damp cloths are washed and dried in a drier; then they are sorted in a sorting box into active and potentially non-active waste. Active waste is put in a barrel and pressed using NT press;
- Compressible waste – active waste, after measuring, is put in a barrel, pressed on hydraulic press (Room No. 217/1);
- Non-compressible waste – active waste is put in a barrel;
- No change in physical-chemical properties of the waste occurs during the waste treatment in the above mentioned ways.

The solid RAW produced in MO34 will be concentrated in the Nuclear Auxiliary Service Building (ASB building No. 801/1-02).

Other waste with its package will be put in 200 l barrels or on specified pallets.

Fragmentation equipment

In order to ensure the fragmentation of larger solid RAW pieces to achieve the maximum size of 600×800 mm that can be stored in 200 l barrels. No change in physical-chemical properties of metallic or wooden waste occurs during the fragmentation. The following equipment is assumed to be used for the fragmentation of large solid RAW pieces at MO34:

- hydraulic shears;
- circular saw; and
- mechanical filtration unit.

The use of the following existing EMO12 equipment is assumed for the purposes of radioactive waste treatment:

- low-pressure press;
- automatic washing machine with a drier;
- sorting box;
- sorting carousel;
- manual metal detector;
- workbench equipped with an exhaustion device
- PE foils disintegrator;
- 1 m^3 container RAW (2 pcs); and
- 2 m^3 container (non-active waste).

2.6.5 Radioactive waste storage facilities

The liquid radioactive waste volumetric capacities are made up of a system of closed stainless steel tanks. Tanks containing the same medium type may be operated interchangeably. In case of a tank leakage, the leaks can be pumped from the floor of the relevant room to the stand-by tank.

The assumed storage capacity for MO34 liquid waste is reported in Table 4.

Table 4 - Assumed storage capacity for MO34 liquid waste

Medium	Tank capacity
Sedimentation tank- collection tank for waste water sedimentation	1 x 460 m^3
Overflow tank – redundant water from sedimentation tank	1 x 24 m^3
Spent ion exchange resins from filters	1 x 460 m^3
Stand-by tank for ion exchange resins	1 x 460 m^3
Concentrate produced by evaporators	2×550 m^3
Concentrate – stand-by tank	1 x 460 m^3
Manipulation tank - water with sorbents	460 m^3

Solid radioactive waste is stored in one of the following package types:

- steel box pallets – bulk waste that is not stored in standard steel 200 l barrels;
- steel grate pallets – are intended for the storage of steel barrels; there are two types of pallets – for 2 or for 4 barrels;
- steel 200 l barrels where solid radioactive waste is stored, measured pre-compacted and transported;
- PE canisters, small barrels of various volumes for the collection and storage of combustible liquid radioactive waste that are handled as slid radioactive waste;
- HVAC filtration inserts stored on palettes.

The final point of solid RAW temporary storage is ASB 34, building No. 801/1-02. Solid radioactive waste is stored in rooms consisting of concrete cubicles located on the floor –1.30 m. The waste is transported to the room through ceiling openings in the height of +10,8 m. For organized, economic and safe management of solid RAW, the rooms will be equipped with steel built-in structures. The steel built-in structures will consist of fixed distance guiding grid which will serve for stacking pallets. The structure ensures stability of pallets and against swerving and falling. The steel built-in structures are made of columns and guiding profiles which will be anchored in the walls and floor, so that the guiding profiles could not be deformed. The dimensions of grid will be based on dimensions of pallets used in EMO12. The assumed dimensions of distance grid are 1500x1005 mm (for 4-barrel pallets) and 861x1005mm (for 2-barrel pallets).

The openings are fitted with hermetic steel closures, or removable ceiling covering.

The spaces for organized storage of solid RAW are divided as follows:

- 108/3 – storage of air-conditioning inserts;
- 108/4 – storage of solid RAW;
- 108/5 – storage of sorted non-active waste before it is released to environment;
- 108/6 – storage of active oils before they are transported to final processing;
- 108/7 – storage of barrels with fixed sludge.

Table 5 - Assumed storage capacity for MO34 solid radioactive waste

Cubicle designation	**Storage capacity** (ca m^3)
108/3	500
108/4	500
108/5	500
108/6	300
108/7	175

Room No. 302 (the solid radioactive waste receipt point) and room No. 305 (the SRAW loading hall) are used for temporary SRAW storage before the waste is stored in the organized SRAW storage cells or transported to the Bohunice Processing Centre.

Institutional Radioactive Waste Storage

The institutional radioactive waste is stored in room No. 302 and room No. 305 in Mochovce NPP Building 801/1-01 within the SRAW storage system.

High-Active Radioactive Waste Storage

High-active radioactive waste is stored in the storage rooms intended for absorption sections and guiding rods of control assemblies. The storage rooms are located in the Reactor Hall (room No.314). Special containers are used for handling high-activity objects. The containers are put in holes with removable covers and of variable heights depending on the waste size. Absorption sections of control assemblies, guiding rods, in-core neutron detectors, thermocouples, ionisation chambers with expired lifetimes and other smaller objects are inserted in the storage rooms. In addition to those parts, in-core parts and high-activity sludges removed from the reactor pressure vessel bottom can be included in the high-activity RAW group. They will only be disposed after the end of the reactor units operation, during putting the reactor out of service.

Storage of Radioactive Oil Products and Oils

During the MO34 operation a certain amount of contaminated oils will be produced. The contaminated radioactive oil products management procedure does not include their processing, but only preparation for transport to the Bohunice Processing Centre. Radioactive oils, radioactive oil products, dilution agents, etc., are stored in room No. 108/6 in Building 801/1-01. Based on experiences with Mochovce NPP Units 1 and 2, the production of approximately 9.5 m^3 of radioactive oils and dilution agents is assumed.

2.6.6 Disposal from radioactive waste installations

Final processing of radioactive waste

The conception of radioactive waste disposal originating from the operation of nuclear installations and other workplaces including sources of ionising radiation in the Slovak Republic is approved by Resolution of the Government of the Slovak Republic No. 190 of 8 March 1994. The FP LRAW results from the conception and its output product is (treated) RAW built-in in fibre concrete containers meeting permissible limits for the disposal/storage in the National Radioactive Waste Repository.

Technologies used during FP LRAW are the following:

- Processing of radioactive concentrates in concentrating evaporator where the salt of the concentrate is mixed with bitumen and poured to barrels; the liquid radioactive waste processing technology enables to process 5.3 m^3 of radioactive concentrate with the salinity of 200 g/dm^3 in one fibre concrete container (out of which 3.3 m^3 will be bituminised in 7 barrels and 2 m^3 cemented in one fibre concrete container),
- Bituminisation of saturated radioactive sorbents and sludges after drying in the drier and mixing with the bitumen from where the mixture is poured to the barrels;
- Cementation - barrels containing the bituminised liquid radioactive waste are put in fibre concrete container and poured with an active filler made of thickened concentrate;
- Compressible solid radioactive waste originating from the Services Building with active substances will be packed in storage boxes and barrels and put in ISO containers for transport and processing in Bohunice Processing Centre.

The maximum design capacity of liquid radioactive waste processing and conditioning by combination of bituminisation and cementation is 870 m^3/year for radioactive concentrates and 40 m^3/year for sorbents and sludges which is a 4-year production of both reactor units, i.e. FP LRAW capacity is sufficient also for MO34.

All requirements of the existing radioactive waste management system and requirements for separated collection of waste water were taken into account when preparing design of radioactive waste processing technology. The designed technology will ensure that ALARA ("As Low As Reasonably Achievable") principles will be adhered to during operation and maintenance.

Interfaces to other linked RAW management systems under conditions existing in the Slovak Republic are also important for comprehensive assessment of the designed technology:

- from both the technical and capacity point of view, the National Radioactive Waste Repository in Mochovce will be capable to store processed radioactive waste in packages(containers) from FL RWP and BPC (fibre concrete containers from FP LRAW are taken into consideration in relation to repository site extension and its additional inventory);
- there will be introduced combined transport system of fibre concrete containers from Jaslovské Bohunice to the National Repository (12 containers/transport), at present a truck with semi-trailer is used twice a week (8 containers/week), truck with semi-trailer will go to Mochovce, because there is enough time for transport of fibre concrete containers produced by BPC and FP LRAW;
- the requirement to process Mochovce NPP wastes in BPC - the Mochovce wastes will be transported to BPC for immediate processing (not for storage, it is not necessary to extend the BPC storage capacities), BPC operation management will offer sufficient capacity for processing of Mochovce NPP radioactive wastes (RAW).

The combustible waste and compressible waste processed using low-pressure press will be transported to BPC. Here it is processed to a form suitable for disposal (processing is made using combustion and high-pressure pressing) and subsequently it is transported and stored in the National Radioactive waste Repository.

Radioactive waste disposal

Following the processing and treatment, the MO34 operational wastes will be disposed in the National Radioactive Waste Repository Mochovce. RAW which do not meet acceptance criteria for above-ground storage will be stored in the Integrated RAW Storage Facility of JAVYS, a.s. in Jaslovské Bohunice and subsequently disposed in the deep underground geological storage. The RAW, which cannot be stored in the above-ground storage, include particularly metallic in-core parts that will be activated during reactor operation and processed during decommissioning stage together with other metallic RAWs.

2.6.7 Non radioactive waste management (conventional)

Disposal of waste generated at the Mochovce NPP is performed based on valid waste handling legislation and internal guidelines (PO/5100 and EMO /SM 013.05, to which a Waste Management Program and others were included) and pursuant to the Decision of ObÚŽP Levice on the disposal of hazardous waste No. T-2004/00469-ODP from 30.3.2004, Decision ObÚŽP Levice No.T-2004/00468-ODP on the collection of hazardous waste without prior separation and valid waste disposal contracts, closed with relevant authorized subjects. From March the 26th 2007 has come into force the Decision No. T-2007/00516-ODP-Z, which substitutes previous decisions.

Waste balances for the period 1996 – 2000 and 2001-2005 are reported in Table 6, Table 7, and Table 8 respectively.

Table 6 - Waste balance for the period 1996 – 2000

Year	1996	1997	1998	1999	2000
S (t)	1,113.3	386.55	898.35	1,213.668	1,070
H (t)	24.738	21.721	11.664	35.678	34
O (t)	1,302.71	332.035	3,840.54	3,876.64	8,470
Total (t)	2,440.748	740.306	4,750.554	5,125.986	9,574

Note: **S –** special waste, **H –** hazardous waste, **O -** other waste

Table 7 - Waste balance for the period 2001 - 2005

Year	2001	2002	2003	2004	2005
S (t)	1,206.6	-	-	-	-
H (t)	41.1	67.807	73.12	40.925	50.47
O (t)	7,706.4	9,603.4	5,402.99	3,282.2	3,993.88
Total (t)	8,954.1	9,671.207	5,476.11	3,323.125	4,044.35

Note: **S –** special waste, **H –** hazardous waste, **O –** other waste

Table 8 - Waste balance for the period 2006 - 2008

Year	2006	2007	2008
S (t)	-	-	-
H (t)	62.991	55.8918	269.417
O (t)	3,884.44	3,994.398	4,425,812
Total (t)	3,947.43	4,050.2898	4,695.229

Note: **S –** special waste, **H –** hazardous waste, **O –** other waste

In the period 1996 – 2000, due to the starting of operation of unit 1 (1998) and unit 2 (1999), the total production of waste increased for the overall production of sludge from the treatment of raw water. Production of other waste was generally the same for the whole period.

From 2002 the category of special waste was not recoded as it was cancelled through new legal amendments in the field of waste management and the waste was re-classified based on the valid catalogue.

In fact, the classification into hazardous and non hazardous waste is based on the system for the classification and labelling of dangerous substances and preparations, which ensures the application of similar principles over their whole life cycle. The properties which render waste hazardous are laid down in the Directive 91/689/EEC and are further specified by the Waste List Decision 2000/532/EC as last amended by Decision 2001/573/EC.

Of the 4,695.229 t of the total volume of waste in 2008, 347,558 t was assessed and 4,347.671 t disposed of , and 3,403 t of sludge was produced from purification of raw water and consequently disposed in sludge bed (Čifare), that were involved in total amount of waste category "O".

Total fees for sludge disposal in 2008 at sludge bed in compliance with Act 17/2004 Coll. on fees frp sludge disposal represents 27 224 Sk, 8 Sk/t which represents unit tariff.

An increase in the total volume of waste in 2008 compared with 2007 was caused by an increase in the generation of sludge about 108 t from the raw water treatment (it is linked with the power up rate) and caused by increasing dangerous waste what represent the production of 234 t waste of category No. 190810 fat and oil mixture comes from reconstruction and cleaning of the oil tanks on rain water sewer. The reasoning of increase of waste production category No. 190 810 the NPP EMO12 asked for change of decision of District Office of Environment to produce such amount of waste for permitting amount of waste production up to 300 t. Environment District Office issued Decision No. T-2008/02004-ODP-Z, dated by 10, December, 2008 and this change was permitted.

SE a.s. does not operate any facilities for the assessment, treatment and disposal of waste. Sludge from water treatment is deposited in a sludge bed what is a water management construction.

Collection and storage of waste is performed based on internal guidelines elaborated in conformity with valid legislation and decisions of supervisory bodies. At the Mochovce NPP site there is a central waste store and labelled areas for individual waste types. Waste is collected at the workplace when necessary and temporarily stored in the central waste store which is secured against the leaking of hazardous substances.

Waste management is performed in conformity with the requirements of the implemented environmental management system (EMS) pursuant to the standard STN EN ISO: 14001/2004. The specified long-term and short-term goals of the (DaKEC) EMS between 2000 and 2005 are incorporated into the aims of the waste management plans of causers and municipalities (POH) on the reduction of waste volumes.

Taking into consideration that SE a.s. EMO o.z. does not operate facilities for the assessment, treatment and disposal of waste, they have contracts with specialized companies for most waste for the assessment or disposal operations.

In conformity with the long-term and short-term goals specified in the environmental management system, measures have been taken for the separation of reusable types of waste and collection of secondary raw materials. Waste is separated at the point of generation in individual workplaces in dedicated and labelled containers. Separation of waste is done in the central collection and storage waste management store, where its central evidence is kept. Separation of all waste types is performed apart from municipal waste and oils, which are collected without prior separation in the sense of Decision OÚ Levice No. T-2004/00468-ODP as updated by Decision No. T-2007/00516-ODP-Z of March the 26th 2007. Measures were taken for the reduction of the volume of municipal waste with emphasis on the separation of paper, batteries and toner.

Measures for the reduction of biologically degradable waste sent to landfill – in comparison with 1995 reduced the volume of biologically degradable waste sent to landfill by more than 25%. Considering the further reduction of the proportion in municipal waste composting of this waste is planned in the subsequent period in conformity with long-term and short-term aims specified in environmental management systems.

Based on the materials provided by POH, an inventory of selected hazardous substances and site visit, the types of waste and methods of disposal reported in Table 9 are assumed.

Table 9 - Overview of assumed waste and method of disposal

EWC (European Waste Code)	Category	Name	Disposed by
03 01	**wastes from the wood management**		
03 01 05	0	Sawdust, wood shawings, wood scraps, decks not containing dangerous material,	Specialized company
05 01	**wastes from petroleum refining**		
05 01 03	H	tank bottom sludges	Specialized company
06 04	**wastes containing metal others then in 06 03**		
06 04 04	H	Wastes containing the mercury	Specialized company
06 13	**wastes from inorganic chemical processes not otherwise specified**		
06 13 99	H	wastes not otherwise specified	Specialized company
07 01	**wastes from the manufacture, formulation, supply and use (MFSU) of basic organic chemicals**		
07 01 03	H	organic halogenated solvents, washing liquids and mother liquors	Specialized company
07 01 04	H	other organic solvents, washing liquids and mother liquors	Specialized company
07 01 99	-	wastes not otherwise specified	Specialized company
07 07	**wastes from the MFSU of fine chemicals and chemical products not otherwise specified**		
07 07 03	H	organic halogenated solvents, washing liquids and mother liquors	Specialized company
07 07 04	H	other organic solvents, washing liquids and mother liquors	Specialized company
07 07 99	-	wastes not otherwise specified	Specialized company
08 01	**wastes from MFSU and removal of paint and varnish**		
08 01 11	H	waste paint and varnish containing organic solvents or other dangerous substances	Specialized company
08 01 12	O	waste paint and varnish other than those mentioned in 08 01 11	Specialized company
08 01 17	H	wastes from paint or varnish removal containing organic solvents or other dangerous substances	Specialized company
08 01 18	O	wastes from paint or varnish removal other than those mentioned in 08 01 17	Specialized company
08 01 99	-	wastes not otherwise specified	Specialized company
08 03	**wastes from MFSU of printing inks**		

EWC (European Waste Code)	Category	Name	Disposed by
08 03 17	H	waste printing toner containing dangerous substances	Specialized company
08 03 18	O	waste printing toner other than those mentioned in 08 03 17	Specialized company
08 04	**wastes from MFSU of adhesives and sealants (including waterproofing products)**		
08 04 09	H	waste adhesives and sealants containing organic solvents or other dangerous substances	Specialized company
08 04 10	O	waste adhesives and sealants other than those mentioned in 08 04 09	Specialized company
08 04 99	-	wastes not otherwise specified	Specialized company
09 01	**wastes from photographic industry**		
09 01 01	H	solutions of water soluble developing bath and activators	Specialized company
09 01 03	H	solutions of developers bath in diluents	Specialized company
09 01 04	H	solutions of fixers	Specialized company
10 01	**wastes from power plants and other combustion facilities**		
10 13 04	O	wastes of lime slaking	Specialized company
11 01	**wastes of chemical and surface conditioning metals and metal and other materials deposition**		
11 01 05	H	Acid bating removers	Specialized company
12 01		**Wastes from shaping, physical and mechanical treatment of surface metals and plastic materials**	
12 01 10	H	Synthetic thread cutting oil	Specialized company
12 01 16	H	Wastes from sand blast materials contains dangerous materials	Specialized company
12 01 20	H	Used brush tools and brushes materials contains dangerous materials	Specialized company
13 01	**waste hydraulic oils**		
13 01 01	H	hydraulic oils, containing PCBs	Specialized company
13 01 10	H	mineral based non-chlorinated hydraulic oils	Specialized company
13 01 11	H	synthetic hydraulic oils	Specialized company
13 01 12	H	readily biodegradable hydraulic oils	Specialized company
13 01 13	H	other hydraulic oils	Specialized company

EWC (European Waste Code)	Category	Name	Disposed by
13 02		**waste engine, gear and lubricating oils**	
13 02 04	H	mineral-based chlorinated engine, gear and lubricating oils	Specialized company
13 02 05	H	mineral-based non-chlorinated engine, gear and lubricating oils	Specialized company
13 02 06	H	synthetic engine, gear and lubricating oils	Specialized company
13 02 07	H	readily biodegradable engine, gear and lubricating oils	Specialized company
13 02 08	H	other engine, gear and lubricating oils	Specialized company
13 03		**waste insulating and heat transmission oils**	
13 03 06	H	mineral-based chlorinated insulating and heat transmission oils other than those mentioned in 13 03 01	Specialized company
13 03 07	H	mineral-based non-chlorinated insulating and heat transmission oils	Specialized company
13 03 08	H	synthetic insulating and heat transmission oils	Specialized company
13 03 09	H	readily biodegradable insulating and heat transmission oils	Specialized company
13 03 10	H	other insulating and heat transmission oils	Specialized company
13 05		**oil/water separator contents**	
13 05 01	H	solids from grit chambers and oil/water separators	Specialized company
13 05 02	H	sludges from oil/water separators	Specialized company
13 05 03	H	interceptor sludges	Specialized company
13 05 06	H	oil from oil/water separators	Specialized company
13 05 07	H	oily water from oil/water separators	Specialized company
13 05 08	H	mixtures of wastes from grit chambers and oil/water separators	Specialized company
13 07		**wastes of liquid fuels**	
13 07 01	H	fuel oil and diesel	Specialized company
13 07 02	H	petrol	Specialized company
13 07 03	H	other fuels (including mixtures)	Specialized company
13 08		**oil wastes not otherwise specified**	
13 08 02	H	other emulsions	Specialized company
13 08 99	-	wastes not otherwise specified	Specialized company

EWC (European Waste Code)	Category	Name	Disposed by
14 06	**waste of organic solutions, cooling compositions and foams and aerosols propelents**		
14 06 03	H	Other solutions and mixture of solutions	Specialized company
15 01	**packaging (including separately collected municipal packaging waste)**		
15 01 01	O	paper and cardboard packaging	Specialized company
15 01 02	O	plastic packaging	Specialized company
15 01 03	O	wooden packaging	Specialized company
15 01 04	O	metallic packaging	Specialized company
15 01 05	O	composite packaging	Specialized company
15 01 06	O	mixed packaging	Specialized company
15 01 07	O	glass packaging	Specialized company
15 01 09	O	textile packaging	Specialized company
15 01 10	H	packaging containing residues of or contaminated by dangerous substances	Specialized company
15 01 11	H	metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers	Specialized company
15 02	**absorbents, filter materials, wiping cloths and protective clothing**		
15 02 02	H	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	Specialized company
15 02 03	O	absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02	Specialized company
16 01	**end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)**		
16 01 03	O	end-of-life tyres	Specialized company
16 02	**wastes from electrical and electronic equipment**		
16 02 12	H	discarded equipment containing free asbestos	Specialized company
16 02 13	H	discarded equipment containing hazardous components (2) other than those mentioned in 16 02 09 to 16 02 12	Specialized company
16 02 14	O	discarded equipment other than those mentioned in 16 02 09 to 16 02 13	Specialized company

EWC (European Waste Code)	Category	Name	Disposed by
16 02 15	H	hazardous components removed from discarded equipment	Specialized company
16 02 16	O	components removed from discarded equipment other than those mentioned in 16 02 15	Specialized company
16 05		**gases in pressure containers and discarded chemicals**	
16 05 04	H	gases in pressure containers (including halons) containing dangerous substances	Specialized company
16 05 05	O	gases in pressure containers other than those mentioned in 16 05 04	Specialized company
16 05 06	H	laboratory chemicals, consisting of or containing dangerous substances, including mixtures of laboratory chemicals	Specialized company
16 05 07	H	discarded inorganic chemicals consisting of or containing dangerous substances	Specialized company
16 05 08	H	discarded organic chemicals consisting of or containing dangerous substances	Specialized company
16 05 09	O	discarded chemicals other than those mentioned in 16 05 06, 16 05 07 or 16 05 08	Specialized company
16 06		**batteries and accumulators**	
16 06 01	H	lead batteries	Specialized company
16 06 02	H	Ni-Cd batteries	Specialized company
16 06 04	O	alkaline batteries (except 16 06 03)	Specialized company
16 06 05	O	other batteries and accumulators	Specialized company
16 07		**wastes from transport tank, storage tank and barrel cleaning (except 05 and 13)**	
16 07 08	H	wastes containing oil	Specialized company
16 07 09	H	wastes containing other dangerous substances	Specialized company
16 07 99	-	wastes not otherwise specified	Specialized company
17		**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**	
17 01		**concrete, bricks, tiles and ceramics**	
17 01 01	O	concrete	Landfill
17 01 02	O	bricks	Landfill
17 01 03	O	tiles and ceramics	Landfill

EWC (European Waste Code)	Category	Name	Disposed by
17 01 06	H	mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances	Landfill
17 01 07	O	mixtures of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06	Landfill
17 02		**wood, glass and plastic**	
17 02 01	O	wood	Specialized company
17 02 02	O	glass	Specialized company
17 02 03	O	plastic	Specialized company
17 02 04	H	glass, plastic and wood containing or contaminated with dangerous substances	Specialized company
17 04		**metals (including their alloys)**	
17 04 01	O	copper, bronze, brass	Specialized company
17 04 02	O	aluminium	Specialized company
17 04 03	H	lead	Specialized company
17 04 04	O	zinc	Specialized company
17 04 05	O	iron and steel	Specialized company
17 04 06	O	tin	Specialized company
17 04 07	O	mixed metals	Specialized company
17 04 09	H	metal waste contaminated with dangerous substances	Specialized company
17 04 11	O	cables other than those mentioned in 17 04 10	Specialized company
17 05		**soil (including excavated soil from contaminated sites), stones and dredging spoil**	
17 05 03	H	soil and stones containing dangerous substances	Landfill
17 05 04	O	soil and stones other than those mentioned in 17 05 03	Landfill
17 05 07	H	track ballast containing dangerous substances	Landfill
17 05 08	O	track ballast other than those mentioned in 17 05 07	Landfill
17 06		**insulation materials and asbestos-containing construction materials**	
17 06 01	H	insulation materials containing asbestos	Specialized company

EWC (European Waste Code)	Category	Name	Disposed by
17 06 03	H	other insulation materials consisting of or containing dangerous substances	Specialized company
17 06 04	O	insulation materials other than those mentioned in 17 06 01 and 17 06 03	Specialized company
17 06 05	H	construction materials containing asbestos	Specialized company
17 09		**other construction and demolition wastes**	
17 09 03	H	other construction and demolition wastes (including mixed wastes) containing dangerous substances	Landfill
17 09 04	O	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	Landfill
19 08		**wastes from waste water treatment plants not otherwise specified**	
19 08 02	O	waste from desanding	Landfill
19 08 05	O	sludges from treatment of urban waste water	Landfill
19 08 06	H	saturated or spent ion exchange resins	Landfill
19 08 07	H	solutions and sludges from regeneration of ion exchangers	Landfill
19 08 09	H	grease and oil mixture from oil/water separation containing only edible oil and fats	Landfill
19 08 13	H	sludges containing dangerous substances from other treatment of industrial waste water	Landfill
19 08 99	-	wastes not otherwise specified	Landfill
19 09		**wastes from the preparation of water intended for human consumption or water for industrial use**	
19 09 01	O	solid waste from primary filtration and screenings	Landfill
19 09 02	O	sludges from water clarification	Settling tank
19 09 03	O	sludges from decarbonation	Landfill
19 09 99	-	wastes not otherwise specified	Landfill
19 12		**Mechanical treatment and conditioning waste not otherwise specified**	
19 12 06	H	wood containing dangerous substances	Landfill

EWC (European Waste Code)	Category	Name	Disposed by
19 12 11	H	other waste materials (including mixed wastes coming from mechanical treatment) containing dangerous substances	
20 02		**garden and park wastes (including cemetery waste)**	
20 02 01	O	biodegradable waste	Landfill
20 02 02	O	soil and stones	Landfill
20 03 00		**other municipal wastes**	
20 03 01	O	mixed municipal waste	Landfill
20 03 03	O	street-cleaning residues	Landfill
20 03 06	O	waste from sewage cleaning	Landfill
20 03 07	O	bulky waste	Landfill
20 03 99	-	municipal wastes not otherwise specified	Landfill

Note: **H –** hazardous waste, **O -** other waste

During construction of units 3 and 4 the waste generation will increase and the waste management will be in compliance with Waste Act 223/2001 Coll.on waste as amended and supplemented by other regulations, in compliance with SE, a.s MO34 technical safety requirements, Integrated safety plan of proponent, in compliance with Construction Organizational Plan, in accordance with integrated safety plans of suppliers and pursuant to the Environmental Offices Levice Decisions No. T – 2009/00160 – ODP – Z and No.T-2009/00621-ODP – Z respectively, dated by 18 March, 2009. The increase in the production of electrical energy after starting units 3 and 4 will double the generation of non-radioactive waste.

2.7 Resources consumption at the installation

2.7.1 Land

Further development of the Mochovce NPP, units MO34, has a minimal demand for new land usage. The majority of the construction (70%) is already built and used by the existing site for operational areas of EMO12. The existing auxiliary operations will also be utilized i.e. water mains etc. A minimal amount of land will be required for the construction of the required independent electrical network for connection to the Veľký Ďur distribution plant.

2.7.2 Water

Surface water

Water for the operation of Mochovce NPP is extracted from the dam at Veľké Kozmálovce on the Hron River approximately 5 km from the site (Decision of the district authorities in Banská Bystrica, No. 1094/2/177/405.1/93-M from 6.7.1993).

The volume of extracted water is given based on the water needs of the circulating cooling system of the condensers and depends on the season and external climate conditions. Operation of all four units at Mochovce NPP would require the consumption of water from the dam in Veľké Kozmálovce in the average volume of $Q_{\varnothing}$ = 1.5 m^3/s, to the maximum volume of Q_{max} = 1.8 m^3/s.

Bigger parts of solids from the withdrawal structure are collected from the extracted water, first through a coarse 3 to 5 cm hack at the inlet of the piping, and then refined, through a 16 mm hack at the entrance of the pumping station. This second set of hacks is cleaned by an automatic device and the impurities are gathered into a 3.2 m^3 tank. Water deprived of mechanical impurities is pumped from the pumping station to two reservoir tanks, each with a volume of 6.000 m^3 at the Mochovce NPP.

A total volume of supplemented water consists of the water loss due to evaporation from the cooling towers in the range of 0.85 m^3/s to 1.33 m^3/s depending on the external air temperature and humidity. A further part of the water in the range of blow-down from 0.18 m^3/s to 0.36 m^3/s is supplemented for the purpose of keeping the chemical regime in the cooling circuit. The water is discharged into the industrial drainage system, and then to the waste piping of EMO.

- Consumption of surface water in 2004 - 2008

The volume of consumed surface water in 2004-2008 is given in Table 10. In 2008, the total amount of surface water extracted was 20,626,000 m^3 from the source at Veľké Kozmálovce, which is in conformity with the yearly limits permitted by the water authorities valid for 4 units to the amount of 47,304,000 m^3/year. Once Units 3 and 4 are in operation, extraction of surface water will be doubled.

Table 10 - Volume of consumed surface water in relation to the production of electrical energy

Year	Water consumption [m^3]	Production of electric energy [MWh]	Specific water consumption [m^3/MWh]
2004	17,615,583	5,482,865	3.21
2005	19,313,417	6,239,944	3.09
2006	18,949,001	6,320,254	2.99
2007	19,994,286	6,828,737	2.93
2008	20,626,000	6,890,967	2.99

The quality of extracted surface water depends on the water reservoir at Veľké Kozmálovce, which serves for the supply of utility water to the Mochovce NPP.

A deterioration in the quality of water from the water reservoir V. Kozmálovce leads to a higher consumption due to worsening of the parameters of treated water. The deterioration of water quality is caused by sediments in the water reservoir. Their amount is estimated to be about 50% of the volume of the reservoir.

It resulted from the analysis of water consumption for operation of all four units that the permitted average consumption of 1.5 m^3/s - representing the amount of 47,304,000 m^3 per year, as stated in the valid licence, will not be exceeded.

The volume of water in V. Kozmalovce water reservoir will be sufficient for water needs of four units in operation. It is necessary, however, to monitor sedimentation in the reservoir.

Groundwater

Groundwater is extracted from two wells, HMG-1 and HMG-1/A, owned by SE in Červený Hrádok approximately 8 km away from Mochovce NPP. The maximum permitted take-off is 18 l/s for HMG-1 and 15 l/s for HMG-1/A. After treatment, the groundwater is used for drinking.

Groundwater is extracted on the basis of a decision issued by the Western Slovak Regional State Commission in Bratislava No. PLVH-4/1746, 1747/1984-8 of 29 April 1985.

Up to 2005 groundwater was mostly taken from the two wells in Červený Hrádok, and the remaining part from a substitute source in Kalná nad Hronom (Table 11). Since 2006, it has been supplied only from the drinking water source in Červený Hrádok. The supply of drinking water from the substitute sources was stopped in June 2005 following the decision of NPP management.

In 2008, the volume of pumped groundwater from the source at Červený Hrádok was 126,606 m^3, out of which 116,750 m^3 being effectively supplied to Mochovce NPP.

Currently the well at Červený Hrádok provides sufficient drinking water for the Mochovce NPP.

Table 11 - Volume of consumption of drinking water from the different sources in the period 2004-2008

Year	Volume of consumed drinking water [m^3]		
	Wells	Substitute source	Total
2004	353,940	47,167	401,107
2005	178,760	22,305	201,065
2006	96,183	=	96,183
2007	83,478	=	83,478
2008	91,378	=	91,378

The volume of extracted groundwater had a decreasing trend in 2005-2007. The reduction in the consumption of drinking water was related to the fitting of water meters at all consumption points whereby determining leaks in the distribution network which were repaired or replaced. In 2008, the volume of extracted ground water slightly increased. However, no measures beyond common activities need to be taken.

2.7.3 Raw materials

The principal raw materials' consumption for Mochovce NPP is represented by chemical, oil products and fuel. In Table 12 and Table 13 the quantities of raw materials consumed during 2008 are reported.

Table 12 - Consumption of chemical and oil products at Mochovce NPP in 2008

Raw material	Consumption [t]	Raw material	Consumption [t]
Sulphur acid H_2SO_4	278.8	AKTIPHOS Stabilizer	26.9
Sodium hydroxide NaOH	282.9	DILURIT GM AC, GM ACT	14.7
Activated hydrazine – Levoxine	15.3	DILURIT GM AC, GM Cat	28.7
Ferric sulphate $Fe_2(SO_4)_3$	1,467.9	POF KOARET	7.4
Lime hydrate $Ca(OH)_2$	2,240.0	NALCO ST70 BIOCIDE for TVD	5.4
Hydroxide ammonia NH_4OH (24%)	56.5	INHIBITOR NALCO 73 199 for TVD	2.5
Nitric acid HNO_3	14.4	Stabilizer NALCO TRASAR 3DT 195	2.0
Sodium phosphate Na_3PO_4	0.9	H_2 in Nm^3	9,972.0
Sodium sulphite Na_2SO_3	2.3	Calc-casing remover BREX	0
Boric acid H_3BO_3	6.7	TOPECOR	0
MIKROSORBAN COAGULANT	7.3	N_2 in m^3	536.1
Isolation oils, in m^3	0.6	Sodium hypochloride NaClO	1.4
Hydraulic oil in m^3	1.9	Petroleum products lubricant oils	9.3

Table 13 - Consumption of fuel at Mochovce NPP in 2008

Source	Consumed fuel
Auxiliary start-up boiler plant heated by natural gas, Mochovce NPP	724,388.0 m^3
Diesel generator station – oil fuel (motor diesel)	80.6 t

2.7.4 Energy source and self-consumptions

In order to maintain the operation of Mochovce NPP it is essential to have a sufficient supply of electrical energy. An increase in consumption is common for larger installations and self-starting systems.

The energy self-consumptions are about 35 MW (8% of rated power) for units.

2.7.5 Requirements for transport and other infrastructure

The Mochovce NPP requires transport communications for a constant flow of raw materials and waste created during its operation and for the transport of employees. The current road and rail communications are used for the majority of material flow. The transport of utility water from the river Hron and drinking water is ensured by pipelines. Transport of liquid waste to the sludge pit in Čifáre is also provided by a pipeline.

Road transport

Communication network is concentrated to the regional town of Nitra and to individual provincial towns Levice, Nitra, Nové Zámky, Zlaté Moravce and Žiar nad Hronom. The main transport routes respect the relief of the terrain and provide the following transport directions:

- Sereď - Nitra - Zlaté Moravce - Nová Baňa;
- Trnava - Nitra - Levice – Sebechleby;
- Galanta - Šaľa - Nové Zámky – Šahy;
- Dunajská Streda - Komárno – Štúrovo;
- Komárno - Nové Zámky - Nitra - Topoľčany – Prievidza;
- Štúrovo - Kalná nad Hronom – Žarnovica;
- Šahy - Kalná nad Hronom – Vráble.

Classification of the roads is in accordance with the Slovak standard STN 736101.

The most important communications in the close vicinity of Mochovce (within 20 km) are 1st class roads No. 51 Trnava - Nitra - Vráble - Levice, and No. 65 Nitra -

Banská Bystrica. Another important route is No. 64 Topoľčany - Nitra - Nové Zámky. The direction from east to west is less assessable with a less dense distribution of municipalities than the direction from north to south.

The land is properly connected to international roads. The site is connected to international road No. 65 (a part of which coincides with International E-road E571) through a stretch of approximately 33 km of road I/51. In north-south direction the region is connected to international roads No. 75 and No. 77 by the road I/51 and I/65 Trnava, Sereď, Nitra, and Zvolen.

Links to the other regions in north-south direction are provided by the road I/66 from Hungary to Zvolen through Sahy and the road I/76 Štúrovo - Levice - Tlmače.

Links in east – west direction in the region is secured by the road I/63 Štúrovo - Komárno- Bratislava.

By means of the road I/64 passing in north – south direction, a link to Hungarian highway network is provided about 9 km from Komarom town through bridge on Danube River.

Transport road 176 Kalná nad Hronom, Tlmače, Hronský Beňadik is linked to road 165 Nitra, Zlaté Moravce, and Zvolen that is a part of European road E571. In west – east direction the other transport roads are constructed, such as road 175 Nové Zámky, Tekovské Lužany, Lučenec, road 151 Nitra, Levice, Krupina, Zvolen and road 166 from Hungary to Zvolen through Šahy and road 176 Štúrovo, Levice, Tlmače.

Railway communication

The main railway in the described area is the line No. 130 Bratislava – Galanta - Šaľa - Nové Zámky - Štúrovo, which continues to Hungary. Significant railway nodes are Trnovec nad Váhom, Palárikovo, Nové Zámky and Šurany.

Other significant lines in the wider area are:

- Nové Zámky - Šurany - Zlaté Moravce;
- Komárno - Nové Zámky - Nitra - Topoľčany – Prievidza;
- Komárno – Bratislava;
- Leopoldov - Lužianky – Kozárovce;
- Galanta - Šaľa - Nové Zámky;
- Bratislava - Nové Zámky – Štúrovo;
- Zvolen - Levice - Nové Zámky.

The area has a good connection in west – east direction, because it is located on southern urban planning axis of the Slovak Republic, presented by the arterial railway line No 141-150 Leopoldov - Kozárovce - Zvolen – Košice that is fully electrified on the territory of the area. The area has a direct connection on Kozarovce station provided by railway line No 130-150 from Bratislava through

Palárikovo, Šurany and Levice to Zvolen. The links of the area with other regions in north – south direction are provided by railway line No 152 Štúrovo - Šahy - Zvolen.

Mochovce NPP is also connected to a dedicated railway branch. The construction of this railway branch to serve MO34 was permitted by the railway construction permit No. 8460/1986-13/4 issued by the Railway Administration Authority in Bratislava on 31 October 1986. As regards operation of the railway serving the Mochovce NPP, SE is authorised to operate both the railway and the transport on the railway.

The railway connection of Mochovce NPP is shown in Figure 19.

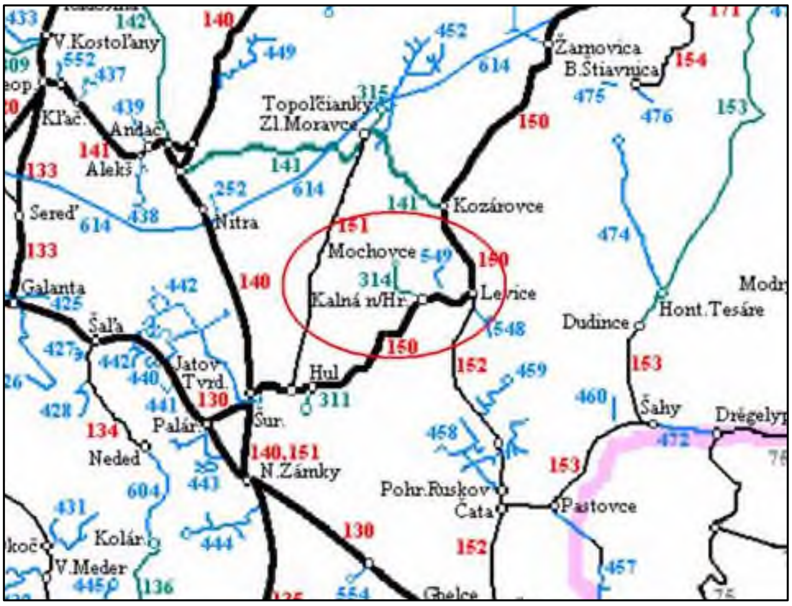


Figure 19 - Mochovce railway connection

Utility distribution

Within 20 km of the power plant there are transit, international and domestic oil and gas pipelines, and utility distribution.

Gas distribution

Gas distribution is made up of transit, interstate and domestic lines which ensure the supply of natural gas to local towns.

Transit gas pipeline passes over the border line of 20 km area of Mochovce NPP nearby Mytne Ludany, then to Dolna Sec, Horna Sec, Kalna nad Hronom, Lok, Melek, Pana and Velky Cetin. Transit gas pipeline has automatic isolating valves installed nearby to Plastovce and Stary Hradok. Aboveground parts of the gas pipeline are constructed at Mytne Ludany – bridge over water course Sikenica and at Kalna nad Hronom – bridge over Hron river.

Compressor stations of transit gas pipeline are constructed at Mytne Ludany, Tehla and Ivanka pri Nitra.

Interstate gas pipeline enters to 20 km area at Brhlovce, goes to Krškany, Hronské Kosihy, Tlmače and branches out to Tesárske Mlyňany, Žirany and to Hronský Beňadik, Tekovskú Breznicu and Novú Baňu.

Domestic gas pipeline enters to 20 km area at Babindol, goes to Malé Chyndice, Tesárske Mlyňany, Zlaté Moravce and Topoľčianky.

Minimum distance from the line part of transit and interstate gas pipeline to area of Mochovce NPP is about 7 km.

The gas distribution is operated by Slovenský plynárenský priemysel.

Oil distribution

The oil pipeline in the Slovak Republic is operated by Transpetrol a.s. Bratislava which transports the crude oil by oil pipelines of DN 500 and DN 700 from suppliers to the Czech Republic and to processing centre of Slovnaft a.s. Bratislava. Oil pipelines with diameters of 500 mm and 700 mm pass over the territory of 20 km area of Mochovce NPP simultaneously.

Nearest pumping station is a Pumping station No 4 in Sahy located about 45 km by the most direct route from the area of Mochovce NPP, Units 3&4, the next one is the Pumped station in Bucany (Trnava district).

On the territory of the related area in Sahy – Tupa branches out Druzhba oil pipeline (Transpetrol a.s. Bratislava, Pumping station No 4 Sahy - Tupá) and goes over the territory in two lines: in direction to Vrable and in direction to Sala. Both lines of the oil pipeline cross over the territory of 20 km area of Mochovce NPP, Units 3&4 at Jur nad Hronom, while the line of Vrable direction goes approximately to Bajka, Horný Pial, Iňa, Tehla, Melek, Paňa, Čechynce and the line of Sala direction goes to Ondrejovce, Dolný Pial, Trávnica, Maňa, and Mojzesovo.

On operated stage of the oil pipeline are installed isolating valves (ball closure) on pipe DN 500 or DN 700 at Malý Cetín by bridge over Nitra river 2 x GU 5,7; Vráble by bridge over Žitava river 2 x GU 5,7; Cabej - Čápor GU 5,7; Branč 2 x GU 5,7; Veľké zálužie 2 x GU 7 and GU 5;Zelenice 2 x GU 5,7; Horný Pial 2 x GU 5,7; Bajka 2 x GU 5,7; Jur nad Hronom GU 5,7; Demandice 2 x GU 5,7; Tupá GU 5,7.

Minimum distance of the oil pipe line – its line in Vrable direction from the area of Mochovce NPP, Units 3&4 is about 9.5 km.

Utility pipelines

Utility pipelines are used for long distance transport of diesel and petrol. From the town of Jur nad Hronom they continue to the north towards Horná Seč, Veľké Kozmálovce, Tlmače, Hronský Beňadik, where it braches out towards Tesárske Mlyňany and Kľačany (region of Hlohovec).

Valve shafts of the utility pipelines are located in the towns of Tupá, Demandice, Jur nad Hronom, Tlmače, Slepčany, Čechynce, Ivanka pri Nitre, Júrsky Dvor, and Veľké Zálužie.

Fuel storage is located in the towns of Kľačany and Hronsky Beňadik. The minimal distance of the utility pipelines is approximately 7 km from the power station. The utility pipelines are operated by the company Slovenský produktovod a.s.

External electrical system

EMO12 are currently in operation and the power output is fed to the nearby 400 kV distribution plant at Veľký Júr, which is connected to the surrounding distribution plants through four 400 kV lines. One line leads to the 400 kV distribution plant at Levice, one line leads to the 400 kV distribution plant at Križovany and one to the 400 kV distribution plant at Horná Ždaňa. Reserve power supply for units 1 and 2 is connected to the 110 kV distribution plant at Veľký Ďúr, which is connected to the distribution plant at Levice through 110 kV lines. The Levice distribution plant is a 400/110 kV transformer station with two 250 MVA transformers. The transformers serve as an initial source for the Mochovce NPP which is also supplied by the adjacent region.

The transmission grid 400/220 kV is part of the interconnected energy system CENTREL, which was established on 11 October 1992 among Hungary, Poland, Czech Republic, and Slovakia. This system works in synchrony with the energy system of western Europe UCPTE.

2.8 Occupational Health and Safety and workers' Radioprotection

2.8.1 Requirements for workers

In order to assure the operation of Mochovce NPP Units 1&2 approximately 1,780 employees are required. The expansion of the NPP with other two units should only lead to an increase in the number of employees by the addition of service staff in the reactor and workers that cannot be taken from the existing service staff in Units 1&2. The increase of employees will not be more than a few hundreds and the assumed total should not exceed 2,000 persons.

2.8.2 Summary of Legislation Requirements for OH&S and Radioprotection

The basic legislation on the OH&S in the SR is the Act No. 311/2001 Coll. "Labour Code" as amended, and NR SR Act No. 124/2006 Coll. on "*occupational safety and health protection and on amendments to, and alterations of certain acts*", as amended. These acts, in connection with the requirements of further legal and other OH&S regulations (as Government Ordinances and Decrees), lay down general principles of prevention and basic conditions to ensure occupational health and safety and to eliminate risks and facts related to the occurrence of occupational accidents, occupational diseases and other injuries to health resulting from the activities for SE, a.s.

The basic legislative document in Slovakia related to radioprotection is the Act of NR SR No. 126/2006 Coll. on "public health service and on amendments to, and alterations of certain acts" and the Act of NR SR No. 355/2007 on "protection, support and development of public health and on amendments to, and alterations of certain acts". It respects recommendations of the International Commission on Radiological Protection (ICRP), in particular the ICRP Recommendation No. 60 as well as its new wording, ICRP No. 103/2007, basic international standards for protection against adverse effects of ionising radiation, safety of radiation sources" and respects the Safety Series No. 115, IAEA Vienna (1196) as well as legislation valid in the EU.

The Act stipules the rights and obligations of bodies of state administration, municipalities, other legal and natural persons, the execution of state administration, and state health supervision in the area of protecting human health (hereinafter referred to as the "protection of health"). For a permit holder, the Act stipulates the rights and obligations in the area of health protection against adverse effects of ionising radiation on a human body if executing activities leading to radiation and activities important from the radioprotection viewpoint.

Legislative requirements for health protection are specified and detailed in a form of further Ordinances of the Government of the SR and Decrees of the Ministry of Health of the SR.

The following legislative regulations are in particular concerned:

- Approximation Ordinances of the Government of the SR:

  - Ordinance of the Government of the Slovak Republic No. 345/2006 Coll. laying down safety requirements for protection of personnel and population health against ionising radiation,
  - Ordinance of the Government of the Slovak Republic No. 340/2006 Coll. on protection of human health against adverse impacts of ionising radiation at medical radiation,
  - Ordinance of the Government of the Slovak Republic No. 346/2006 Coll. laying down requirements for assurance of radiation protection of external personnel potentially exposed to ionising radiation during their work in a controlled area,
  - Ordinance of the Government of the SR No. 348/2006 Coll. on requirements for provision of control of high-radioactive emitters and left emitters.
- Decrees of the Ministry of Health of the SR
  - No. 524/2007 Coll. laying down details on radiation monitoring network,
  - No. 528/2007 Coll. laying down details on requirements for radiation limitation from natural radiation,
  - No. 545/2007 Coll. laying down details on requirements to assure the radiation protection at activities leading to radiation and activities important from radioprotection viewpoint.

The Act No. 355/2007 Coll. and related Ordinances of the Government of the SR No. 345/2007 Coll. define the “basic principles of radioprotection” in the following areas:

- justification;
- dose limitation;
- optimisation of radioprotection;
- notification and authorisation;
- clearance;
- radioprotection quality assurance;
- radiation limits for employees and close population;
- qualified experts;
- technical requirements;
- safety assessment;
- records; and
- interventions.

2.8.3 OH&S Methodical Guidelines and Implementations

The Head of STS and FP department is responsible for elaboration of the methodical guidelines for organisation and control of status of OH&S. These have to be based on the generally binding regulations that are adapted to the local conditions in the form of control acts such as directives, statements and other instructions. Observance of the methodical guidelines is controlled in the framework of the control activity of the STS and FP department.

The Head of the STS and FP department evaluates individual tasks by means of analyses of occupational accident rate. Such analyses are regularly half-yearly submitted to the Plant management. In the framework of the submitted analyses, the Head of the STS and FP department evaluates observation by own or external employee with proposals for corrective measures and applies the relevant corrective measures.

Control by supervisory and superior bodies, such as SE, a.s., NIP and ŠZÚ is ensured by audits and controls. The employees of the supervisory and control bodies elaborate the records and protocols from audits aimed at resolution of raised deficiencies.

The respective heads of departments and units will ensure resolution of mentioned deficiencies on the basis of the relevant protocol or record. The record of detected deficiencies is provided by issuance of the Director's Statement or by Internal Announcement of the Director's Office Division for the particular division which was subject to the control.

Labour inspectors from NIP are authorised to enter anytime the areas of the organisation for supervision. The organisation is obliged to create conditions for such supervision. The labour inspectors from NIP suggest the teams to resolve determined deficiencies based on the finding of fact and the results of controls are elaborated in the form of protocol. Labour inspectors exercise the control in cooperation with the STS team.

Pursuant to Article 19 of the Act No. 124/2006 Coll. on labour safety and protection and on amendments to, and alterations of certain acts, as amended, the organisation has to designate and determine the representatives of employees only with their consent and after they are informed of all requirements resulting for these employees from such designation. The representatives of employees can be appointed only on the basis of elections among them.

The organisation is obliged to provide and organise training for the selected employees in the required extent for the specific workplaces of the employer and to inform them on specificities of the respective workplace of the employer.

Pursuant to Article 20 of the Act No. 124/2006 Coll. on labour safety and protection and on amendments to, and alterations of certain acts, as amended the employer establishes the Commission as an advisory body formed by the representatives of employees and representatives of the employer, mainly by the experts in a given area; the representatives of employees have to be the absolute majority. Establishment of the OH&S Commission has not to prejudice competences of the representatives of employees.

The OH&S Commission shall:

- regularly evaluate the occupational health and safety condition, the state and development of industrial injury rage, occupational diseases and other events according to Article 17 of the Act No. 124/2006 Coll., and evaluate other issues of the occupational health and safety, including working environment and working conditions,
- propose measures in the field of occupational health and safety management, control and improvement,
- comment all issues related to the occupational health and safety,
- require necessary information from the employer for discharge of its function.

According to the Ordinance of the Government of the SR No. 392/2006 Coll. on minimum safety and health requirements if using personal protective equipment, the employer is obliged to:

- perform necessary measures so that the work equipment given to the employee to be used is suitable or adapted for a respective work so that safety and health protection of the employee is assured;
- at the selection of the work equipment, to consider special work conditions and work type, risks existing in his/her workplace or in his/her area, and other risks that can occur consequently from the use of the work equipment;
- in case that at using of the work equipment it is not possible to assure the safety and health protection for the worker at full range, to perform necessary measures to minimise the risk as much as possible;
- to assure that the work equipment provided to the worker conforms to the minimum requirements for the work equipment stated in the annex No. 1 to the Ordinance of the Government No. 392/2006 Coll. unless stated otherwise by a special regulation;
- to assure that the work equipment conforms the minimum requirements set forth in the Annex No. 1 to the Ordinance of the Government No. 392/2006 Coll. and in special regulations during the whole period of its use;
- to assure that the work equipment is used in accordance with the requirements stated in the Annex No. 2 to the Ordinance of the Government No. 392/2006 Coll.;
- to assure performance of an inspection of the work equipment after its installation and before its first use, and an inspection after its installation at another place to assure a correct installation of the work equipment and its correct functionality. The inspection is performed by authorised persons according to legal and other regulations dealing with the occupational health and safety;
- to assure performance of:

    a. a regular inspection or test of the work equipment by an authorised person,

b. a special inspection of the work equipment by an authorised person always when extraordinary circumstances occur that could endanger the safety operation of the work equipment, especially a modification, failure, accident, act of a natural phenomenon, or a longer pause in its use;

- keep records on the inspection result for a period set forth by the legal regulations and other regulations for assurance of occupational health and safety so that they are anytime available to the respective regulatory bodies. If the work equipment is used out of the workplace or area of the employer, it shall be furnished at the place of its use with respective documents on performance of the last inspection.

If the use of the work equipment can specifically endanger the safety and health of the worker, the employer is obliged to perform necessary measures so that:

a. the work equipment is used by the worker authorised by him,

b. the care of the work equipment, maintenance work, repairs and reconstructions are performed by an authorised person.

With regard to character of operation of the work equipment – construction - the organisation has to:

- inform its employees with the use of work equipment;
- inform an employee on the operating rules and instructions of the work equipment;
- inform an employee on the risk that can threaten him/her or the working environment during operation;

Table 14 - Statistic assessment of the accident rate in SE from 2001 to 2008

	2001	2002	2003	2004	2005	2006	2007	2008
Average number of employees	9150	8839	8494	8009	7066	6683	6193	5712
Work hours	14841394.2	14425316.6	13777441.9	12997840.8	11456831.7	11307284	10372320.3	9692692.6
Number of occupational accidents	15	19	25	16	14	16	13	5
- fatal	0	0	0	1	0	0	0	0
- severe	5	10	9	6	6	8	8	3
Absent calendar days due to disability	534	1454	1268	680	796	833	1144	433
Frequency Rate (F.R.)	1.01	1.32	1.81	1.23	1.22	1.42	1.25	0.52
Severity Index (S.I.)	0.04	0.10	0.09	0.05	0.07	0.07	0.11	0.04

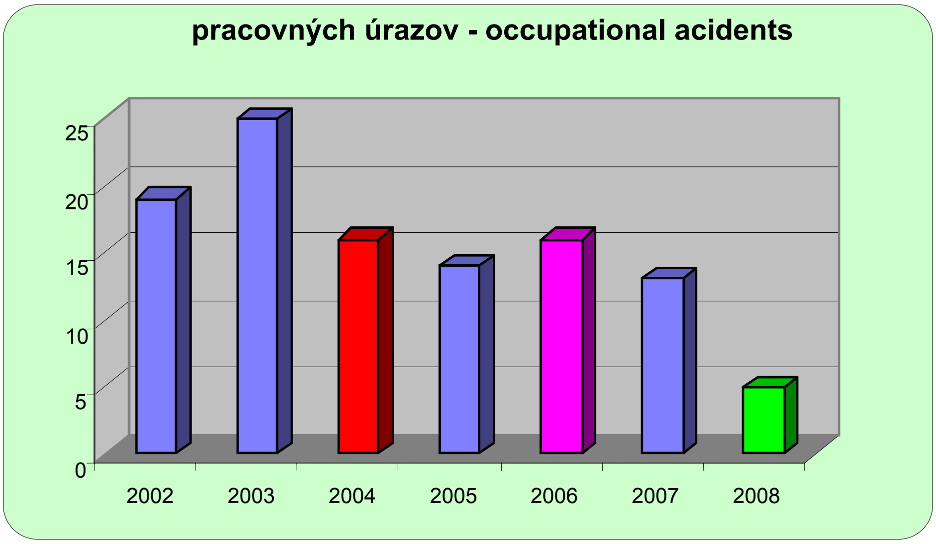


Figure 20 - Graph of occupational accidents in SE from 2002 to 2008

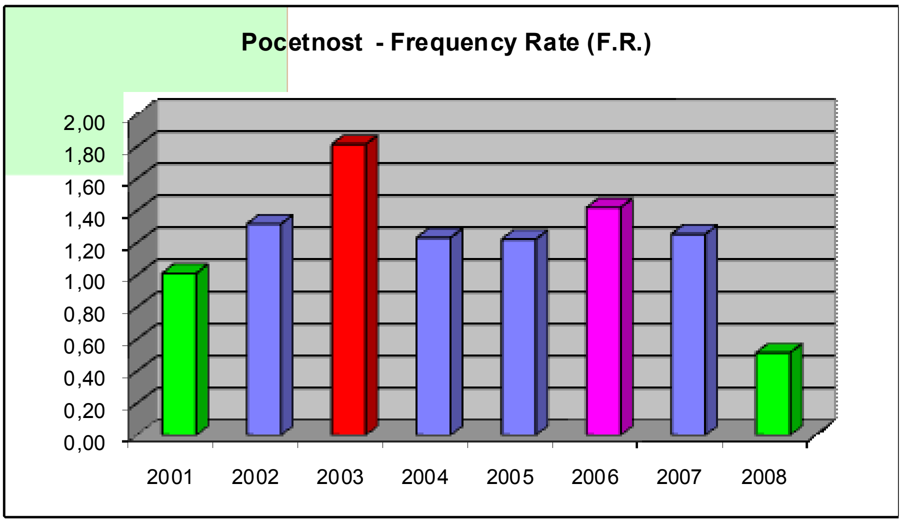


Figure 21- Frequency rate from 2001 to 2008

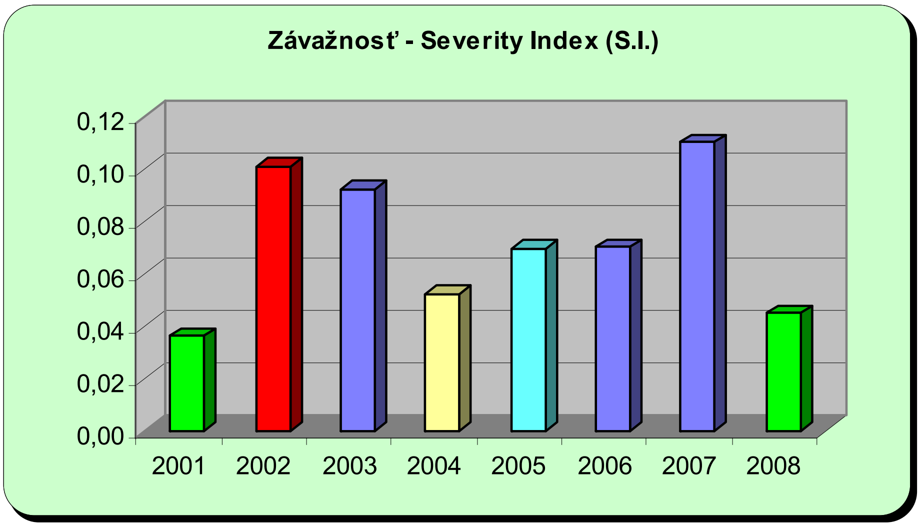


Figure 22- Severity rate from 2001 to 2008

2.8.4 Radioprotection methodical guidelines and implementations

To assure tasks of radioprotection of the NPP staff and close population, an organisational unit within EMO12 has been established. The EMO12 Radioprotection Department is organisationally included in the EMO12 Safety Department. The future MO34 operation is planned as a common one with EMO12. The main task of the Radioprotection Department is to monitor and fulfil requirements resulted from valid legislation and to assess operation from the radioprotection viewpoint that monitors respecting requirements resulted from legislation, operation radiation controls, dosimetry and supervision in the power plant organisation. This Department is included in the Division of Technical Support of the Mochovce NPP and its organisational chart (with reference to EMO12) is reported in Figure 23. At the beginning of 2009, LRKO and TDS teams were included in the Radioprotection Department.

Main activities of the Radioprotection Department:

1) Management of personnel radiation protection in the Plant premises.

2) Keeping and administration of RP systems in the Plant, including LRKO, operation of an Access to the controlled area.

3) Preparation and keeping quality documentation and internal procedures in the radiation protection area in compliance with legislative requirements, the state regulatory authorities and international recommendations.

4) Control of keeping the radiation protection requirements in compliance with clause 3, including the ALARA principle at all activities leading to radiation.

5) Performance of activities of employees' personal dosimetry with ionising radiation sources.

6) Performance of radiation protection activities and direct management and surveillance of execution of works with ionising radiation sources so that the personnel doses are below the limit and in compliance with the ALARA principles, including required PPE, radioactive waste management and radioactive materials' transport.

7) Monitoring of radioactivity in the working environment, technology, in the Plant premises and its vicinity. Monitoring of condition of technological barriers, monitoring and control of radioactive releases from the Plant so to be in compliance with the ALARA principle, proving their impacts in the surrounding environment, release of radioactive materials into the environment.

8) Execution of radiation protection activities in case of an extraordinary radiation incident required for identification of protective measures for employees and population.

9) Preparation of radiation protection evaluating reports and notifications pursuant to the regulatory authority (ÚVZ SR) requirements, the Plant management and international institutions the Plant is a member of.

10) Analysis of deficiencies and breaches of radiation protection rules and proposal of corrective measures.

11) Discharge of the function of the Plant's technical representative in the radiation protection area in compliance with valid state legislation of the SR and cooperation with the ÚVZ SR Bratislava.

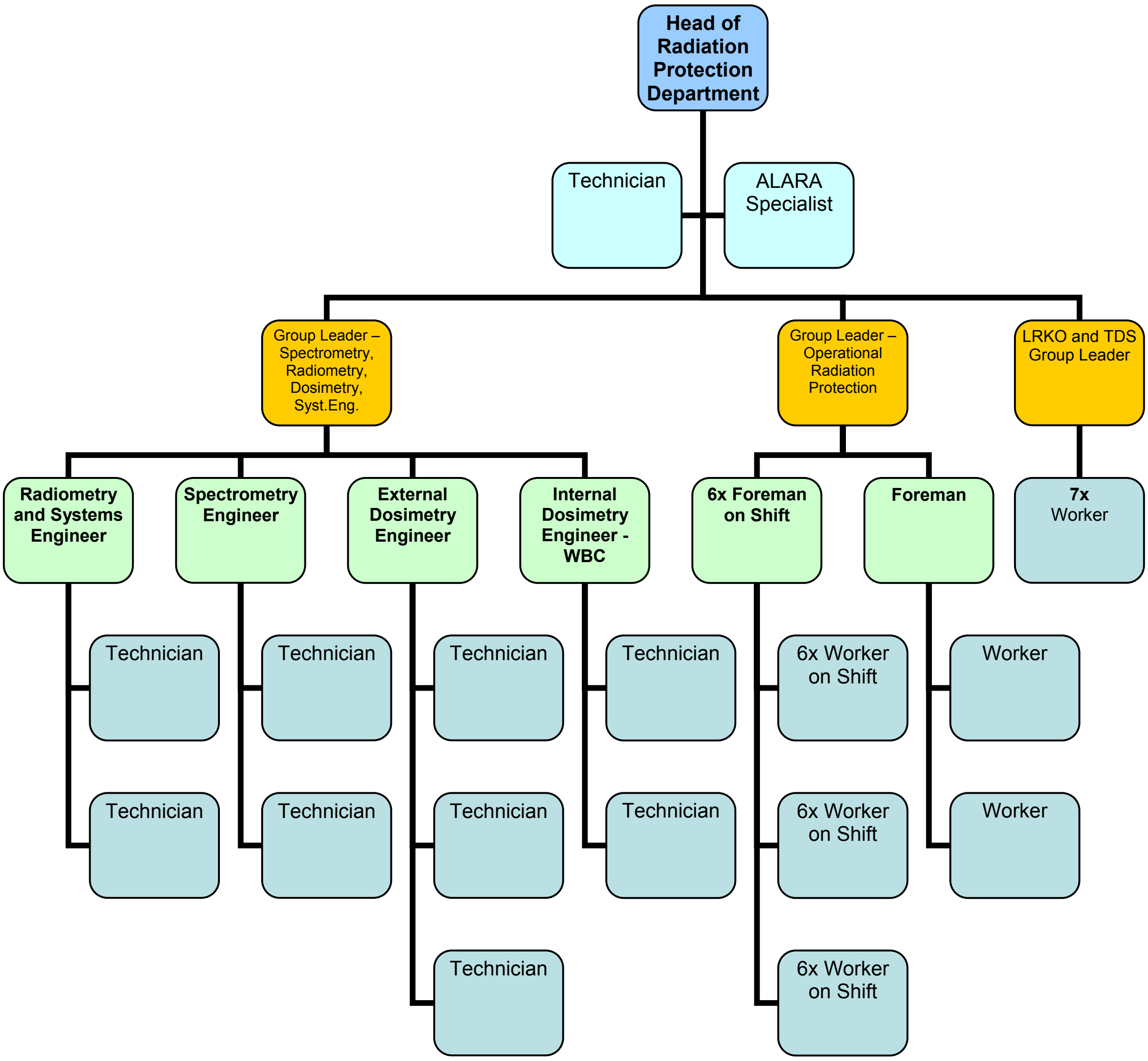


Figure 23 - Organisational chart of the Radioprotection Department

The Radioprotection Department consists of total 52 workers. The Radioprotection Department in situated in EMO12 locality, the radioprotection laboratory is situated in Levice and other staff is situated in the nuclear power plant premises.

Main activities of the unit are as follows:

- Implementation of the radioprotection programme;

- Work scheduling;
- Preliminary planning - ALARA;
- Data collection as a radioprotection feedback tool;
- Analyses and evaluation of obtained doses and radiation situation;
- Corrective measures;
- Personal dosimetry activities;
- Gamma spectrometric analysis of samples;
- Monitoring and radiation control of gas and liquid releases from the NPP;
- Control of radioactivity of materials and objects from the controlled area released into the environment;
- Monitoring of radioactivity of the environment components in the NPP vicinity;
- Radiation control of operation divided to a technological radio-control, radiation control of leaks, radiation control of workplace and RWP management.

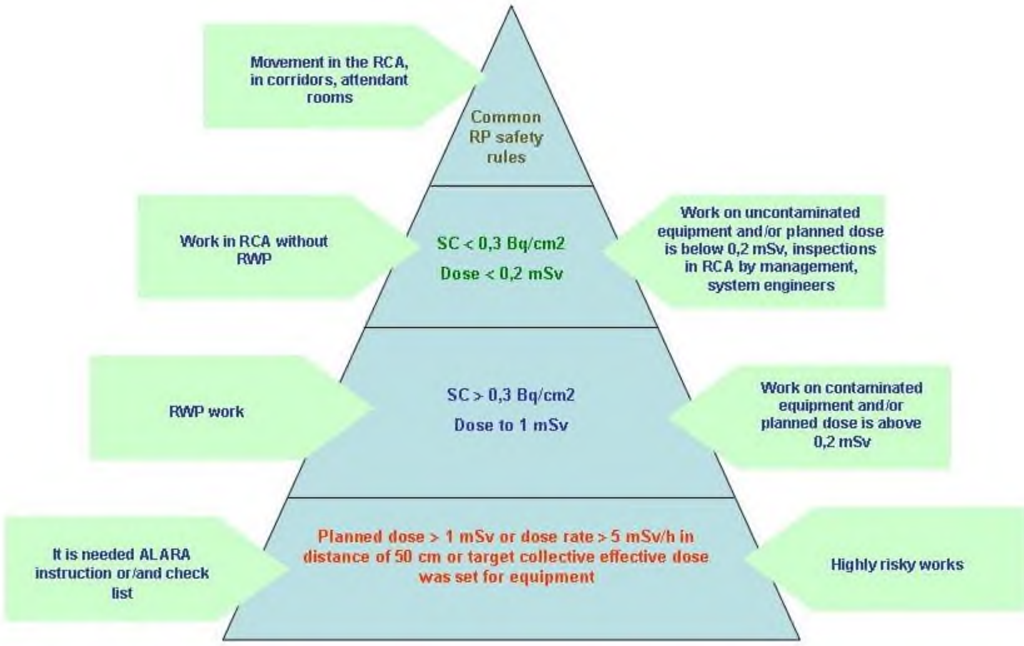
The Radioprotection Department is responsible for Radioprotection Programme implementation in the EMO plant and for this purpose it has sufficient human and financial resources, technical means and authority. The RPD has defined interfaces with other departments and its representatives participate in everyday coordination meetings during operation and in outage planning and in coordination meetings during outages.

Activities of the RPD are periodically reviewed and checked by internal and external audits, international reviews (WANO and OSART), by ÚVZ SR Bratislava as a regulatory body in the area of health protection and other controls.

In order to train employees in radioprotection and to enlarge their knowledge, a system of radioprotection rule training and testing has been established at EMO. The training deals with theoretical and practical aspects of radioprotection, correct use of PPE, contamination barrier crossing and radiation protection barrier crossing etc. The training is the same for plant personnel and for suppliers and it is a prerequisite but not sufficient condition for issuance of a controlled area entry permit. The training in radioprotection rules is made each year.

Work control under increased radiation risk conditions in the radiological controlled area

Work performed under increased radiation risk conditions is always planned and it is forbidden to perform any unplanned work under the risk of ionizing radiation in EMO NPP. Rules of work in the RCA are described in QA-07-05-Rules of common radiation protection. For the work planning in the area with an increased radiation risk, a graded approach is used (Figure 24):



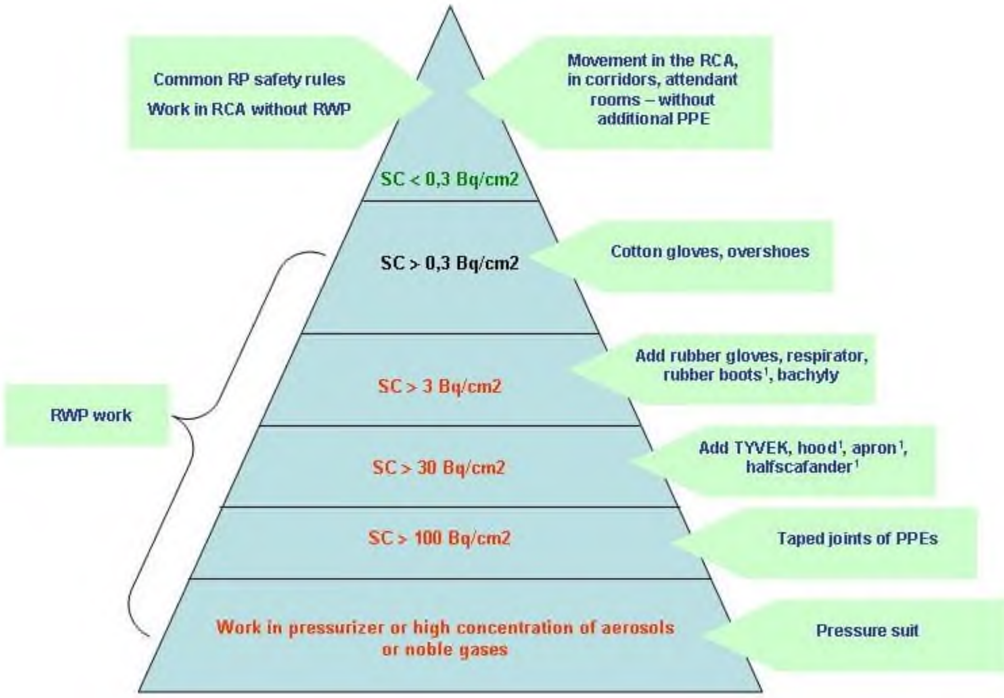


Figure 24 - Graded approach in work management under an increased radiation risk conditions (/1) and use of PPE (/2)

Areas in the RCA are classified as according to the following thresholds:

- accessible dose rate < 14 μSv/h
- semi-accessible dose rate ≤ 28 μSv/h
- inaccessible dose rate > 28 μSv/h

Equipment, tools and workplaces with dose rate higher than 25 μSv/h and/or surface contamination higher than 0.3 Bq/cm^2 are posted with stickers showing a radiation warning sign and information on a specific kind of risk. "Hot" spots are identified and posted as well. "Hot" spots in technology lines or "traps" are cleaned by flushing or decontamination.

Regular survey of radiation is performed according to plant procedures with the aim of finding in the RCA any non standard radiological situation. Results of the survey are reported and archived, and these data together with data from the stable radiation monitoring systems are kept in Dosimetry Control Room, where the shift personnel of radiation control is located. The Head of Radioprotection Department is responsible for continuous radiological situation monitoring and radiation work control under an increased radiation risk conditions, and he/she performs the RP deputy in compliance with valid legislation requirements.

The only access to and exit from the radiological controlled area are via change rooms (an access to the controlled area). They are a physical boundary between the NPP radiological controlled area and other NPP spaces. They are situated in the operational building 840/1-01 and there are three floors for men at levels +10, +14 and +18 m and one for women at the level +23 m. They consist of lockers for personal clothes on the "clean side", lockers for PPE on the "hot" side, showers, surface contamination monitors for personnel monitoring and for tools (apparatus, aids, tools used at performance of activities in the RCA) and personal items (identity card, keys etc). Entry into the RCA is permitted only in special personal protective equipment (PPE). If going from the "hot" to the "clean" change room through measuring apparatus, only personal underwear is acceptable. The basic PPE are white socks, white T-shirt, trousers with white shoes, white overalls with red stripes. A hard hat is obligatory at the entry to the reactor building 800/1-01. Used basic PPEs are sorted according to level of contamination, washed in the specific laundry situated in the operation building 840/1-01 and reused, if possible.

In case of an emergency there are many emergency exists that can be unlocked by means of an exit knob.

Cleaning of spaces and equipment with potential surface contamination occurrence is performed in order to keep cleanliness and possible contamination as low as reasonable. Water from cleaning can be poured only into the specific sewage points. In the RCA it is permitted to use only authorised vacuum cleaners with HEPA filters or with a water filter.

Storage of equipment, tools and manipulations in the RCA is ruled by a specific procedure for the given purpose. For tools and specific machines and equipment used in the RCA there is a "hot" workshop designed for the purpose, together with a tool storage area and a decontamination workshop.

Control of occupational exposure

Based on results of radiation survey and monitoring, measures on reduction of radiation sources are taken. Places, lines or technological parts with higher dose rate are shielded by stable or temporary shielding. The technology is, if possible, filled with coolant or medium in order to reduce dose rate. Various alternatives are used for dose optimisation in order to reduce doses of personnel. Usually it is achieved by reducing one of the following factors:

- distance from the source (including shielding, workplace preparation etc);
- reduction of time needed for work performance (i.e. qualification of workers, training of workers, pre-job briefing, light, communication means, access to the workplace, manipulation means, procedure preparation etc);
- reduction of number of workers;
- cooperation of workers with RP staff;
- taking measures against spread of contamination.

Control of work under an increased radiation risk conditions is regulated by administrative requirements for radiation work.

In case the work should be done in areas and at equipment with the anticipated dose higher than 0.2 mSv or the surface contamination higher than 0.3 Bq/cm2, works can be done only with an RWP. The RWP as a written and permitting instruction for execution of activities under an increased radiation risk conditions defines conditions of work execution and responsibilities of individual employees before, during and after the work execution. It is valid for a shift (16 hours at most) and an anticipated personal effective dose should be 1 mSv at most. It is archived 1 year from the end of activities.

In case the work should be done on non-contaminated equipment and anticipated dose is less than 0.2 mSv, the RWP (a radiation work permit) is not requested. If any of the criteria are not fulfilled, the RWP is requested.

If the anticipated dose of a worker is higher than 1 mSv or an anticipated collective effective dose, ALARA procedure and permission for the dose are needed, and in any case this permission is authorised by the Head of RPD.

If the dose rate at 50 cm distance from the source surface is higher than 5 mSv/h, a specific check-list has to be prepared. This check-list is a list of single steps for performing the specific job. The next step is accepted only in case the previous step has been performed and criteria defined in advance are met. The check-list contains also safety measures in case of anticipated events (loss of power, loss of crane control etc).

As a help for work leaders on RWP, there are ten “rules” elaborated in a simplified form for minimisation of workers’ doses and for how to prevent spread of contamination.

The personal dosimetry is managed by means of film badge dosimeters. The film badge dosimeters are obligator for every worker in the RCA. They are evaluated usually once per month. Beta and gamma dose is measured. For operative personnel and visitors' dose monitoring, an electronic personal dosimeter (EPD) system is used. The EPD measures beta and gamma radiation doses. Use of such dosimeters in the radiological controlled area is obligatory for all persons.

In case of inhomogeneous radiation field at workplace, there are additional dosimeters. For this purpose, mainly the TLD dosimeter that measures gamma radiation is used. Such a dosimeter is also suitable for hand dose measurement as a ring dosimeter (this is usually the case of chemistry workers and radioactive waste treatment workers). For the specific rooms, as for example primary coolant pumps room personnel has to wear the neutron dosimeter as well.

In case of loss or damage of the film badge dosimeter, the dose is evaluated by the prescribed procedure.

Together with the hardware, in EMO12 is being used SEOD software that ensures that we keep dose of workers in an online system below dose limits and authorised dose limits. The software is working online with the so called ARSOZ system. Internal contamination of workers is measured in the whole body counter laboratory. For the purpose a fast counter is used – so called quick body monitor. In case of workers from internal contamination risk group (decontamination workers, cleaners, primary circuit operation shift personnel etc.) gamma spectrometry system using a whole body counter is used, and there are also laboratories for bioassays measurement. Urine is routinely monitored for H^3. Doses from identified intake are calculated using IAEA documents or specific software (LUDEP).

As regard personal dosimetry, an integrated system is in use at EMO plant. It comprises check of health examination (fitness), results of professional ability (test results), doses of the person according to requirements of ICRP (last 5 years), lifetime dose, annual dose and monthly dose. The doses are recorded in quantity effective doses, equivalent doses for lens, for hands, feet, skin etc. Calibration of dosimeters and WBC laboratories is authorised by the State Metrology Institute.

Figures 25 and 26 show the collective dose and the maximum individual dose for workers of EMO12 and contractors from the start-up till 2008. The low exposure (e.g. compared with WANO performance indicator) indicates strong management attention to radiological protection.

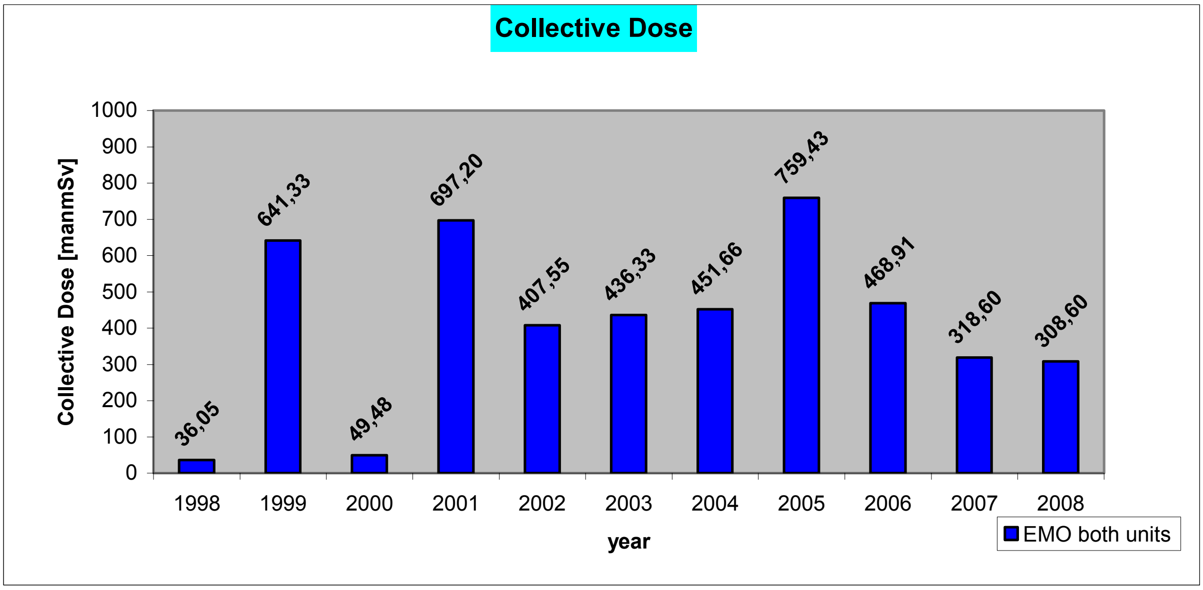


Figure 25 - Workers' collective doses

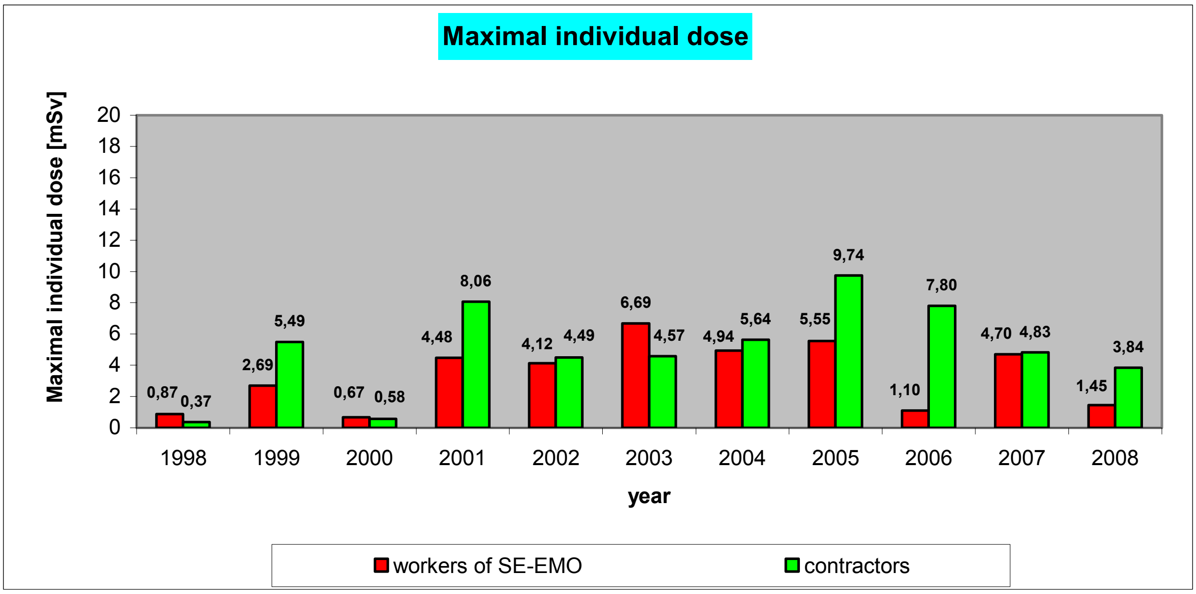


Figure 26 - Workers' maximum individual dose

The Ordinance of the Government of the SR No. 345/2006 Coll. states the following limits for workers' professionally exposed of A category:

a) effective dose of 100 mSv during five successive calendar years and the effective dose in each calendar year must not exceed the value of 50 mSv,

b) equivalent dose in eye lens of 150 mSv in a calendar year,

c) equivalent dose in skin of 500 mSv in a calendar year that is specified as an average dose on a surface of one cm^2 of the most exposed skin regardless the irradiated skin surface size,

d) equivalent dose in upper extremities from fingers up to the forearm and in legs from feet up to ankles of 500 mSv in a calendar year.

The Ordinance of the Government of the SR No. 345/2006 Coll. states the following limits for population exposed:

a) effective dose of 1 mSv in a calendar year,

b) equivalent dose in eye lens of 15 mSv in a calendar year,

c) equivalent dose in skin of 50 mSv in a calendar year that is specified as an average dose on a surface of 1 cm^2 of the most exposed skin regardless the irradiated skin surface size.

Radiation Protection Instrumentation and Facilities

Radiological control in the NPP is a set of radiological parameter measures (radiological monitoring) of environment and media that are required for assessment of a radiation risk and contamination of NPP staff and population with radioactive substances. The basic aim of radiological control in the NPP is a systematic radiological monitoring required for provision of the NPP staff and the NPP surrounding population protection against adverse effects of ionising radiation under normal and abnormal operation conditions as well as at emergency. The radiological control (monitoring) enables to control radioprotection means and measures.

With regard to an obsolescence of equipment of the original MO34 basic design for the radiological control area, incompleteness of supply and problems at provision of supply and service of radioprotection equipment, it was decided to supply a completely new radiological control system to MO34.

The MO34 radioprotection basic design review comprises the following:

- Radiological control in the Unit 3 or 4 power block,
- Radiological monitoring – additional equipment,
- Laboratory for dosimetry apparatus repair, and
- RD apparatus calibration laboratory.

Radiation control in the main production Unit 3 and 4

The aim of radiological protection in the power block, i.e. in the reactor building, the turbine hall, the nuclear auxiliary service building, the venting stack and in the NPP premises is to systematically and permanently monitor levels of radiation situation of the environment, to control levels, movement and collection of activities in technological circuits and equipment, to control function and leak-tightness of equipment including radioactive substance release prevention barriers, to control levels of radioactive releases from the venting stack, radioactive waste, to provide for control of surface contaminated working areas, equipment and personnel in working premises to assure the radioprotection of the NPP staff and population in the NPP vicinity.

The system of radiological control is from the function view divided into:

- control of radiation situation of working environment (radiological situation), and
- radiation control of technological circuits.

From the viewpoint of permanent and operative measurement, the radiological control system is divided to:

- a centralised remote measurement radiological control information system;
- a stationary apparatus individual (autonomous) system;
- a stationary apparatus system for local measurements;
- portable devices;
- laboratory evaluation of medium, filter, abrasive wear samples etc..

The radiological control draft design specifies some applied and agreed changes:

- Innovation of the radiological control system that consists of change of the centralised radiological control information system SEJVAL, including autonomous radiological control apparatus and systems. The new system will be integrated into the MO34 information system and the following safety measures implemented in EMO12 will be included:
  - OP11/2 – Continual primary circuit gamma spectrometry;
  - OP11/3 – Monitoring of steam generator leaks by measurement of 16 N and total radiological situation at main steam lines;
  - OP11/4 – Essential service water volume activity measurement downstream the emergency core cooling system coolers;
  - OP11/5 – Replacement of gas release measurements from the NPP vent stack;
  - OP11/7 – Computer superstructure of radiological control monitoring systems;
  - OP11/8 – Emergency release measurement in the NPP vent stack;

  - OP11/9b – Emergency measurement in the NPP containment and the reactor hall;

- Establishment of a centralised workplace for optimisation of operation and control for all units 1-4 in the EMO12 radiological control room.

- Completion of quick closing valves to sample lines of the radiological control of air masses for the radiological control system from the containment so the localisation group consists of 2 quick closing valves without additional line components.

- Output of the entire power plant radiological control system data to the MO34 radiological control room. Data of the entire power plant radiological control system (teledosimetry system - connection to OP-11/9a, radiological control of the environment, waste water measurement at the NPP boundary - connection to OP11/6) output from the EMO12 radiological control room to the MO34 radiological control room is concerned. Information that has to be assured for the MO34 operation is concerned.

- Completion of the safety measure OP11/1 – Personal dosimetry for emergency monitoring, to assure operative and emergency dosimetry of the MO34 staff and completion of 4 intelligent readers and assure of connection to the information network with personal doses database (ARSOZ) in the access room to the MO34 radiological control room and to intermediate circuit radiological control room (No. 504/1) and steam generator sanitary closure rooms (No. 253/1,2) of both units, to rooms where office network must be installed where the ARSOZ system is operated (the power plant information network).

- Completion of safety measure OP11/9d – modification of the staff monitoring in the access to the controlled area in the operational building for MO34 needs. Completion of the whole body monitors with α/ß radionuclides and contamination of small items at the controlled area exit – one set for a men‘ change room (at the 4th floor +18.90 m) and one set for a women‘ change room at the 5th floor +23.10 m. Both change rooms shall be fitted with a tool monitor. Information from the whole body counter monitors and tool monitors will be transmitted to the existing radiological control system in the EMO12 radiological control room.

- Completion of the radiological control laboratory in the operational building with a complete gamma spectrometry system (detector, shielding, electronic modules, PC, SW and accessories) for measurement of substance, filter, abrasive wear samples etc. from the MO34 operation.

- Completion of the radiological control in the secondary gate house 652/101. The gate house will be completed with a set for monitoring transportation means and a frame for monitoring persons.

- Completion of environment and personal contamination monitoring on a radioactive waste treatment workplace in the nuclear auxiliary service building (rooms No. 215/1 and 305) and completion of the workplace with a facility for measuring radioactive waste barrels.

Within the radiological control – the completion is assured by:

- EPDS;
- measurement of personal contamination in the access to the controlled area;
- measurement of contamination of persons and vehicles at their exit through the secondary gatehouse (CS 652/1-01);
- laboratory gamma spectrometry system in the operational building (CS 840/1-01, room No. 203) intended for laboratory analysis of liquid and gas samples of operating media and filters.

Calibration of radiological control apparatus

There is already constructed and put into operation a radiological control apparatus calibration laboratory at Mochovce NPP within the EMO12; it is fitted with instruments for calibration of ionising radiation meters at Mochovce NPP. The new radiological control system for MO34 supply requires to complete the calibration laboratory.

Within the radiological control system supply, equipment and means for the calibration laboratory will be selected and supplied so to enable to calibrate all delivered apparatuses for ionising radiation monitoring. In particular holders of detection units, electronic blocks – evaluating units with particular software –are concerned.

Safety measures were implemented to increase the safety level in Mochovce NPP. Within the radioprotection, the following safety measures were implemented (reference document R.G.1.97 rev. 2):

- a new redundant system of gas releases monitoring, including an isokinetic representative sampling system;
- a new redundant system of liquid releases monitoring, including sampling and independent device for sampling;
- a EPD dosimetry system with hardware, software, reading and calibration equipment;
- an N16 monitoring system at the main steam lines to monitor leaks from the primary to the secondary circuit;
- a new system monitoring the cooling service water radioactivity - RHRS (residual heat removal system);
- an online gamma spectrometry of the primary circuit coolant radioactivity;
- an emergency monitoring system of technology for a dose rate in the containment, in the reactor hall, in the shaft (the shaft common for both units because the plant has been proposed as a doubled at each main steam line);
- a teledosimetry system with two circuits:

- the first circuit is within the fenced plant premises (16 detectors of dose rate, 4 stations continuously monitoring aerosol and iodine concentration in air);
- the second circuit is within the zone 3 - 5 km from the plant premises (in each from 16 sectors, a dose rate monitoring station and aerosol and iodine sampling equipment is installed; additional 4 stations continuously monitor aerosol and iodine concentration in air and they are situated in more populated areas).

The personal dose assessment of EMO staff is made according to the ICRP recommendations. The evaluated effective dose quantity is traceable up to the first national standard. The film badge dosimeters are calibrated in the plant calibration facility that has been authorised by the State Metrology Institute.

2.9 Release of airborne effluents in normal conditions

One of the sources of gaseous discharges is the primary coolant decontamination system. The primary coolant becomes contaminated during the operation of the reactor through activation of the impurities present in the coolant and through fission products that may enter the coolant from a failed fuel element. The primary coolant decontamination system is designed to keep the activity level in the primary coolant system within specified limits.

The system operates at primary coolant system pressure. In addition, it also removes corrosion products that are present in the coolant. Part of the coolant is taken from the disconnectable section of each circulation loop, cooled in the heat exchangers and returned to the primary coolant system. In this process, non condensable radioactive gases are gathered and sent to the radioactive gas purification system.

The radioactive gas purification system removes radioactive gases. In the blow-down system, these gases are diluted with Nitrogen, removed from the primary circuit, and directed into the special gas cleaning system.

For releasing (discharging) gaseous and liquid radioactive substances into the ambient of the NPP, limits are determined. The purpose of these limits is to ensure that the discharge of radioactive products (whether liquid or gaseous) into the ambient of the NPP under normal conditions as well as abnormal operation does not cause the value of effective exposure of 0.250 mSv/year of individual citizens to be exceeded in the whole region due to the operation of the NPP.

2.9.1 Permit to release gaseous radioactive substances into the environment

The permit to release gaseous substances into the environment in the manner of their discharge in pollutants through a ventilation stack under normal conditions is given by a permit of the Office of Public Health Care of the Slovak Republic No 000ZPZ/6274/2006 of 2 November 2006.

This decision set the conditions for operation of EMO12 (Table 15) including the yearly limit of emitted activity of noble gases ($4.1 \cdot 10^{15}$ Bq), iodine radioisotope ^{131}I in total gaseous and aerosol forms ($6.7 \cdot 10^{10}$ Bq) and radionuclide mixtures (except ^{131}I) in aerosol with half-life greater than 8 days ($1.7 \cdot 10^{11}$ Bq).

In addition, it sets reference investigation levels for releases to atmosphere for radionuclides of noble gases ($1.1 \cdot 10^{13}$ Bq/day), iodine radioisotope ^{131}I in gaseous form ($1.8 \cdot 10^{8}$ Bq/day) and radionuclide mixtures in aerosol ($0.5 \cdot 10^{9}$ Bq/day) and also intervention levels for release to the atmosphere for radionuclides of noble gases ($5.5 \cdot 10^{13}$ Bq/day), iodine radioisotope ^{131}I in gaseous form ($9.0 \cdot 10^{8}$ Bq/day) and radionuclide mixtures in aerosol ($2.5 \cdot 10^{9}$ Bq/day).

The decision also sets the requirement for continual monitoring of total bulk activity of noble gas radionuclides, total bulk activity of aerosol and bulk activity of iodine radioisotopes ^{131}I in gaseous form, in gas emissions; dose loads for balancing and evaluation of gaseous emissions, and the reporting requirements to the Office of Public Health Care of the Slovak Republic.

The decision is valid until the 1st of November 2011.

Table 15 - Yearly limits, reference investigation levels and intervention levels for releasing radioactive substances into the environment under normal conditions for EMO12

	Yearly limits	Reference investigation levels	Intervention levels
Radionuclide of noble gases	$4.1 \cdot 10^{15}$ Bq	$1.1 \cdot 10^{13}$ Bq/day	$5.5 \cdot 10^{13}$ Bq/day
Iodine radioisotope ^{131}I	$6.7 \cdot 10^{10}$ Bq	$1.8 \cdot 10^{8}$ Bq/day	$9.0 \cdot 10^{8}$ Bq/day
Radionuclide mixtures	$1.7 \cdot 10^{11}$ Bq	$0.5 \cdot 10^{9}$ Bq/day	$2.5 \cdot 10^{9}$ Bq/day

In 2008, for gaseous discharges, the percentage of using of the annual limit for noble gases was 0.037 %, for iodine ^{131}I 0.00027 %, and for aerosols 0.0049 % of the permitted annual limit for EMO12.

2.9.2 Technical aspects

Gaseous radioactive substances from containment and from some selected areas of the controlled zone are conducted through the ventilation system to the ventilation stack (one shared by both units, MO34). Exhaust gases are conducted through a system of filters.

Should there be aerosol or iodine in the hermetic areas there is a circulation filter system installed to reduce the volume of aerosol in order to protect the surroundings of Mochovce NPP against aerosol and iodine isotopes.

The ventilation systems are supplemented with a system of technical measures so they will function even if the environmental parameters are exceeded (in particular temperature and temperature load of the ventilation system, when heat extraction is provided by an independent system).

During normal operation the ventilation system is constantly monitored and the results of measurements of individual qualitative and quantitative parameters are recorded by an information system.

Ventilation of areas of the containment is provided by an independent air-conditioning system, which works independently of the regime of the operation of the NPP and the reactor. Air tight zones of the areas in the block are boxes, areas and rooms in the reactor to which the worst possible accident can not spread. Air tight areas are ventilated based on the presence (periodic, permanent) or absence of service staff. The ventilation system is for areas with an absence of service staff and periodic presence of service staff under pressure with a moderate circulation of air to areas with a potentially higher activity. Areas with permanent presence of the attendance staff do not have a guaranteed value of pressure difference compared to its surroundings.

The outflow system creates pressure in the ventilated areas by the flow of air from one area to another in the direction of cumulative activity. Filters are fitted to clean the air, including aerosol filters and also iodine filters. The ventilated air from the controlled zone is discharged to the atmosphere through an air-conditioning stack.

The safety system includes a ventilation system of the all active operations of the NPP.

The ventilation systems of active operations of Mochovce NPP (including the FSKRAO-LRAWTF) are led into a ventilation stack. At the end of the ventilation stack it is present a final quality control of the discharged air to the environment with continual measurements taken of 10% of air flown. In addition to the continual measurement the system is fitted with an air sampler for periodic analysis.

The effectiveness of the filtration ranges from min. 99.97% (for standard oily mist) to 99.5% for iodine filters (for methyl iodide).

All of the calculated values of individual and collective doses during normal conditions are below the limits pursuant to the Atomic Energy Act 541/2004 Coll., Act 355/2007 Coll. on public health and Govermental decree No. 345/2006 Coll. on basic protection requirements for protection of employess and public aginst ionizing radiation.

2.9.3 Radioactive discharges to atmosphere from other installations

The only installation at Mochovce NPP which emits to the atmosphere are the NPP itself with the ventilation system from units 1 and 2, and from the final processing of the liquid radioactive waste – FSKARAO (LRAWTF). This facility does not have its own air emissions. The ventilation system of the LRAWTF is connected to the ventilation system of Units 1 and 2 of the NPP. The pathway from the LRAWTF to the ventilation system of the NPP is monitored independently.

The safety report for the LRAWTF evaluated the impact on the critical group of inhabitants and concluded that the “systems provide a sufficient guarantee of negligible impact on the environment”.

2.9.4 Monitoring of discharges

The main source of radioactive emissions to the atmosphere during operation are technological equipment for the treatment and degasification of cooling water from the primary circuit, which can reach the working environment through various ways through the air-conditioning system and the ventilation stack. Radioactive substances discharged to the atmosphere are made up of gas, aerosol and iodine. Total flow volume of discharge is approximately 5.10^5 Nm^3/hour.

Table 16 shows data obtained from measurements by instruments located in the ventilation stack and from laboratory analyses.

Table 16 - Balance of radioactive substances discharged to the atmosphere

Year	Noble gases		I-131		Aerosols	
	Annual limit [GBq]	4.1E+06	Annual limit [MBq]	6.7E+04	Annual limit [MBq]	1.7E+05
	Exhaust [GBq]	% of the annual limit	Exhaust [MBq]	% of the annual limit	Exhaust [MBq]	% of the annual limit
1998	7,890	0.192	77.25	1.2E-01	13.62	0.0080
1999	12,507	0.305	108.57	1.6E-01	24.13	0.0142
2000	14,412	0.352	56.53	8.4E-02	10.92	0.0064
2001	12,712	0.310	14.65	2.2E-02	17.77	0.0105
2002	11,419	0.279	14.93	2.2E-02	8.18	0.0048
2003	10,805	0.264	1.93	2.9E-03	12.52	0.0074
2004	3,145	0.077	2.18	3.2E-03	8.12	0.0048
2005	4,566	0.111	0.38	5.6E-04	20.53	0.0121
2006	3,061	0.075	0.43	6.4E-04	19.23	0.0113
2007	2,691	0.066	10.18	1.5E-02	10.28	0.0061
2008	1,517	0.037	0,18	2,7E-04	8.39	0.0049

2.10 Release of liquid effluents in normal operation

Discharge receptors of waste water coming from Mochovce NPP are (Map 2):

- the Hron River, for waste water of EMO, and rainfall water collected in Mochovce NPP;
- the Telinsky Stream for water coming from the operational premises of MO34 (facilities of the construction site) and the de-sludged water from the Čifáre sludge bed after the drinking water treatment;
- the Širočina Stream from sludge lagoons after washing sand filters.

The main waste water source discharged to river Hron is represented by industrial wastewater (cooling water) from EMO12. The industrial wastewater can be divided into:

- waste water without radionuclides comprising cooling tower blow-downs and water coming from the regeneration of the installation for demineralised water production; and
- waste water with presence of low activity radionuclides, constituted by condensation of vapour coming from radioactive liquid treatment.

Waste water is led away by three types of drainage system (sewage, rain, and industrial special) into a common waste piping (Ø 1,000 mm, made of steel, along the full length covered by concrete) about 6.0 km long, by gravity force into the Hron River.

In 2008, a total amount of 4,812,920 m^3 water from the operation of EMO12, out of which 91,378 m^3 of sewage water, and the remaining 4,721,442 m^3 of industrial waste water (Table 17).

Table 17 - Discharged waste water into the Hron River from Mochovce NPP between 2004 and 2008

	2004	2005	2006	2007	2008
Discharged industrial wastewater [m^3]	4,285,390	4,969,195	4,762,647	4,367,000	4,721,442
Treated sewage wastewater [m^3]	363,466	157,609	96,000	83,000	91,378
Total discharged wastewater [m^3]	**4,648,856**	**5,126,804**	**4,858,647**	**4,450,000**	**4,812,820**
Permitted annual value [m^3](*) for EMO12	***6,000,000***	***6,000,000***	***6,000,000***	***6,000,000***	***6,000,000***

(*) The permitted annual value for four units of Mochovce NPP is 12,000,000 m^3/year.

The volume of waste water discharged to the Telinské Stream from the Čifáre settling tank was 141,000 m^3 in 2008. The limit value set in the decision of Regional Environmental Authority /REA/ Nitra No. 2004/00408, from 22.7.2004 is 252,288 m^3.

The last group of wastewater related to the operation of the NPP is wastewater from drinking water treatment at Červený Hrádok. The volume of waste water discharged to the Širočina Stream was 810 m^3 in 2008. The limit value set in the decision of Nitra No.2003/015778, from 19.9.2003 is 10,000 m^3.

2.10.1 Evaluation of the quality of non radioactive discharged water

The decision of the waste water management department of the regional environmental authority in Nitra No 2003/01320 of 8 January 2004 specified values of indicators of waste water discharged into the Hron River (the validity of the decision expired in 2007).

New values of indicators of wastewater discharged to the Hron River were specified in a decision of the water management environmental authority in Nitra, OŽP No. 2003/01320 issued on 25 January 2007, replacing the decision No 2003/01320.

The development in the concentration values of chemical indicators of the waste water discharged into the Hron River in mg/l in the period 2004 – 2008 is given in Table 19.

Balance data given in Table 20 are annual averages of 24-hour samples.

Table 18 - Comparison of quality and quantity indicators of pollution discharged into the Hron River with limits valid for 2008

Indicator	Permitted limit concentration [mg/l] (excluding pH and T)	Average concentration in the discharged water [mg/]l	Permitted balance values t/year	Achieved balance values of pollution discharged into the Hron [t/year]	Concentration of pollutants in the Horn (upstream the discharge) [mg/l]	Balance value of pollution in the water taken from Hron (upstream the discharge) [t/year]
COD_{Cr}	35	14.47	210	69.64	<10	<48.12
$N\text{-}NH_4$	1.5*	0.42	9	2.021	0.12	0.577
Cl^-	100	39.40	600	189.625	8.76	42.16
BOD_5	12	2.00	90	9.625	2.2	10.58
NEL (non-polar extractable substances)	0.5	<0.1	3	<0.481	<0.1	<0.481
soluble substances RL_{105}	1,500	965.31	9,000	4645.863	215.3	1,036.2
soluble substances RL_{550}	1,000	768.67	6,000	3699.470	154.3	742.618
$P_{celk.}$	1.00	0.39	6	1,877	0.22	1.059
T_{max} [°C]	30	18.70	-	-	-	-
non-soluble substances NL	40	13.80	240	66.417	15.17	73.01
SO_4^{2-}	690	323.75	4,140	1558.15	37.17	178.892
pH	6.0-9.0	8.80	-	-	8.14	-
Hydrazine	0.5	<0.2	3	<0.962	0.022	0.106
Active Cl	0.1	0.05375	0.6	0.258	0.052	0.25
AOX	0.2	<0.1	1.2	<0.481	<0.1	<0.481
$N\text{-}NO_3^-$	16**	10.51	96	50.582	1.77	8.519

** At the time of discharging waste water from neutralization tanks 3.0 mg/l*

*** With a possibility to exceed the value of 22 mg/l five times a year. Analyses in particular indicators are performed, in line with the valid decision, 48 times a year except BOD_5, hydrazine – 12 times a year, and AOX, NEI, active Cl – four times a year.*

Collected pollution from the Hron River is analyzed in raw water six times a year, and the given balance values are calculated in the total volume of the collected Hron water.

In 2008, concentration and balance values of the waste water discharged into the Hron Rive were not exceeded.

Table 19 - Development in concentration values of chemical indicators of the waste water discharged into the Hron River in mg/l in 2004-2008.

	2004	2005	2006	2007	2008
COD_{Cr}	14.54	14.32	16.275	15.38	14.47
$N\text{-}NH_4$	0.67	0.26	0.414	0.38	0.42
Cl^-	44.97	37	43.31	42.22	39.40
BOD_5	4.2	5.02	2.7	2.0	2.00
NEL (non-polar extractable substances)	0.16	0.1	0.1	<0.1	<0.1
soluble substances RL_{105}	855	857	992.65	1,115.44	965.31
soluble substances RL_{550}	607	638	710.775	895	768.67
$P_{celk.}$	0.38	0.34	0.358	0.39	0.39
T_{max} [°C]	15.2	11.8	15.33	18.12	18.70
non-soluble substances NL	14.78	13	11.46	11.56	13.80
SO_4^{2-}	328	357.9	424.47	416.96	323.75
pH	8.7	8.68	8.715	8.75	8.80
Hydrazine	0.2	0.17	<0.2	0.04	<0.2
Active Cl	0.05	0.05	0.053	<0.05	0.05375
AOX	0.22	0.207	<0.2	<0.11	<0.1
$N\text{-}NO_3^-$	9.16	8.74	8.834	11.04	10.51

The decision of the water management department of the regional environmental authority in Nitra, No 2003/01320 of 8 January 2004 specified new values of indicators of the waste water discharged into the Hron River, and these values were implemented based on the subsequent decision of the Environmental Ministry No 132/2004-4.3 of 26 April 2004.

The regulation sets limits for the discharged flow, concentration and maximum annual amounts of various parameters, temperature, and pH of the discharged waste water.

The regional authority in Nitra issued on 25 January 2007 a new decision in connection with discharging waste water into the Hron River, under number 2007/00029 OŽP č. 2003/01320.

Table 20 - Development of balance values of chemical indicators of waste water discharged into the Hron River in t/year in 2004-2008

Effective pollution of discharged waste water t/year					
Indicator	**2004**	**2005**	**2006**	**2007**	**2008**
COD_{Cr}	67.594	75.67	79.05	68.44	69.64
$N\text{-}NH_4$	3.11	1.33	2.01	1.69	2.021
Cl^-	209.06	189.66	210.4	187.88	189.625
BOD_5	19.52	25.7	13.1	8.9	9.625
NEL (non-polar extractable substances)	0.74	0.51	0.485	<0.445	<0.481
Solubles RL_{105}	3,974.77	4,736.4	4,822.29	4,963.708	4,645.863
Solubles $_{550}$	-	3,618.9	3,452.94	3,982.75	3,699.470
$P_{CELK.}$	1.766	1.74	1.74	1.735	1.877
Non-solubles NL	68.71	65.8	55.67	51.442	66.417
SO_4^{2-}	1,524.82	1,834.54	55.68	1,855.472	1,558.15
Hydrazine	0.93	0.87	<0.97	0.178	<0.962
Active Cl	0.232	0.25	0.257	<0.2225	0.258
AOX	1.022	1.02	<0.97	<0.4895	<0.481
$N\text{-}NO_3^-$	42.58	44.8	42.91	49.128	50.582

2.10.2 Evaluation of effectiveness of sewage waste water treatment

In 2008, the following concentration values were achieved in the monitored indicators as given in the Table 21.

Table 21 - Balance of effectiveness of sewage waste water treatment in 2008

Indicator	Input value [mg/l] (pH no unit)	Output value [mg/l]	Treatment effectiveness [%]
COD_{Cr}	207.6	12.5	94
NH_3	17.1	0.176	99
PO_4^{3-}	9.4	1.0	89

Analyses of samples from the inflow and outflow from the waste water treatment plant are made at intervals four times a year.

The permit to discharge waste water was issued by the regional authority in Nitra, the environmental department, by its decision No 2003/02664 of 5 November 2003 as amended by decision No 2004/00408 of 22 July 2004, modifying the balance values as well as the amount of discharged waste water.
The quality and the amount of waste water discharged from the settling tank in Čifáre are given in Table 22 and Table 23. Analyses are made six times a year. The permitted amount of waste water discharged from the settling tank is 252,288 m^3/year. In 2008, in total 141,000 m^3 waste water was discharged from the settling tank.

Table 22 - Comparison of quality indicators of pollution of waste water discharged into the Telinský Stream from the Čifáre settling tank in 2005 - 2008.

Indicator	Permitted limit concentration [mg/l]	Average concentration mg/l			
		2005	2006	2007	2008
N-NH_4	0.5	0.11	0.11	<0.1	<0.1
Solubles RL	2,000	304.00	307.8	313.3	284.3
Non-solubles NL	20	10	<10	<10	<10.3
pH	6.0-8.7	7.85	7.96	8.06	8.23

Table 23 - Comparison of quantity indicators of pollution of waste water discharged into the Telinský Stream from the Čifáre settling tank in 2005 - 2008.

Indicator	Permitted balance values [t/year]	Achieved balance values [t/year]			
		2005	2006	2007	2008
$N\text{-}NH_4$	0,126	0,015	0,025	<0,0123	<0,0141
Solubles RL	504,6	41,30	70,16	38,75	40,086
Non-solubles NL	5,0	1,36	<2,28	<1,24	<1,452

Analyses were made from 8-hour mixed samples in line with the decision.

Following the decision of the company, the sampling and analyses of the samples to monitor the permitted pollution limits of waste water as set by state authorities for EMO are performed by the accredited laboratory of EMO.

Analyses of samples consisting of mixtures of samples regularly taken over 8 hours are made six times a year. The limit values have never been exceeded.

Limit and average values for water discharged into the Telinský Stream in 2005 are recorded for various monitored parameters which are contained in Tables 24 and 25.

Table 24 - Limit and effective values for waste water discharged into the Telinský Stream in 2005

Parameter	Limit value [t/year]	Effective value [t/year]
dispersed particles non-solubles NL	13.8	1.36
solubles - RL	1,382.4	41.30
$N\text{-}NH_4$	0.35	0.015

Table 25 - Limit and average measured values of monitored parameters of waste water discharged into the Telinský Stream (2005)

Parameter	Unit	Limit value	Average annual concentration
pH	-	6.0-8.7	7.85
dispersed particles non-solubles NL	mg/l	20	10
solubles - RL	mg/l	2.000	304
$N\text{-}NH_4$	mg/l	0.5	0.11

The permit to discharge waste water into the Širočina Stream from the process of drying sludge produced as a result of drinking water treatment was issued by the environmental department of the regional authority in Nitra following the decision No 2003/01577 of 19 September 2003. The permit is valid until 31 December 2009.

The analyses have been made four times. The limit values have never been exceeded.

Limit and average values for the waste water discharged into the Širočina in 2004 are recorded for various monitored parameters and contained in Tables 26 and 27.

Table 26 - Limit and effective values for waste water discharged into the Siročina (2004)

Parameter	Limit value [t/year]	Effective value [t/year]
COD_{Cr}	0,30	0,01
non-solubles - NL	0,40	0,03
Fe	0,006	0,0004
Mn	0,003	0,00003
Cl_2	0,005	0,0001

Table 27 - Limit and average values for waste water discharged into the Širočina in 2004

Parameter	Limit value [mg/l]	Average annual concentration [mg/l]
COD_{Cr}	30	4
non-solubles - NL	40	10
Fe	0.6	0.15
Mn	0.3	0.01
Cl_2	0.5	0.05

From the above information about the waste water discharged from the Mochovce NPP, it is clear that the limits for waste water discharged into the surface watercourses have never been exceeded. It is reasonable to expect that during the operation of four units of the NPP, the volume of discharged water will double, but the quality of the discharged waste water will not substantially change applying the current water treatment technology. When these assumptions are met, the permitted limits for discharging waste water from the NPP and for drinking water treatment in Červený Hrádok will be observed. Measurement in the Čifáre settling tank need to be made to ensure not to exceed the limit values.

2.10.3 Permit to discharge liquid radioactive substances into the environment

The permit to discharge liquid radioactive substances from the installation under normal conditions is established by the permit of the Office of Public Health Care of the Slovak Republic No. 000ZPZ/6274/2006 of 2 November 2006.

This decision set the conditions for operation of EMO12 (Table 28) including the yearly limit of radionuclide activity in emissions for Tritium (1.2×10^{13} Bq) and for fission and activation/corrosion products (1.1×10^{9} Bq).

In addition, it sets limits for volume activities of liquid outlets releases to hydrosphere for Tritium (1.0×10^{5} Bq/l) and for fission and activation/corrosion products (40·Bq/l).

The decision is valid until the 1st of November 2011.

Table 28 - Yearly limits and volume activities limits for discharging radioactive liquids under normal conditions for EMO12

	Yearly limits	Volume activities limit
Tritium	1.2×10^{13} Bq	1.0×10^{5} Bq/l
Activation/corrosion products	1.1×10^{9} Bq	40 Bq/l

In 2008, for liquid radioactive discharges, the percentage of using the yearly limit for tritium was 65.47%, and for other radionuclides (corrosive and fission products, transuranium) was 1.26% of the permitted annual limit for EMO12.

2.10.4 Radioactive liquid effluents

Starting from the operational experience gained at EMO12, the amount of wastes deriving from the treatment of liquid radioactive substances, which can be expected during the assumed 40-year period of MO34, is reported in Table 29.

Table 29 - Assumed amount of wastes deriving from liquid radioactive treatment during the MO34 operation period

Waste type	Amount [m^3]
Radioactive concentrate	9,025
Low-activity sorbents	122
Medium-activity sorbents	204
Radioactive oils	9.5
Sludges	400
Sediments	8.5

From the radioprotection point of view, the conditionally active water containing tritium that is released into the environment after a dilution is the most significant low-activity liquid waste. Tritium is produced in the reactor core coolant and is a very low-energy β-emitter having a long transition half-life (12.34 years). The radioactive hydrogen isotope cannot be removed from the coolant using common purification processes. That results in the increase in its activity in the coolant.

The limit tritium concentration is based on the limit volumetric activity value in the primary circuit water 3.7×10^9 Bq/m^3. Within the waste water purification system, all waste water originating from MRB, ASB and impure condensate tanks are collected in the subsystem of waste water collection tanks. The water is purified and mechanical, chemical and radioactive impurities are removed so that the water can be reused for internal needs of reactor units or discharged to the waste water sewer.

The mechanical purification is performed in the waste water purification subsystem. The waste water and impure condensate are deactivated in the evaporator subsystem by means of distillation. The impure condensate is thickened to the concentration of 40 g H_3BO_3/l in the evaporator and the concentrate is further purified in the boric acid regeneration system. The waste water is thickened in two evaporator stages to the concentration of 400 g/l (a piece of design data, the real value is 150 to 200 g/l) and the concentrate is pumped by means of the handling tank to a temporary liquid radioactive waste storeroom. The vapour condensate is drained to the condensate evaporator subsystem for purification and it is stored in purified concentrate monitoring tanks after the purification.

The waste water purity below the volumetric activity limit of 4.0×10^4 Bq/m^3 is achieved by the purification by means of sedimentation, distillation, filtration and ion exchange units, and by combination of those processes. The purified water (purified concentrate) collected in the monitoring tanks is radiochemically controlled. If the volumetric activity limit value is exceeded, the water is returned from the monitoring tanks back to the purification process for further purification. If the volumetric activity limit value is not exceeded, a major part of the water (approximately 133,000 m^3/year) is pumped from the monitoring tanks to the pure condensate tanks, a small part of the purified condensate with a satisfactory β volumetric activity (up to 4.0×10^4 Bq/m^3 without tritium) is discharged to the industrial sewer system in order to maintain the concentration in the primary circuit water.

The tritium volumetric activity in the water does not exceed 3.7×10^9 Bq/m^3. The assumed amount of water discharged from both EMO12 reactor units equals approximately to 3,200 m^3/year. Before the purified condensate is discharged to the industrial sewer system, the water containing tritium is diluted already in the Mochovce NPP by means of the cooling water so that the resulting water conforms to requirements specified by Act No. 345/2006 Coll., on protection, support and development of the public health as last amended. Following the dilution, 192,000 m^3 of water containing tritium with the total activity of 1.2×10^8 Bq/m^3 are discharged from the nuclear power plant annually. The volumetric activity of 4.0×10^4 Bq/m^3, i.e., the value determined by the efficiency of purification processes, is the decisive criterion for the water discharged from TCCP and for the discharged regeneration water from steam generator blow-down purification plants.

The tritium volumetric activity values in the water discharged from the monitoring tanks (radioactive media purification stations) exceed the activity values of other β and γ radionuclides in all the waters discharged from the power plant by approximately 5 orders. The tritium water is discharged from the monitoring tanks in an organized manner by batches and after the preceding radiochemical control. Two monitoring tanks are assumed for NPP Mochovce to be discharged weekly.

The tritium water must be diluted 30 times by means of the following:

- cooling towers blow-down;
- waste water from the chemical water treatment plant containing also regeneration solutions;
- water from the waste water purification plant containing water originating from the Operational Building;
- water from the liquid organic waste purification plant;
- cooling water originating from the compressor plant;
- neutralised regeneration solutions originating from the steam generator blow-down treatment stations.

As for the optimisation of releases, it is important to ensure the automatic control of tritium water dilution. Limit values of summary activities specified for releases from operated VVER V213 reactor power plants into the environment are given in Table 30.

Table 30 - Annual releases and limit values for summary activities of tritium, corrosion and fission products in waste water in some operated power plants

Release type	Unit	EBO V2 (2005)	EMO12 (2004)
Tritium water ^3H	Bq/year	7.207×10^{12}	9.83×10^{12}
Corrosion and fission products	Bq/year	4.03×10^{7}	3.78×10^{6}
Annual limit value for tritium water releases	TBq/year	43.7	12
Annual activity limit value for corrosion and fission products in waste water	GBq/year	38	1.1

Based on the design, the levels of low-activity and conditionally active releases assumed for four Mochovce NPP reactor units are reported in Table 31.

Table 31 - Assumed annual average levels of low-activity and conditionally active releases for four Mochovce NPP reactors units

Source	Amount [m^3/year]	β volumetric activity without tritium [Bq/m^3]	Tritium volumetric activity [Bq/m^3]
Operational building	75,000	3.7×10^{3}	0
TCCP	22,000	5.5×10^{4}	0
Regeneration solutions from the steam generator blow-down treatment plant	6,000	5.5×10^{4}	0
Tritium water	6,400	5.5×10^{4}	3.7×10^{9}

Table 32 gives values obtained over ten years of the operation of EMO12.

Table 32 - Activity of the radioactive liquid effluents discharged to river Hron during the last 11 years (1998 – 2008)

	Tritium		Activated/corrosive and fission products		Amount of the discharged water
	Annual limit 1,2E+04 GBq		Annual limit 1,1E+03 MBq		
	Discharge [GBq]	% of the annual limit	Discharge [MBq]	% of the annual limit	[m^3]
1998	1,095	9.1	29.17	2.7	24,751
1999	5,772	48.1	50.63	4.6	47,272
2000	10,484	87.4	57.93	5.3	53,321
2001	9,248	77.1	72.41	6.6	48,637
2002	9,130	76.1	49.36	4.5	46,620
2003	10,714	89.3	40.88	3.7	52,532
2004	9,826	81.9	37.84	3.4	43,830
2005	8,959	74.7	59.58	5.4	40,360
2006	10,230	853	32.75	3.0	22,220
2007	7,458	62.2	13.01	1.18	21,280
2008	7,856	65.5	13.88	1.26	16,800

2.11 Evaluation of radioactivity exposure to man (POSAR EMO12)

The basis for evaluation of radiological impact of nuclear power plants on the environment is monitoring and balancing of discharges of radioactive substances (RAL) into atmosphere and hydrosphere. Through atmosphere and hydrosphere and other links of food chains, radioactive substances may get directly to individuals and all groups of population in the surrounding of the nuclear power plant, and may cause external radiation of whole body or internal radiation of particular organs after penetrating into the organism by inhalation or ingestion.

Balancing of discharged radionuclides into atmosphere is made by monitoring in the ventilation stack (the so-called balancing monitoring). At the Mochovce NPP, the basis of such monitoring is a radiometer that enables separated monitoring of beta activity of long-living aerosols, gamma active iodine (^{131}I) and beta activity of noble gases (such as ^{41}Ar, ^{85}Kr, ^{133}Xe). This system is appropriately supplemented with sampling, including sampling of gas into pressure bottles for laboratory measurements of some radionuclides (^{3}H, ^{14}C) and for radiochemical and spectrometric evaluation of discharged radionuclides.

Radionuclides discharged into hydrosphere are balanced based on analyses of samples taken from controlling tanks in which the so-called over-balance water intended for discharging into a water recipient is kept. Water management is closed, and no other waste water except water from controlling tanks may get into the environment. At the discharge of waste water into the piping system leading the waste water away from the grounds of the Mochovce NPP, monitoring of liquid waste is installed at the measurement station of waste water control – object 368/1-01. Liquid waste is led directly to the Hron River through a ground piping system. It joins the river below the dam in Veľké Kozmálovce.

The monitoring of waste water discharged from the NPP is generally given a primary importance in connection with evaluation of the impact of the NPP on the surroundings. Reference levels of water discharged beyond the borders of the NPP are controlled. Discharged radionuclides are diluted only with water from the NPP (blowdowns from cooling towers etc.). Radionuclides discharged into surface water (through a piping trap into the Hron River below the dam in Veľké Kozmálovce) are further diluted with the water from the recipient itself, therefore their measurements are more challenging.

Discharging of radionuclides into the environment is governed by strict criteria that are based on current legal requirements and are embedded in the Quality Requirements for MO34 Designing. Generally in line with Appendix No 3 of the Slovak Republic Government Decree No 345/2006 Coll., radioactive substances may be discharged from nuclear facilities into atmosphere and hydrosphere provided that effective exposure of the relevant critical group of population as a result of such a discharge does not exceed 250 µSv per calendar year. This value is regarded as a limit exposure for designing and building nuclear facilities. When there are more than one nuclear facility on the region influencing exposures of the citizens in the same critical group, this value refers to the total radiation from all nuclear facilities in the region.

A calculation of dose to the critical groups of inhabitants for Mochovce NPP operation is included in the POSAR of EMO12. The following results are only reported for completeness as "*design*" data and they are referred to "*historical*" limit set by Czechoslovakian Atomic Energy Commission Decree No. 4 in 1979 that has not been in force for several years. Anyway, an updated and complete evaluation of radiological consequences during normal operational state for all the four units is reported in the chapter 6.2 of the Environmental Framework.

Exposure of inhabitants in the surroundings of the Mochovce NPP depends on several factors connected to meteorological conditions, the distribution of radioactive sources, the population distribution, agricultural products and the distribution of agricultural products and age, anatomic and physical characteristics of inhabitants. In EMO12 POSAR, the critical group if inhabitants was established for the NPP site by a calculation of the maximum individual dose beyond the protection zone (3 km).

Based on the results of the calculation, the critical group of inhabitants for gaseous radioactive emission to the atmosphere is constituted by adults and the maximum effective dose results in zone 161, which is the village of Nevidzany, approximately 5 - 7 km W-NW from the site. The highest individual dose values were calculated in zone 73, approximately 1 km to the SE of the site which is not permanently inhabited. The calculated values of the effective dose in these two zones for infants and adults and their comparison with the limit values are included in Tables 33. From the results of the above mentioned calculation it follows that the critical pathway was in external irradiation from radioactive cloud which in zone 73 represents approximately 80% of the proportion of the effective dose and in zone 161 represents 50-60%. The critical nuclides are noble gases, in particular ^{88}Kr, ^{135}Xe and ^{133}Xe.

For the selection of the critical group it is also necessary to consider the consumption of drinking water that could be hypothetically contaminated by liquid discharges from the NPP. On the basis of data on drinking water resources from wells in the surroundings of the NPP, for which infiltration of water from the Hron River was conservatively assumed, the critical group of inhabitants resulted in Nový Tekov, which is supplied by water from the group of water mains at Levice-Kalná-Hronské Klačany. Considering the fact that the nuclide from the ingestion of drinking water is likely tritium, it is possible to make a conservative assumption that the dose from the consumption of drinking water from the above-mentioned source is the same as for the consumption of drinking water from the River Hron downstream from the wastewater discharge point from the NPP. This dose is 1.495E-06 Sv (risk 1.091E-07) based on the critical group of inhabitants, i.e. infants.

A comparison of the limit values given in the Atomic Energy Act with the maximum values of the effective dose of the protection zone at Mochovce NPP is included in the Tables 33 and 34. Effective dose are compared with siting limits of 1 mSv and 5 mSv and with dose constraint of 0.25 mSv.

Table 33 - Effective dose from air emissions for adults and infants in the zones with max. values and safety coefficients taken from the limits pursuant to the Atomic Energy Act

Zone	Effective dose [Sv]	5 mSv limit	1 mSv limit	0.25 mSv limit
		adults		
zone 73	$1.395 \cdot 10^{-5}$	358	72	18
zone 161	$1.643 \cdot 10^{-6}$	3,043	609	152
		Infants		
zone 73	$1.582 \cdot 10^{-5}$	316	63	16
zone 161	$1.365 \cdot 10^{-6}$	3,663	733	183

Table 34 - Effective dose of discharge to the hydrosphere for all age categories in the zone with max. values for Nový Tekov and safety coefficient related to the limits pursuant to the Atomic Energy Act

Age	Effective dose [Sv]	5 mSv limit	1 mSv limit	0.25 mSv limit
0-1	$1.495 \cdot 10^{-6}$	4,013	669	167
1-2	$9.403 \cdot 10^{-7}$	5,317	1,063	266
2-7	$1.083 \cdot 10^{-6}$	4,617	923	231
7-12	$7.502 \cdot 10^{-7}$	6,665	1,333	333
12-17	$5.688 \cdot 10^{-7}$	8,790	1,758	439
adults	$8.601 \cdot 10^{-7}$	5,813	1,163	291

All calculated values of individual and collective doses during normal conditions are under the limits pursuant to Act No 355/2007 Coll. and other relevant legal provisions.

2.12 Production of radioactive solid waste in normal conditions

The design basis related to the solid radioactive waste production and storage of two VVER 440 assumes values of 230 to 330 m^3/year.

The following approximate division of that amount by waste type is assumed by the design:

- 65% of compactable waste;
- 25% of non-compactable waste;
- 10% of HVAC filters.

Solid radioactive waste can be further divided into dry and wet wastes. Dry solid radioactive waste represents a mixture of different materials combined to a various extent (wood, paper, fabric, plastics, metal, building materials, thermal insulation, inserts from HVAC filters, etc.). High-activity in-core parts (non-fuel sections of control assemblies, thermocouples, etc.) form a specific part of dry solid radioactive waste. Wet solid radioactive waste is produced during the liquid radioactive waste treatment process; it includes saturated ionexes, sludges and crystallised salts.

Based on experience gained during the operation of EBO V2, as well as of EMO12, the amounts that can be really expected during the assumed 40-year period of MO34 operation are reported in Table 35.

Table 35 - Assumed amounts of solid radioactive waste to be produced during the whole MO34 reactor unit's operation period

Waste type	Amount (kg)
Solid radioactive waste intended for sorting(*)	170,000
Combustible radioactive waste	252,000
Compactable non-metallic radioactive waste	56,600
Compactable metallic radioactive waste	79,920
Wet rags	6,900
Total of solid radioactive waste	565,420

Note: Solid radioactive waste intended for sorting consists of combustible, compactable and non-compactable radioactive waste, the amount data relates to the state prior to sorting.

The assumed amounts of conditionally non-active waste, inserts from HVAC filters and the waste that will be allowed to be released into the environment due to its below-limit activity values is shown in Table 36.

Table 36 - Assumed amounts of solid radioactive waste produced during the 40 year period of MO34 reactor reduction plan units operation

Waste type	Amount
Conditionally non-active waste	232,500 kg
HVAC filter inserts	4,930(*) pieces
Radioactive waste released into the environment	237,500 kg

(*) Assumed amount taking into account the solid radioactive waste production

2.13 Non nuclear malfunctions and accidents

In this Report, two types of accidents are considered:

- nuclear accidents, that are discussed in sections C, Part IV, chapter 4.0; and
- non-nuclear accidents, which are described below.

Non-nuclear accidents can be divided into three categories:

Accidents involving workers

As described in section II.2.8.3 all risky workplace are under the supervision of bodies of the State Professional Inspection and Hygiene while they are operated in compliance with the valid regulations of the Slovak Republic. Statistical data of industrial accidents show the attention of Mochovce management system about prevention, elimination and minimization of the effects of dangerous and injurious factors of the working process. A dedicated industrial health service provides for the benefit of professional health. This service maybe understood, first of all, as an institute authorized to perform preventive tasks and to render consultancy to employers with the aim of establishing and maintaining safe and healthy working environment. The tasks of industrial health service are carried out by professional health personnel qualified for rendering the service.

Given that:

- workplace safety is well managed;
- plant record is in line with industrial average; and
- policies and procedures adequately address worker safety;

it can be stated that SE H&S management system has a beneficial effect on workers compared with many other industrial facilities.

Accidents involving facility

Under a non-nuclear point of view, the most likely accidents involving facility are related to fire. The Plant fire fighting program is fully integrated with nuclear emergency plan.

The original design solutions of Fire Protection (FP) for the nuclear units at Mochovce were based on the requirements and recommendations of IAEA SG-50-D2 "Fire Protection in Nuclear Power Plants" revised in 1992. These were reflected in the "Decision No. PO-1037/3-1992 of the former Main Administration of Fire Fighting Brigades of the Ministry of Interior of the Slovak Republic (MA FFB MI SR) dated 4 May 1992".

During the completion of units 1 and 2 of EMO the international consortium for this completion – EUCOM suggested further safety improvements relating to the FP. These technical and safety improvements (TSI) were elaborated in amendments to the individual detailed designs for FP and then included by the MA FFB MI SR into the binding statement for the completion of units 1 and 2.

The innovated philosophy and concept of FP for the first two units of Mochovce are based on more than 80 specific TSI reflected in the FP designs in the following areas:

- Analysis of fire risk and marginal external event (external fire)" – „ Internal hazard 01" (IH 01),
- Technical findings related to the preventive FP systems - "Internal hazard 02" (IH 02),
- Technical findings related to the detection and extinguishing systems - "Internal hazard 03" (IH 03).
- Safety improvements related to the minimising of fire impacts - "Internal hazard 04" (IH 04).

At the end of 1998 there was a IAEA mission at Mochovce (from 6 - 16 October 1998), where its purpose was to assess the reviews of TSI, which was done in the IAEA headquarters in Vienna (from 6 – 9 October 1998), and to confront the unsolved issues, technical issues and the state of facts regarding FP directly at the power plant.

During the preparation of units 3 and 4 completion, the Presidium of Fire Fighting Brigades of the Ministry of Interior of the Slovak Republic already applied all requirements of the innovated philosophy and concept of FP, which were reflected in the reviewed FP designs for units 3 and 4.

After the comparison of requirements and criteria for the assessment of fire safety and FP standards pursuant to the procedures, recommendations and directives of IAEA, it was declared at the international level that the innovated concept of FP at nuclear units at Mochovce represents a significant increase of FP at these nuclear units and fully corresponds to the current international requirements specified in the reviewed „Safety Manual" of IAEA No. 50-SG-D2.

At the same time the level is fully acceptable in terms of international directives for FP at nuclear power plants prepared by the managing board „Nuclear pool's".

In Mochovce NPP, performance of inspections, reviews, tests, repairs, operation and maintenance of fire technology and equipment, principles and requirements for fire safety, responsible professionally qualified persons, authorised persons, etc. are specified in details in individual execution directives of fire protection system assurance.

Acoustically or optically signalled fire alarm is installed in the site area. Technical inspections and functional tests on fire fighting equipment are assured each 12 months; they are performed by professionally qualified personnel in compliance with valid legislation. The performance of fire safety inspection at electrical equipment operation is regulated by Regulation of MV SR No. 79/2004 Coll.

Mobile and portable extinguishing devices serve for fighting of small fires or fires in their initial phase of development. They are situated in all structures in marked places.

Principles of fire safety at work with flammable gases and combustion-supporting gases are regulated by Regulation of MV SR No. 124/2000 Coll. Function, operation reliability and safety of a pressure bottle for flammable gas or combustion-supporting gas storage is verified by professionally qualified persons with a certificate in compliance with Regulation of MPSVaR SR No. 718/2002 Coll.

To prevent fire accidents, the pressure bottles shall be situated on a visible place and readably and inerasably marked. The label contains a full unabbreviated name of the flammable gas or combustion-supporting gas, a name or trademark of the vessel manufacturer, a date of the last pressure test performance, in case of acetylene, a date of the last periodical test. According to the flammable gas or combustion-supporting gas type, the bottle shall have relevant colour mark on its surface.

In the warehouse of flammable gases or combustion-supporting gases, materials and articles that do not relate to the warehouse operation shall not be situated. Empty and full pressure bottles shall be stored separately and places for their storage shall be labelled.

It can be stated, that adverse effects on the environment as a result of fire inside the power plant are unlikely.

Accidents involving materials

For prevention of Serious Industrial Accidents, according to Act no.261/2002, technical organizational measures have been adopted in order to reduce overall quantities of dangerous substances stored in the facility. An emergency plan addressing the measures to be taken at the time of Serious Industrial Accidents was developed and issued and all necessary training and drills of employees are being ensured. On the basis of the risk assessment of Serious Industrial Accidents and in line with emergency scenarios, the risk of treat of this kind of accidents will not spread over the boundaries of the plant and the surrounding villages will not be exposed to any risk.

The risk assessment was performed, on the basis of the safety data sheets (SDS) for all the dangerous substances or preparations, considering all the storage facilities and their technical features (e.g. tanks equipped either with single or double containment).

The outcome of the analysis confirms that adverse effect on the environment, as a consequence of Serious Industrial Accidents, is unlikely.

2.14 Radiological risks as a consequence of industrial accidents

Radiation risk (as a consequence of industrial accidents) to the surrounding environment can be mainly separated into two possible sources below described.

As regards bituminisation, line was constructed as part of the liquid waste treatment facility FS KRAO. FS KRAO according privatisation process belongs to the JAVYS company. Also operation is performed by the JAVYS Company (in this year were done starting tests of bituminisation). Nonetheless the following considerations are reported for the sake of completeness:

1) Fire risk from the hot bitumen

Fire risk from the hot bitumen produced in the area of the bituminization line of the active and auxiliary operation building connected with the potential release of radionuclide to the air-conditioning system and to the environment was eliminated by technical and organizational measures for fire prevention, including:

- bituminization line makes up an independent fire section, equipped with air-conditioning, permitting effective disposal of the products of fire and released radionuclides;
- the effectiveness of confined products of fire and released radionuclides allows a reduction of about 100,000 times of radionuclide concentration that is sufficient from the point of view of safe prevention of exposure to critical groups of inhabitants under legal limits given by the relevant legislation;
- camera system for monitoring the drum cooling area allows visual control of all of the drums on the conveyor belt for the bitumen evaporation;
- temperature and smoke sensors together with a stable cooling system allows the control of fire situations.

The above-mentioned measures permitted characterisation of the impacts as low to medium impacts.

2) Risk of losing control of concentrate storage

The construction of the storage tanks (used materials and location in individual sumps enabling the confinement of the full volume of stored liquids) sufficiently eliminates the possible risks and impacts to the environment deriving from the rupture of concentrate tank (valid for all tanks containing hazardous liquids) and subsequent release of radioactive concentrates. Environment impacts can be evaluated as negligible or minimal (on the service staff).

Regarding radiation risk associated with the storage of HLW, the storage technology and method for manipulation with HLW used at Mochovce NPP together with the very low expected volume of HLW provide full control and manipulation of this waste during the operational and post operational phases of plant life. This is a very important factor for reducing radiation exposure during manipulation with the waste both during their generation and final disposal (option of manipulation leading to the minimization of volume for deposition in deep repositories).

Environmental impacts can be assumed to be low, focusing only on areas of low radiation exposure for specific members of staff operating the manipulation equipment and transport and storage containers.

2.15 Post-operation phase and decommissioning

The Mochovce NPP post operation phase will start after the final shutdown and will end with the final removal of unit 4 fuel from its spent fuel pool. Hereinafter there is a description of the decommissioning activity for MO34 (prior to the shut-down of MO34, the same sequence of activities will be performed as for EMO12).

The following activities will be carried out for MO34 decommissioning:

- shutdown of plant and cooling-down of the unit 3 spent nuclear fuel present in the spent fuel pool,
- support of unit 4 operation (some of the unit 3 systems are necessary for the safe operation of unit 4),
- operation of systems common to units 3 and 4 (after the deactivation and abandonment of unnecessary systems or reduction of partially necessary systems),
- operation of auxiliary systems, electric systems, I&C and other systems after their potential reduction,
- cooling-down of the unit 4 spent nuclear fuel present in the spent fuel pool of the unit 4,
- reduced operation of selected systems of units 3 and 4, common systems, and auxiliary systems in order to ensure radiation safety (the length of the period in which systems remain in operation is determined by requirements for the approved program for decommissioning).

The gradual reduction of systems in service means their disconnection and abandonment, e. g. in the case of electric systems it implies disconnection in switchgear and load centres; in the case of pressure systems it implies their depressurization and disconnection from pressure sources; in case of delivery of liquid their disconnection from sources and securing interfaces. Other activities, even if they must be performed only one time in the process, can largely affect the fixed costs of shutdown, such as:

- moving the fuel from the reactor into the spent fuel pool;
- activities related to preparation of request to obtain permission for performing decommissioning programs;
- public relations.

Apart from the technical aspects, it is also necessary to consider social impacts. These aspects are represented by costs related to gradual dismissal of employees, such as shift and daily operation personnel.

The first conceptual decommissioning program for the Mochovce NPP units 1 and 2 was prepared in 1996 (Decom Slovakia), and its updated version in 2007 (DECONTA, .a.s.). A preliminary conceptual decommissioning plan for units 3 and 4 was prepared in 2007 (VUJE, a.s.). It compares two basic scenarios of decommissioning.

- immediate decommissioning (ID);
- deferred decommissioning (DD) with protective hermetic packaging including the reactor shafts of reactors for a period of 30 years.

The third, the so-called zero scenario (assuming a situation that would occur when the decommissioning of the EMO units 3 and 4 would not take place) is out of the question under the Strategy of the Final Part of the Nuclear Power Industry. The Strategy assumes that each nuclear power plant in the Slovak Republic will be decommissioned in line with the scenario of immediate decommissioning.

The scenario of immediate decommissioning assumes a start of works immediately after the completion of electricity production, and the removal of fuel from the plant building, and is characterized by an immediate start of works and gradual removal of all facilities and buildings. It is performed in two phases. In the 1st phase, dismantling of unnecessary inactive facilities and systems is made, as well as demolition of unnecessary building objects. In the 2nd phase, decontamination and dismantling of facilities in active objects will be made. After removal of radioactivity, demolitions of objects and final treatment of the location will be made. One of the main arguments for this scenario is the presence of the staff familiar with the work in the environment of ionising radiation.

The variant of deferred decommissioning with safely hermetic closing, including the reactor shafts, for a period of 30 years assumes a creation of a hermetic packaging around the reactor for a period of 30 years. The scenario of deferred decommissioning is performed in three phases. The 1st phase involves the same activities as in the case of the first scenario of decommissioning but is supplemented with several activities for decontamination of equipment and systems that will not be hermetically sealed. The 2nd phase involves the construction of a containment around the reactor and the reactor shaft with an auxiliary system and safety barrier permitting safety monitoring and continuous maintenance. The conclusion of this phase will include preparation for the 3rd phase that involves dismantling of the reactor and the primary circuit with decontamination and final demolition.

The scenario of immediate decommissioning is preferred, and is in line with recommendations of IAEA, and the Strategy of the Final Part of the Nuclear Power Industry in the Slovak Republic, and represents an immediate transfer from operation to decommissioning. One advantage of this scenario is that there is sufficient information on the operation of the nuclear facility, and know-how of the s staff regarding the work in an environment of ionising radiation. The scenario of the deferred decommissioning with protective hermetic packaging for 30 years does not give a significant improvement of the radiation situation because the half-life of critical radionuclides from the point of view of waste handling is about 30. In addition, appropriate technical means and operational experience of the staff may not be available at the later date.

Table 37 (DECONTA, a.s., 2007) gives an overview of the expected wastes produced in the framework of the decommissioning of the EMO12:

Table 37 - Overview of the expected wastes produced in the framework of the decommissioning of the EMO12

Waste Typology	Units	ID	DD
Materials intended for transport to a recycling materials collection yard	kg	143,137,178	143,931,163
Materials intended for transport to a communal dumping site	kg	27,357,274	27,358,943
Materials intended for transport to a special dumping site	kg	47,301	47,301
Materials intended for filling in the location	kg	449,554,481	449,554,481
Number of VBK in surface repository	pieces	1,990	1,276
Number of VBK in deep repository	pieces	53	53
Amount of liquid discharges	m^3	58,291	36,507
Activity of gas discharges	Bg	4,221,508	684,781

An Overview of the expected production of RAW in the framework of the decommissioning of MO34 is shown in Table 38.

Table 38 - Inventory of RAW from decommissioning MO34 NPP

Amount (activity RAW)	Unit	IDO	DDO
C-steel released into environment	kg	74,523,543	74,880,479
C-steel in surface repository	kg	1,100,932	743,997
C-steel in deep repository	kg	0	0
Stainless steel released into environment	kg	4,502,229	5,721,455
Stainless steel in surface repository	kg	1,583,928	364,702
Stainless steel in deep repository	kg	197,706	197,706
Non-ferrous metals released into environment	kg	5,749,468	5,869,829
Non-ferrous metals in surface repository	kg	332,496	212,135
Non-ferrous metals in deep repository	kg	0	0
Non metals released into environment	kg	348,523,412	349,328,412
Non metals in surface repository	kg	1,910,000	1,105,000
Non metals in deep repository	kg	0	0
Liquid RAW	m^3	170,104	28,541
Amount of liquid discharges	m^3	30,594	24,464
Activity of liquid discharges	Bg	3,902,866	5,076,434
Activity of gaseous discharges	Bg	1,197,022	94,863
Number of VBK in surface repository	pieces	2,179	1,629
Number of VBK in deep repository	pieces	42	42
Activity of RAW in surface repository	Bg	1.8E+14	4.6E+13
Activity of RAW in deep repository	Bg	7.7E+17	2.3E+16

source: Engineering/Design Works for MO34 Completion - Preliminary conceptual decommissioning plan, VUJE, a.s., 2007

The most important impact on the environment and the staff in performing decommissioning activities may be caused by the following aspects:

- metal parts of the reactor and primary circuit or the parts that will not be possible to decontaminate;
- concrete parts with induced radioactivity;
- liquid waste created as a result of decontamination work.

From the environmental impact point of view, decommissioning of the Mochovce NPP presents substantially lower risk than the operation of the NPP itself. The risk during this period comes mainly from work with open sources of ionizing radiation from the dismantling of the facilities and particular systems of the primary circuit and subsequent decontamination. The work in serious cases will be performed using remote controlled manipulation equipment.

The elimination of these risks presumes a range of measures that may be modified based on latest information obtained from the operation of the NPP. The main measures to eliminate risks include:

- monitoring and sufficient knowledge of the radiation situation of the individual components of the primary circuit during operation and after stopping during the decommissioning work;
- thorough preparation of the decommissioning plan;
- the level of knowledge of the employees and their ability to deal with abnormal processes;
- minimization of work and activities with open sources of ionizing radiation;
- sufficient finances and availability of financial resources to cover the costs of decommissioning;
- sufficient capacity of the repositories for low and medium active RAW.

2.15.1 Production of solid radioactive waste under normal conditions

Project documentation assumes for the operation of two VVER 440 a production of 230 to 330 m^3 of solid RAW per year. The rough structure of the waste by types is as follows:

- 65% of compressible waste;
- 25% of non-compressible waste;
- 10% collected by filters, and heating, ventilation and air-conditioning facilities.

Solid RAW can also be divided into dry and wet waste. Dry RAW includes mixtures of various materials combined to various extents (wood, paper, textile, plastic materials, metals, construction materials, thermal isolation, cartridges of air-conditioning filters, etc.) The highly active parts from the active zone (non-fuel parts of regulation cartridges, thermo-cells, etc.) comprise a specific part of dry solid RAW. Wet solid RAW is produced during the process of treating liquid RAW. It includes saturated iones, sludge and crystallized salts.

Based on the experience from the operation of V-2 NPP in Jaslovské Bohunice, and units 1 and 2 of the NPP in Mochovce, it is reasonable to expect after 40 years of assumed operation of MO34 the amounts given in Table 39.

Table 39 - Assumed amounts of solid RAW produced during the operational period of MO34

Type of waste	Amount [kg]
Solid RAW for sorting-out ∗	170,000
Flammable RAW	252,000
Compressible non-metal RAW	56,600
Compressible metal RAW	79,920
Used cleaning material (saturated rags)	6,900
Total solid RAW	565,420

Note: Solid RAW to be sorted-out consists of flammable, compressible and non-compressible RAW. The data of the amount refer to the amount prior to sorting-out.

The assumed amount of conditional non-active waste, cartridges of air-conditioning filters and waste that may be released into the environment because of its underlimit values of activity is given in Table 40.

Table 40 - Assumed amounts of the solid RAW produced over 40 years of the MO34 operation

Type of waste	Amount
Conditional non-active waste	232,500 kg
Cartridges of air-conditioning filters	4,930* pieces
RAW released into the environment	237,500 kg

*The assumed amount considers the production of the solid RAW

2.16 Environmental management system certification

In 2005 SE-MO34 completed, introduced and passed the Environmental Management System certification. The subject of MO34 certification is the maintenance of accepted property and preparation of units 3 and 4 completion.

The goal of introducing and applying EMS in SE-MO34 is to show the endeavour of continual improvement in relation to the reduction of impacts of activities performed in SE-MO34 on the environment by managing activities that result in such impacts.

There was a work group created to deal with the issue of EMS implementation preparation proceeding in line with the approved action plan.

In September 2005 there was a certification EMS audit performed at MO34. The certificate was issued on 4 October 2005.

In 2006, the concept of EMS certification in SE, a.s. changed, specifying that SE, a.s. would be certified as a whole... Recertification audit was held in SE, a.s. in June 2007. The certificate was issued on 30 June 2007. In line with the concept of periodical oversight and recertification audits SE, a.s. is audited each year by an accredited certification company.

Certificate pursuant ISO 14001:2004 is shown in the following Figure 27.

BUREAU VERITAS
Certification

BUREAU VERITAS 1828

Certification
Awarded to

Slovenské elektrárne, a.s.
Hraničná 12, Bratislava
Slovak Republic
and
Nuclear power plant Bohunice; Nuclear power plant Mochovce; Blocks 3 and 4 of nuclear power plant Mochovce; Power plant Nováky; Power plant Vojany; Hydroelectric power plant Trenčín;

Bureau Veritas Certification certifies that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the environmental standards detailed below

Standards

ISO 14001:2004

Scope of supply

MANAGEMENT CONTROL AND SUPPORT OF ELECTRICITY AND HEATING POWER PLANTS. SALE OF ELECTRICITY. PRODUCTION AND SUPPLY OF ELECTRICITY AND HEAT BY NUCLEAR POWER PLANT BOHUNICE. PRODUCTION AND SUPPLY OF ELECTRICITY BY NUCLEAR POWER PLANT MOCHOVCE. MAINTENANCE OF HANDLED PROPERTY AND PREPARATION OF FINISHING THE CONSTRUCTION OF BLOCKS 3 AND 4 OF NUCLEAR POWER PLANT MOCHOVCE. PRODUCTION AND SUPPLY OF ELECTRICITY, HEAT AND PRODUCTS BY THERMAL POWER PLANT VOJANY AFTER COMBUSTION. PRODUCTION AND SUPPLY OF ELECTRICITY, HEAT AND PRODUCTS BY THERMAL POWER PLANT NOVÁKY AFTER COMBUSTION. PRODUCTION AND SUPPLY OF ELECTRICITY BY HYDROELECTRIC POWER PLANTS.

Original Approval: 26.07.2007
Subject to the continued satisfactory operation of the organisation's Management System, this certificate is valid until: **22.06.2010**
To check this certificate validity please call +421 2 5341 4165
Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation

Date: 30.07.2007

Certificate Number: **219432**

ANAB ACCREDITED

ISSUING OFFICE ADDRESS: Bureau Veritas Certification Slovakia s.r.o., Plynárenská 7/B, 821 09 Bratislava, Slovak Republic

Figure 27 - SE, a.s. ISO 14001/2004 certificate

A. BASIC DATA

I BASIC PROPONENT DATA

1.0 NAME

Slovenské elektrárne, a.s. Bratislava

NPP Mochovce, Units 3 and 4

2.0 IDENTIFICATION NUMBER

ICO - 35829052

3.0 REGISTERED OFFICE

935 39 Mochovce

4.0 FIRST NAME, SURNAME, ADDRESS, TELEPHONE NUMBER AND OTHER CONTACT DATA OF AUTHORIZED PROPONENT'S REPRESENTATIVE

Mr. Giancarlo Aquilanti, Project Director SE, a.s.MO34,

Units 3 and 4 Mochovce NPP, závod, 935 39 Mochovce,

phone number: +421 36 637 8607,08

5.0 FIRST NAME, SURNAME, ADDRESS, TELEPHONE NUMBER AND OTHER CONTACT DATA OF PERSON WHOM THE RELEVANT INFORMATION ON PROPOSED ACTIVITY AND PLACE OF CONSULTATIONS CAN BE OBTAINED FROM

Mgr. Jozef Belaň, Permits and Licensing Department Manager,

Units 3 and 4 Mochovce NPP, závod, 935 39 Mochovce,

phone number: +421 36 637 8152

II BASIC DATA ON PROPOSED ACTIVITY

1.0 NAME

Nuclear power plant Mochovce VVER 4×440 MW, 3rd construction.

2.0 PURPOSE

The aim of the project is to commission and operate Units 3 and 4 of Mochovce NPP, already authorized for their completion, in order to produce the required base load electric energy that is needed to cover the significant gap between demand and supply of electric energy on the Slovak network.

3.0 USER

Slovenské elektrárne, a.s. Bratislava

NPP Mochovce, Units 3 and 4

4.0 LOCATION (CADASTRAL DISTRICT, PARCEL INDEX)

Units 3 and 4 of Mochovce NPP are located in Central Europe in the southeastern region of Slovakia on the western boundary of the district of Levice, close to the operating EMO12 NPP. The MO34 site lies on the southwestern edge of the Kozmálovské vŕšky (hills) in the Hronskej pahorkatina (uplands). The elevation of the terrain is between 200 and 250 m above sea level. The coordinates of the center of the Mochovce NPP protection zone are:

- longitude 18° 27´ 35´´;
- latitude 48° 15´ 35´´.

From the point of view of the terrestrial and administrative arrangement of Slovakia the MO34 site lies in the eastern part of the Nitra region in the northwestern corner of the district of Levice, close to the boundary with the Zlaté Moravce region, approximately 12 km from the municipality of Levice, which is the largest town in a 20 km radius of the NPP. Other municipalities are Tlmače which is 7 km away, Zlaté Moravce 14 km away, Nitra 27 km away and the outskirts of Slovakia's capital city of Bratislava are approximately 90 km to the west of MO34, i.e. 120 km by public roads. Budapest and Vienna are the closest cities with over 1 million inhabitants in a 200 km radius of MO34. The outskirts of Budapest are approximately 85 km to the southeast of MO34 and the outskirts of Vienna are about 145 km to the southwest. Other large agglomerations with more than 1 million inhabitants are Varšava to the north, Záhreb to the south, Kyjev to the east, and Prague to the west.

Slovakia shares its borders with five other countries: Hungary, Austria, the Czech Republic, Poland and the Ukraine. The approximate distance of the MO34 site from the individual state borders is included in the Table 41.

Table 41 - Distance from MO34 to individual state borders

Country	Distance from MO34 to state border
Hungary	37 km
Austria	110 km
Czech Republic	85 km
Poland	130 km
Ukraine	270 km

The closest state boundary is the border with Hungary. The Ipeľ River forms a natural boundary with Hungary in a 50 km radius of the site with the exception of the boundary between the municipalities of Šahy and Ipeľský Sokolec. The closest NPP is in Jaslovské Bohunice which lies approximately 64 km from MO34.

Land parcel numbers are included in Table 42.

Table 42 - Identification of the area of interest

Code and name of district	402 Levice
Code and name of municipality	502 413 – Mochovce,
Name and number of cadastral territory	838 152 – Mochovce, 842 931 - Nový Tekov,
Parcel number	Number of parcels can be found in Annex No. 1.1

Cadastral map and a diagram of the site are included in Annex 1.1.

5.0 GENERAL SITUATION OF LOCATION OF PROPOSED ACTIVITY (SCALE 1: 50 000)

General overview of the location of the proposed activity in a scale of 1:50,000 is included in Annex 2.1.

6.0 REASONS FOR LOCATION AT GIVEN PLACE

Mochovce NPP was designed and its construction has been launched and realized as a four-unit NPP with common civil structures and technological components to be shared by all the four units. That means that the site of Mochovce NPP has been conceived to host four units and all the environmental evaluations (which were necessary to obtain the siting and construction permits) have been carried out always taking into account the likely impacts and the needs of four units.

From the point of view of water needs, waste production, atmospheric releases and liquid discharges, electric grid, land use, infrastructures, roads, railway and all the external services, the Mochovce site is fully capable of bearing Units 3 and 4.

Moreover, due to the advanced stage of completion of Units 3 and 4, Mochovce site represents a one off opportunity to cover in a short time the significant gap between demand and supply of electric energy on the Slovak network.

7.0 DATE OF BEGINNING AND TERMINATION OF CONSTRUCTION AND OPERATION OF PROPOSED ACTIVITY

Construction works for MO34 started in 1986 with the laying of the foundations of the main buildings (reactor building, longitudinal electrical building, basement of transformers, cooling towers, vent stack) and continued up to 1992. In 1992 construction works were suspended due to insufficient funds. At that time the civil parts were up to 70% complete and the machinery parts up to 30% complete. The basic technological equipment like the reactor vessel, the steam generators, the pressurizer, the safety systems and the main parts of the turbines were delivered to the site and partially installed.

From 1992 to 2000 maintenance and conservation of suspended equipment and components and of the civil structures were carried out by the original main suppliers and constructors. From 2000 to-date the preservation and protection works have been performed on the basis of programs following technical guidelines of the IAEA and approved by the Nuclear Regulator Authority (ÚJD) of the Slovak Republic.

The assumed time schedule for the start and completion of the construction work and operation of the proposed activities is as follows:

Beginning of construction:	1986
End of construction:	February 2012 (Unit 3) – July 2012 (Unit 4)
Commissioning of Units:	October 2012 (Unit 3) – July 2013 (Unit 4)
End of operations:	February 2053 (Unit 3) – October 2053 (Unit 4)

8.0 BRIEF DESCRIPTION OF TECHNICAL AND TECHNOLOGICAL SOLUTION

Primary circuit

The primary circuit of each unit is formed by the reactor and six coolant loops; each loop consists of a hot leg with an isolation valve, a steam generator and a cold leg with a reactor main circulation pump and an isolation valve. The reactor main pumps circulate pressurized water for removing heat from the reactor core. The pressurizer establishes and maintains the reactor coolant system pressure within the operational conditions and allows compensation for reactor coolant volume changes during operation. Steam generators are the interface between the nuclear system (primary) and the steam system (secondary). Each steam generator is a tubular evaporator of horizontal design.

The fuel assemblies are placed in the reactor pressure vessel where chemically treated water (coolant) runs through channels of the fuel assemblies and removes the heat generated by the fission reaction. The water exits the reactor at the temperature of about 295°C (temperature increase through the reactor is about 28°C). The fuel used is uranium dioxide (UO_2). Nuclear units operate in campaigns and periodically the reactor is shut down for refueling.

Secondary circuit

The steam generated by the six steam generators is piped through 6 high pressure steam lines outside the reactor building to the turbine hall. The turbine hall is shared by all four units. For each unit the hall houses two Steam Turbine Generator sets. Each steam turbine is composed of one high-pressure section and two low-pressure sections. The exhausted steam condenses in the main condensers (two per each turbine, i.e. one for each low pressure section), which are cooled by the circulating cooling water system. The condensate (feed water) is then reheated and sent back to the steam generators.

Technical parameters of both the secondary and the primary circuit are reported in chapter 2 (Design Framework) of the part II (EIA structure).

Detailed information on technical and technological solutions of proposed activities can be found in chapter 2 (Design Framework).

9.0 ALTERNATIVES OF PROPOSED ACTIVITY

Based on a request from the proponent, Slovenske elektrarne NPP Mochovce, Units 3 and 4, dated the 15th of June 2008, the Ministry of Environment of Slovakia abandoned the request of alternative solutions for the proposed activity.

This has been confirmed by the Ministry of Environment by the letter to Slovenske Elektrarne a.s. No. 7451/2008-3-4/hp dated July the 31st 2008.

The justification of such a request is based on the peculiarity of Mochovce NPP. As already mentioned, the power plant was designed and its construction has been launched and realized as a four-unit NPP with common civil structures and technological components to be shared by all the four units. From the civil structures point of view, the plant is built up to 70%.

All the environmental evaluations for the issuance of permits, have been carried out taking into account the likely impacts and the needs of four units.

From the point of view of all the external services and infrastructures, the site of Mochovce is already capable of bearing Units 3 and 4.

Moreover, due to the advanced stage of completion, Mochovce site represents a one off opportunity to cover in a short time the significant gap between demand and supply of electric energy on the Slovak network.

Due to the above mentioned reasons, it appears clear that the completion and operation of Mochovce Units 3 and 4 has no reasonable alternatives. A detailed justification is reported in Section C, part V.

10.0 TOTAL COSTS (TENTATIVE COSTS)

The approved overall Project cost is 2.774.848.782 € (overnight as of 1st July 2008).

The main breakdown (in €) is as follows:

■ Nuclear Island	1.255.048.782 €
■ Conventional Island	1.028.000.000 €
■ Balance of Plant	361.800.000 €
■ Main Instrumentation and control	130.000.000 €

11.0 MUNICIPALITY CONCERNED

From the siting and location point of view, Mochovce NPP belongs to the administration municipalities of **Novy Tekov and Kalná nad Hronom** (complex of civil structures lies in cadastral lands of Nový Tekov and Mochovce municipality, that was cancelled due to the construction of Mochovce NPP and Mochovce administration was transferred under the municipality of Kalná nad Hronom).

There will be minor impacts on villages located nearby Mochovce NPP (on the border of the protection zone 3 km from the centre of the power plant) by activities related to commissioning and operation which will lead to a slight increase in discharge into atmosphere and hydrosphere above the current discharge levels. These villages are considered as being affected villages because their cadastral areas are in direct contact with the power plant.

Affected villages are as follows:

- in the district of Levice:	Nový Tekov (Marušová), Starý Tekov, Kalná nad Hronom, Veľký Ďur, Lipník (Tlmače) a Malé Kozmálovce,
- in the district of Zlaté Moravce:	Nemčiňany,
- in the district of Nitra:	Čifáre.

12.0 SELF-GOVERNING REGION CONCERNED

The autonomous region of Nitra is affected by the proposed activities.

13.0 AUTHORITIES CONCERNED

- Ministry of Environment of the Slovak Republic, Department of EIA, Hanulova 5/D Dubravka, 841 00 Bratislava
- Ministry of Environment of the Slovak republic, Department of Nature and Landscape Protection, Nám. Ľ. Štúra 1, 812 35 Bratislava
- Ministry of Environment of the Slovak republic, Department of Water and Energy Resources, Nám. Ľ. Štúra 1, 812 35 Bratislava
- Ministry of Construction and Regional Development of the Slovak Republic, Department of inspection and construction administration, Prievoznická 2/B, 825 25 Bratislava 26
- The autonomous region of Nitra, Department of regional development, Štefánikova trieda 69, 949 01 Nitra
- Regional Office of Environment in Nitra, Department of environment, Janka Kráľa 124. 949 01 Nitra
- District office Levice, Department of Crisis Management, Ludovíta Štúra 53, 934 03 Levice
- Regional office of Public Health in Nitra, Štefánikova 58, 949 63 Nitra
- Regional office of fire and rescue corps in Nitra Dolnočermánska 64 94911 Nitra
- District office of fire and rescue corps Levice, Požiarnická No. 7, 943 01 Levice.

14.0 APPROVING AUTHORITY

Nuclear Regulatory Authority of the Slovak Republic (NRA SR)

15.0 DEPARTMENTAL AUTHORITY

Ministry of Economy of SR, Mierová 19, 827 15 Bratislava 212

16.0 STATEMENT ON ANTICIPATED CROSS-BOUNDARY IMPACTS OF PROPOSED ACTIVITY

Due to the extremely low values of discharges of radionuclides from EMO12, the discharges from MO34 into atmosphere and hydrosphere are not likely to exceed the existing limits. The calculations of radiation load to the public beyond the state boundaries, as reported in chapter 1.5.3 (Section C, part III), show that there are no appreciable cross-border impacts.

B. DATA ON DIRECT AND INDIRECT ENVIRONMENTAL IMPACTS OF PROPOSED ACTIVITY, INCLUDING HEALTH

I REQUIREMENTS ON INPUTS

1.0 LAND

Further development of the Mochovce NPP, Units 3 and 4, will not require additional land other than the one already authorized. Most of the civil works (70%) are completed and are currently not used. Once the MO34 is in operation, besides the dedicated structures and systems, it will use also the common structures and systems shared with EMO12.

2.0 WATER

2.1 Surface water

As already stated in chapter 2.7 (Resources consumption at the installation), water for the operation of Mochovce NPP is extracted from the water reservoir at Veľké Kozmálovce on the Hron River approximately 5 km from the site (Decision of the district authorities in Banská Bystrica, odd. No. 1094/2/177/405.1/93-M from 6.7.1993).

Suspended solids are removed from the extracted water, first through a coarse 3 to 5 cm slot at the inlet of the piping, and then refined, through a 16 mm slot at the entrance of the pumping station. This second set of slots is cleaned by an automatic device and the impurities are gathered into a 3.2 m^3 tank and periodically brought back to the dam. Consequently, clear water (deprived of suspended solids) is pumped from the pumping station to two reservoir tanks, each with a volume of 6,000 m^3 at the Mochovce NPP.

Water loss by evaporation from the cooling towers depends on water and air temperature and is in the range from 0.85 m^3/s to 1.33 m^3/s. A further part of the water in the amount from 0.18 m^3/s to 0.36 m^3/s is used as backup water discharged to the canal from the third circuit in order to maintain the required water quality (blow-down).

The volume of extracted surface water during the period 2000-2008 is reported in Table 43. This table includes data from the start of operation of unit 2 of the NPP (2000). The total amount of surface water extracted from the source at Veľké Kozmálovce is in conformity with the yearly limits permitted by the water authorities.

Table 43 - Volume of water extracted and consumption of surface water in relation to the production of electricity

Year	Surface water extraction (m^3)	Gross electricity production (MWh)	Specific water consumption (m^3/MWh)
2000	19,154,053	5,946,691	3.22
2001	16,788,751	5,391,342	3.11
2002	18,218,200	5,870,235	3.10
2003	19,286,611	6,238,525	3.09
2004	17,615,583	5,482,865	3.21
2005	19,313,417	6,239,944	3.09
2006	18,949,001	6,320,254	2.99
2007	19,994,286	6,828,737	2.93
2008	20,626,000	6,890,967	2.99

(Source: Slovenské elektrárne, a.s. EMO)

A decrease in the quality of extracted water from the water reservoir leads to lower condensation in the cooling circuit and an increase in the actual consumption. On the basis of estimation it can be stated that the volume of sediment is approximately 50% of the retention volume of the reservoir.

When MO34 will be in operation the consumption of surface water shall double. Operation of all four units will require an average annual extraction equal to $Q_{average}$=1.5 m^3/s with a maximum extraction rate of Q_{max}=1.8 m^3/s.

The total annual consumption for 4 units is in conformity with the annual limits set by the water authorities i.e. 47,304,000 m^3 per year.

2.2 Groundwater extraction

As stated in chapter 2.7 (Resources consumption at the installation), groundwater is extracted from two wells, HMG-1 and HMG-1/A, owned by SE in Červený Hrádok approximately 8 km away from Mochovce NPP. The maximum permitted flow rate is 18 l/s for HMG-1 and 15 l/s for HMG-1/A. Groundwater is used for drinking water purposes. A reservoir of drinking water is also constituted by the aqueduct in Kalná nad Hronom.

Up to 2005 groundwater was mostly taken from the two wells in Červený Hrádok, and the remaining part from the aqueduct in Kalná nad Hronom (Table 44). In 2005, drinking water from the water source in Kalná nad Hronom was supplied in the volume of 22,305 m^3. Supply of drinking water from the aqueduct was stopped in June 2005 due to a decision of the management of Mochovce NPP.

Currently the well at Červený Hrádok provides sufficient drinking water for the Mochovce NPP. In 2008, the volume of pumped groundwater from the source at Červený Hrádok was 91,378 m^3, being effectively supplied to Mochovce NPP.

Table 44 - Volume of drinking water consumed from various sources between 2000 and 2008

Year	Volume of drinking water consumption (m^3)				
	Well	Water supply	Total	No. of employees	Consumption per employee l/person×day
2000	380,570	-	380,570	2,435	428
2001	311,393	48,723	360,116	2,349	363
2002	303,950	32,677	336,627	2,192	370
2003	311,020	39,601	350,621	1,870	465
2004	353,940	47,167	401,107	1,783	543
2005	178,760	22,305	201,065	1,613	304
2006	96,183	0	96,183	1,528	172
2007	83,478	0	83,478	1,459	153
2008	91,378	0	91,378	1,505	166

(Source: Slovenské elektrárne, a.s. EMO)

The volume of extracted groundwater had a decreasing trend from 2005 on. The reduction in the consumption of drinking water was related to the fitting of water meters at all consumption points whereby determining leaks in the distribution network which were repaired or replaced.

When MO34 will be in operation the consumption of drinking water will increase by approximately 25%. The permitted extraction from the well in Červený Hrádok will not be exceeded by this increase.

3.0 RAW MATERIALS

In a NPP the main consumed resource is fuel (i.e. uranium); Consumption of fuel in MO34 is dealt with in chapter 2.5 (Fuel).

In EMO12, chemicals are used for operation and maintenance of the mechanical and other technological equipment (sealing material, lubricants, protective paints, cleaning agents etc.) and for operation and maintenance of buildings etc. The consumption of these materials ranges from several tens of kilograms to several hundred tons (e.g. material for reconstruction and maintenance of buildings etc.). Based on a qualified estimation the total consumption of material should range between 20 – 25 thousand tons per year.

Other raw materials needed for the operation and maintenance of EMO12 are either environmentally neutral materials (e.g. protective paints) or are categorized after use as being in the waste category O (paper, wood etc.). As stated in chapter 2.7 (Resources consumption at the installation), the second group is made up of various chemicals and oil products which are included in Table 45.

The operation of Units 3 and 4 of Mochovce NPP is likely to require the same amount of chemicals of Units 1 and 2, and the consumptions for the whole plant will be lower than two times the consumptions for EMO12 due to the existence of common structures and systems.

Table 45 - Consumption of chemical and oil products at Mochovce NPP in 2008.

Raw material	Consumption [t]	Raw material	Consumption [t]
Sulphur acid H2SO4	278.8	AKTIPHOS Stabilizer	26.9
Sodium hydroxide NaOH	282.9	DILURIT GM AC, GM ACT	14.7
Activated hydrazine – Levoxine	15.3	DILURIT GM AC, GM Cat	28.7
Ferric sulphate $Fe_2(SO_4)_3$	1,467.9	POF KOARET	7.4
Lime hydrate $Ca(OH)_2$	2,240.0	NALCO ST70 BIOCIDE for TVD	5.4
Hydroxide ammonia NH4OH (24%)	56,5	INHIBITOR NALCO 73 199 for TVD	2.5
Nitric acid HNO_3	14.4	Stabilizer NALCO TRASAR 3DT 195	2
Sodium phosphate Na_3PO_4	0.9	H_2 in Nm^3	9,972.0
Sodium sulphite Na_2SO_3	2.3	Boric acid H_3BO_3	6,7
MIKROSORBAN COAGULANT	7.3	N 2 v m3	536.1
Petroleum products lubricant oils	9.3	Sodium hypochloride NaClO	1.4
Isolation oils, in m^3	0.6	Hydraulic oil in m^3	1.900
Calc-casing remover BREX	0	TOPECOR	0

(Source: Slovenské elektrárne, a.s. EMO)

4.0 ENERGY SOURCES

The main energy source in a NPP derives from fission of fuel elements. Description of the fuel that will be used in MO34 is dealt with in chapter 2.5 (Fuel).

The consumption of electrical energy of EMO12 is currently ensured by the production of the plant itself. Gross and net electrical energy produced in the last 9 years (2000 – 2008) is reported in Table 46.

Table 46 - Electrical energy production and consumption of EMO12 in the last 9 years (2000 – 2008).

Year	Gross production of electricity (MWh)	Net electrical energy [MWh]	Self-consuption [MWh]
2000	5,946,691	5,458,317	488,374
2001	5,391,342	4,964,468	426,874
2002	5,870,235	5,420,645	449,590
2003	6,238,525	5,761,054	477,471
2004	5,482,865	5,038,187	444,678
2005	6,239,944	5,770,085	469,859
2006	6,320,254	5,845,148	475,106
2007	6,828,737	6,321,591	507,146
2008	6,890,967	6,399,899	491,068

(Source: Slovenské elektrárne, a.s. EMO)

As it can be seen from the table, self-consumption of the plant is approximately 450,000 MWh that is about 7-8% of the whole electrical energy generated. A similar percentage is foreseen also for operation of MO34.

Heating of EMO12 requires roughly 2,231 TJ every year; such energy is directly supplied by the internal heating system of the plant that uses the surplus of thermal energy produced by the two reactors.

Differently, heating of the guarding and storage area (MO 34 offices and warehouses) is provided by a natural gas boiler whose fuel consumption during the last two year is shown in Table 47.

Table 47 - Consumption of fuel at Mochovce NPP in 2007 and 2008.

Source	Fuel consumption	
	2007	2008
Boiler plant heated by natural gas, guarding area	55,762 m^3	120,222 m^3
Auxiliary start-up boiler plant heated by natural gas	4,673 m^3	724,388 m^3
Diesel Generator Stations - oil-fuel	80.6 t	80.6 t

(Source: Slovenské elektrárne, a.s. EMO)

Given that after MO34 completion heating of warehouses will be no more necessary and given that heating of offices will be provided directly by the surplus of produced thermal power, consumption of natural gas by this system will strongly decrease.

An additional source of heat production is the auxiliary natural gas boiler whose aim is to provide the necessary steam supply to the turbine for the start-up of one reactor in case also the other units are shut down (and therefore the auxiliary steam cannot be provided by these ones).

This system is common to all four units and it is normally in cold stand-by. The consumption of natural gas in 2007 and 2008 are reported in table 47.

Consumption in 2007 was entirely due to periodical tests (no start-up was required); differently, consumption in 2008 was noticeably greater than 2007 due to the simultaneous shut down of both units that required the operation of the system for 20 days.

The system is common to all four units and its start-up will be required if either units 1 & 2 or units 3 & 4 are in simultaneous shut down. The consumption of natural gas for the periodical tests will remain approximately the same with the operation of MO34.

A backup source of electrical energy is a diesel generator station (DGS) whose fuel consumption for 2007 and 2008 are reported in table 47. Diesel units ensure energy supply to all safety systems in case of loss of off-site power. Analogously to EMO12, backup electrical supply will be ensured by three diesel generators for each unit of MO34. An additional 13^{th} diesel generator with a little bit lower power than the others, dedicated to MO34, will be installed and will ensure additional electrical supply in case of severe accidents. Also the diesel generators are usually in cold stand-by and are periodically tested to prevent unrevealed failures.

Consumption of diesel is expected to increase twofold (or conservatively by a factor 13/6) due to periodical tests of all the 13 diesel generators.

5.0 DEMANDS ON TRANSPORT AND OTHER INFRASTRUCTURE

As stated in chapter 2.7.5 (Requirements for transport and other infrastructures), the Mochovce NPP requires transport communications for a constant flow of raw materials and waste created during its operation and for the transport of employees. The current road and rail communications are used for the majority of material flow. The transport of utility water from the river Hron and drinking water is ensured by pipelines. Transport of liquid waste to Čifáre is also provided by a pipeline.

Road transport and railway communications

Communication network is concentrated to the regional town of Nitra and to individual provincial towns Levice, Nitra, Nové Zámky, Zlaté Moravce and Žiar nad Hronom. The main transport routes respect the relief of the terrain and provide the following transport directions:

- Sereď - Nitra - Zlaté Moravce - Nová Baňa;
- Trnava - Nitra - Levice – Sebechleby;
- Galanta - Šaľa - Nové Zámky – Šahy;
- Dunajská Streda - Komárno – Štúrovo;
- Komárno - Nové Zámky - Nitra - Topoľčany – Prievidza;
- Štúrovo - Kalná nad Hronom – Žarnovica;
- Šahy - Kalná nad Hronom – Vráble.

Classification of the roads is in accordance with the Slovak standard STN 736101.

The most important communications in the close vicinity of Mochovce (within 20 km) are 1st class roads No. 51 Trnava - Nitra - Vráble - Levice, and No. 65 Nitra - Banská Bystrica. Another important route is No. 64 Topoľčany - Nitra - Nové Zámky. The direction from east to west is less assessable with a less dense distribution of municipalities than the direction from north to south.

The land is properly connected to international roads. The site is connected to international road No. 65 (a part of which coincides with International E-road E571) through a stretch of approximately 33 km of road I/51. In north-south direction the region is connected to international roads No. 75 and No. 77 by the road I/51 and I/65 Trnava, Sereď, Nitra, and Zvolen.

Links to the other regions in north-south direction are provided by the road I/66 from Hungary to Zvolen through Sahy and the road I/76 Štúrovo - Levice - Tlmače.

Links in east – west direction in the region is secured by the road I/63 Štúrovo - Komárno- Bratislava.

By means of the road I/64 passing in north – south direction, a link to Hungarian highway network is provided about 9 km from Komarom town through bridge on Danube River.

Transport road 176 Kalná nad Hronom, Tlmače, Hronský Beňadik is linked to road 165 Nitra, Zlaté Moravce, and Zvolen that is a part of European road E571. In west – east direction the other transport roads are constructed, such as road 175 Nové Zámky, Tekovské Lužany, Lučenec, road 151 Nitra, Levice, Krupina, Zvolen and road 166 from Hungary to Zvolen through Šahy and road 176 Štúrovo, Levice, Tlmače.

The main railway in the described area is the line No. 370 Bratislava – Galanta - Šaľa - Nové Zámky - Štúrovo, which continues to Hungary. Significant railway nodes are Trnovec nad Váhom, Palárikovo, Nové Zámky and Šurany.

Other significant lines in the wider area are:

- Nové Zámky - Šurany - Zlaté Moravce;
- Komárno - Nové Zámky - Nitra - Topoľčany – Prievidza;
- Komárno – Bratislava;
- Leopoldov - Lužianky – Kozárovce;
- Galanta - Šaľa - Nové Zámky;
- Bratislava - Nové Zámky – Štúrovo;
- Zvolen - Levice - Nové Zámky.

The area has a good connection in west – east direction, because it is located on southern urban planning axis of the Slovak Republic, presented by the arterial railway line No 379-390 Leopoldov - Kozárovce - Zvolen – Košice that is fully electrified on the territory of the area. The area has a direct connection on Kozarovce station provided by railway line No 390 from Bratislava through Palárikovo, Šurany and Levice to Zvolen. The links of the area with other regions in north – south direction are provided by railway line No 399 Štúrovo - Šahy - Zvolen.

Mochovce NPP is also connected to a dedicated railway branch (No. 314). The construction of this railway branch to serve MO 3 was permitted by the railway construction permit No. 8460/1986-13/4 issued by the Railway Administration Authority in Bratislava on 31 October 1986. As regards operation of the railway serving the Mochovce NPP, SE is authorised to operate both the railway and the transport on the railway.

Neither new roads nor railways will be needed for completion and operation of MO34. Realization of the proposed activities will not place a greater burden on existing road communications, railway lines or technical infrastructures as far as the operation phase.

External electrical system

EMO12 are currently in operation and the power output is fed to the nearby 400 kV distribution plant at Veľký Júr, which is connected to the surrounding distribution plants through four 400 kV lines. One line leads to the 400 kV distribution plant at Levice, one line leads to the 400 kV distribution plant at Križovany and one to the 400 kV distribution plant at Horná Ždaňa. Reserve power supply for units 1 and 2 is connected to the 110 kV distribution plant at Veľký Júr, which is connected to the distribution plant at Levice through 110 kV lines. The Levice distribution plant at is a 400/110 kV transformer station with two 250 MVA transformers. The transformers serve as an initial source for the Mochovce NPP which is also supplied by the adjacent region.

The transmission grid 400/220 kV is part of the interconnected energy system CENTREL, which was established on 11 October 1992 among Hungary, Poland, Czech Republic, and Slovakia. This system works in synchrony with the energy system of western Europe UCPTE.

Existing electrical system is already adequate for the operation of all four units and construction of no other electrical line will be required.

6.0 DEMANDS ON LABOUR

Human resources employed in EMO12 during the last 9 years (2000 – 2009) are shown in Table 48.

Table 48 - Number of employees in EMO12 during the last 9 years (2000 – 2008).

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Persons	2,435	2,349	2,192	1,870	1,783	1,613	1,528	1,459	1,505

The expansion of the NPP with 2 additional units will lead to an increase in the number of employees by the addition of service staff in the reactor and workers that cannot be taken from the existing service staff in units 1 and 2. This would therefore increase job opportunities.

The expected change in the operations phase workforce is expected to increase by less than 20% compared with current situation.

II OUTPUT DATA

1.0 AIR

Sources of air pollution may be divided in two categories: aerosols of radionuclides produced by the operation of the nuclear reactor and non radioactive effluents deriving from combustion processes.

1.1 Non radioactive airborne effluents discharged to the atmosphere

Concerning EMO12, emissions from the combustion processes are connected with a natural gas source (auxiliary start-up and site security boiler) and a diesel source (diesel generators).

The Auxiliary start-up boiler provides the necessary steam supply to the turbine for the start-up of one reactor in case also the other unit is shut down (and therefore the auxiliary steam cannot be provided by this one). This system is common to all four units.

The site security natural gas boiler provides heating of the guarding and storage area (MO34 offices and warehouses).

Diesel units ensure energy supply to all safety systems in case of loss of off-site power. Analogously to EMO12, backup electrical supply will be ensured by three diesel generators for each unit of MO34. An additional 13th diesel generator with a little bit lower power than the others, dedicated to MO34, will be installed and will ensure additional electrical supply in case of severe accidents. Also the diesel generators are usually in cold stand-by and are periodically tested to prevent unrevealed failures.

Both diesel generators and auxiliary boiler are in cold stand-by, given that their continuous functioning isn't required. Due to possible failure during stand-by, the diesel generators and the auxiliary boiler undergo periodical tests. Differently, heating of MO34 offices and warehouse is continuous.

Fuel consumption of the three systems in 2007 and 2008 is reported in table 49 (see chapter Other raw material and energy source); annual emissions of the most common pollutants deriving from the described combustion processes are reported in the following table for the last two years.

Table 49- Sources of air pollution from non-radioactive emissions in 2007 and 2008

Source: SE-EMO		**Solid contaminants [t/year]**	**SO_2 [t/year]**	**NO_x [t/year]**	**CO [t/year]**	**ΣC (total carbon) [t/year]**
2007	Auxiliary natural gas start-up boiler	0.000355	0.000043	0.007813	0.002619	0.000333
	Natural gas boiler, site security	0.004238	0.000509	0.082639	0.033374	0.005562
	EMO12 DGS	0.114452	0.001612	0.403	0.06448	0.009188
	TOTAL	0.119045	0.002164	0.493452	0.100473	0.015083
2008	Auxiliary natural gas start-up boiler	0.000355	0.006606	1.211177	0.406019	0.051613
	Natural gas boiler, site security	0.009137	0.001096	0.178169	0.071953	0.011992
	EMO12 DGS	0.114452	0.001612	0.403	0.06448	0.009188
	TOTAL	0.123944	0.009314	1.792346	0.542452	0.072793

(Source: Slovenské elektrárne, a.s. EMO)

Emissions in 2007 from auxiliary natural gas boiler were entirely due to periodical tests (no start-up was required); differently, emissions in 2008 are noticeably greater than 2007, due to the simultaneous shut down of both units that required the operation of the system for 20 days.

Given that the system is common to all four units, low emissions due to periodical tests will remain approximately the same with the operation of MO34. Start-up of the system will be required if either units 1 & 2 or units 3 & 4 are in simultaneous shut down.

Given that heating of warehouses will be no more necessary after MO34 completion and given that heating of offices will be provided directly by the surplus of produced thermal power, non radioactive emission from natural gas boiler used for the heating of guarding and storage areas will strongly decrease.

Non radioactive emissions from diesel generators are the same in both 2007 and 2008. Given that the number of diesel generators will increase from 6 to 13 with operation of MO34, there will be approximately a twofold increase (or conservatively by a factor 13/6) as far as concerns non radioactive airborne emissions from diesel generators.

1.2 Radioactive airborne effluents discharged to the atmosphere

During normal operation, the most important fraction of the radioactive gaseous effluents is created by the de-aeration system of the primary circuit; the remaining part derives from possible leakages from the primary circuit (or from other systems containing radioactive material) and from the radioactive liquid waste large capacity tanks. The air from these compartments is led to the air cleaning system whose aim is to ensure the limitation of the releases of the gaseous radioactive substances (airborne particulates, noble gases and Iodine isotopes) into living environment.

In the air cleaning system, airborne effluents pass trough absorbing filters (specifically designed for gaseous radioactive pollutants) and then are led to a delay line (constituted by non impregnated charcoal), whose function is to increase the permanence time of radioactive effluents in the system and therefore to allow radioactive decay of the short-life isotopes before being released in atmosphere.

The treated effluents are then merged with the air of the ventilation system and subsequently discharged in atmosphere through the ventilation stack. A description of the ventilation system, the purifying line and its efficiency may be found in chapter 2.6 (radioactive and non-radioactive waste management) and 2.9 (Release of airborne effluents in normal conditions).

Radioactive substances discharged to the atmosphere are made up of highly volatile isotopes that easily separate from the liquid phase: noble gases, Iodine and other radionuclides in form of aerosols.

The limit values of the nuclear facility for discharge of RAL to the environment are set so that the effective dose will not exceed 250 μSv per calendar year in the relevant critical group of inhabitant. This value is considered as a limit dose for the design and construction of a nuclear facility in the given location (Annex 3 of Act No. 345/2006 Coll.).

Requirements for operation of EMO12 (Table 50) are set forth including the yearly limits in emissions for radionuclide of noble gases ($4.1 \cdot 10^{15}$ Bq), iodine radioisotope 131I in total gaseous and aerosol forms ($6.7 \cdot 10^{10}$ Bq) and radionuclide mixtures (except ^{131}I) in aerosol with half-life greater than 8 days ($1.7 \cdot 10^{11}$ Bq).

On the basis of this limits, the following reference levels are set:

a) investigation levels for releases to atmosphere for radionuclides of noble gases ($1.1 \cdot 10^{13}$ Bq/day), Iodine radioisotope ^{131}I in gaseous form ($1.8 \cdot 10^{8}$ Bq/day) and radionuclide mixtures in aerosol ($0.5 \cdot 10^{9}$ Bq/day);

b) intervention levels for release to the atmosphere for radionuclides of noble gases ($5.5 \cdot 10^{13}$ Bq/day), Iodine radioisotope ^{131}I in gaseous form ($9.0 \cdot 10^{8}$ Bq/day) and radionuclide mixtures in aerosol ($2.5 \cdot 10^{9}$ Bq/day).

Table 50 - Limits of output activity from EMO12 to the atmosphere

	Yearly limit	Reference investigation level	
		a) investigation level	b) intervention level
Radionuclide of noble gases	$4.1 \cdot 10^{15}$ Bq/year	$1.1 \cdot 10^{13}$ Bq/day	$5.5 \cdot 10^{13}$ Bq/day
Iodine radioisotope ^{131}I	$6.7 \cdot 10^{10}$ Bq/year	$1.8 \cdot 10^{8}$ Bq/day	$9.0 \cdot 10^{8}$ Bq/day
Radionuclide mixtures	$1.7 \cdot 10^{11}$ Bq/year	$0.5 \cdot 10^{9}$ Bq/day	$2.5 \cdot 10^{9}$ Bq/day

(Source: Slovenské elektrárne, a.s. EMO)

If the intervention levels mentioned in the table 50 are met or exceeded for any of the components, then measures are taken to reduce the discharge below the limits and, moreover, additional and adequate measures are undertaken in order to not exceed annual discharge limits.

The results of the latest 11 years annual reports (Annex 4.2) show that the overall amount of RA noble gases being emitted to the atmosphere has a decreasing trend (Figure 28).

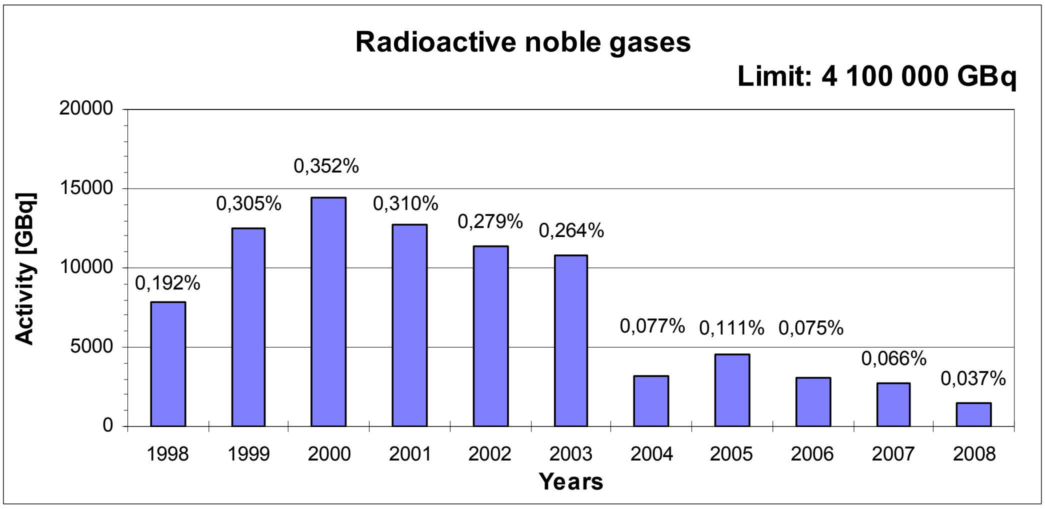


Figure 28 - RA noble gases emission and percentage of permitted annual limit

Also RA Iodine shows a decreasing trend in the amount of emissions (Figure 29).

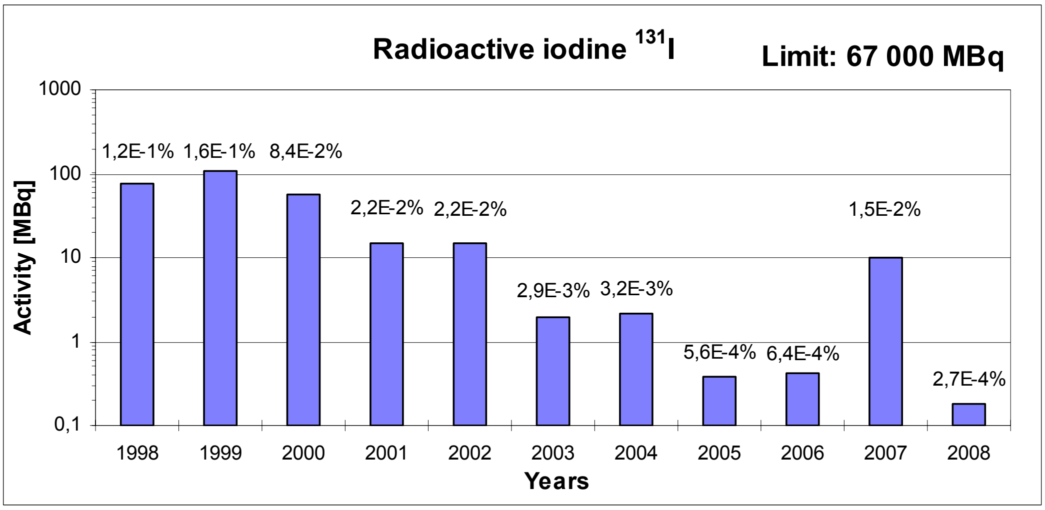


Figure 29 - RA Iodine emission and percentage of permitted annual limit

The trend for RA aerosol shows a variable trend over the past 11 years, nevertheless the registered values are always high below the permitted annual limit (Figure 30).

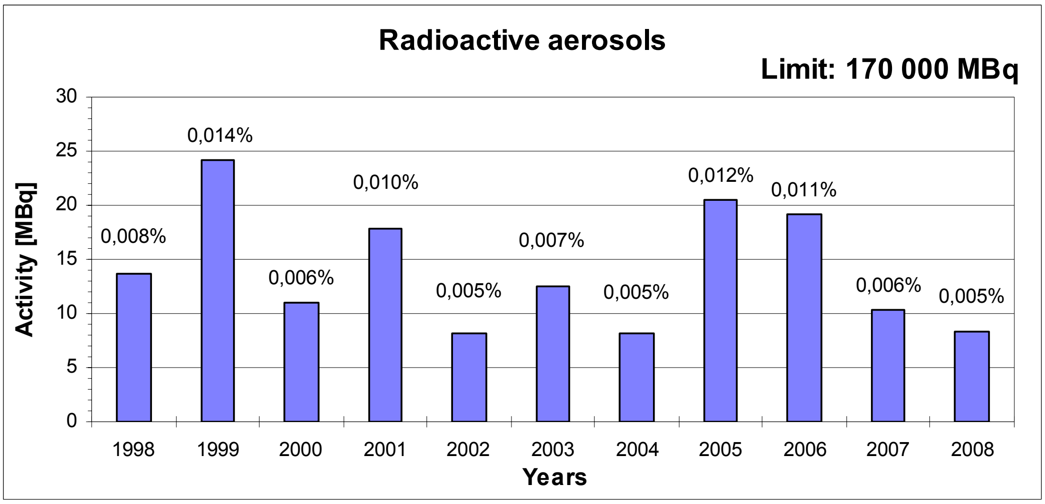


Figure 30 - RA aerosol emission and percentage of permitted annual limit

Table 51 summarizes data reported in the previous figures.

Table 51 - RAL released to the atmosphere from EMO12

Year	Noble gas		Iodine ^{131}I		Aerosol	
	Limit [GBq]	$4.1 \cdot 10^6$	Limit [MBq]	$6.7 \cdot 10^4$	Limit [MBq]	$1.7 \cdot 10^5$
	Unit [GBq]	% of annual limit	Unit [MBq]	% of annual limit	Unit [MBq]	% of annual limit
1998	7,890	0.192	77.25	0.12	13.62	0.0080
1999	12,507	0.305	108.57	0.16	24.13	0.0142
2000	14,412	0.352	56.53	0.084	10.92	0.0064
2001	12,712	0.310	14.65	0.022	17.77	0.0105
2002	11,419	0.279	14.93	0.022	8.18	0.0048
2003	10,805	0.264	1.93	0.0029	12.52	0.0074
2004	3,145	0.077	2.18	0.0032	8.12	0.0048
2005	4,566	0.111	0.38	0.0005	20.53	0.0121
2006	3,061	0.075	0.43	0.0006	19.23	0.0113
2007	2,691	0.066	10.18	0.0150	10.28	0.006
2008	1,517	0.037	0.18	0.0003	8.39	0.005

(Source: Slovenské elektrárne, a.s. EMO)

Among the elements possibly found in the discharged aerosol, the most significant fraction of gamma aerosols generated radionuclides are (in brackets the fractions measured in 2008 are reported): ^{110m}Ag (42.4%), ^{60}Co (15.2%), ^{59}Fe (9.7%), ^{51}Cr (8.8%) and ^{54}Mn (7.9%).

The releases of 110mAg to the atmosphere (in the form of aerosol) or to water results in particular from work being performed on the primary circuit equipment during suspension of unit operations, as the mass activity in the emissions after completing the suspension of operations decreased until the time of the next suspension.

A negative trend can be seen from the measured values of mass activity of silver 110mAg in the total amount of RA aerosol (Figures 31). The negative trend was stopped and inverted in year 2006.

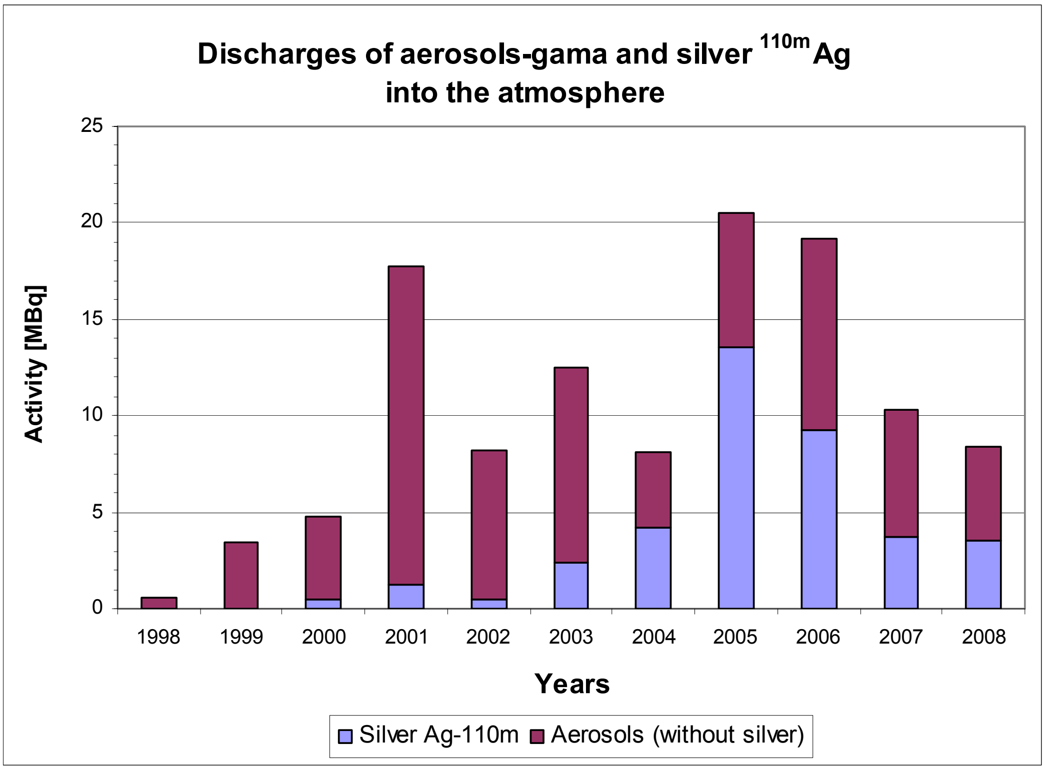


Figure 31 - Emission of ^{110m}Ag aerosol into the atmosphere

RAL releases to the atmosphere are limited by annual values which are monitored and submitted in the form of reports to the relevant authorities e.g. UVZ SR and UJD SR.

Limit conditions for radionuclide activity were set for the operation of all four units prior to starting the operation of EMO12. After beginning operation of EMO12 they were amended for the operation of 2 units; nevertheless, given that the values for RAL discharges to the atmosphere are well below the authorized limits (less than 1% for all components), an increase of operation of the NPP will not cause the overcoming of such limits.

2.0 WASTEWATER

Discharge receptors of wastewater coming from Mochovce NPP are as follows (see hydrographic map 2):

- River Hron, for wastewater from EMO12 and meteoric water collected in Mochovce NPP;
- Telinsky stream for sanitary water coming from MO34 and drainage water from Čifáre sludge bed;
- Širočina stream for drainage water coming from the drying process of sludge produced during the drinking water treatment from the source in Červený hrádok.

Both Telinsky and Širočina streams merge into the Zitava River.

The water cycle of the entire Mochovce NPP is reported schematically in Figure 32.

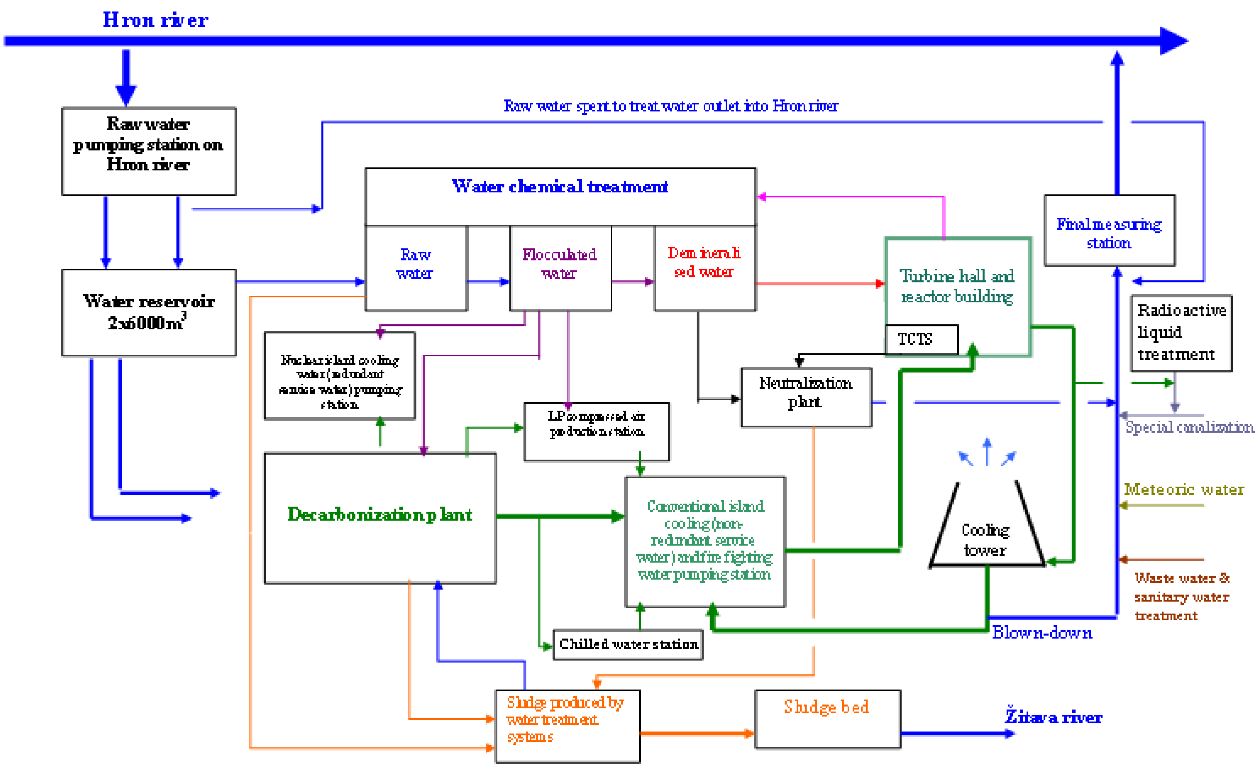


Figure 32 - Water cycle for the Mochovce NPP.

The main wastewater source discharged to river Hron is represented by industrial wastewater (cooling water) from EMO12. The industrial wastewater can be divided into:

- wastewater without radionuclides comprising cooling tower blow downs and water coming from the regeneration of resins for demineralised water production; and
- wastewater with presence of low activity radionuclides, constituted by condensation of vapour coming from radioactive liquid treatment.

The different typologies of wastewater are collected by three different pipelines which join into a steel pipe of 1.0 m diameter and 6.0 km long, and by gravity, flow into the river Hron. The three pipelines are dedicated to the collection of:

- meteoric water from EMO12 and MO34;
- non radioactive wastewater and treated sanitary wastewater from EMO12; and
- low radioactive wastewater from EMO12.

In 2008, a total amount of 4,812,820 m3 of water has been discharged from operation of EMO12. 91,378 m3 derived from sanitary wastewater treatment and the remaining 4,721,442 m3 from industrial wastewater (Table 52).

The volume of discharged wastewater has never exceeded the permitted annual value set in the decisions of the Regional office in Nitra No. 2003/01320 valid for 2 and 4 units.

Table 52 - Discharged wastewater to river Hron from Mochovce NPP between 2001 and 2008

	Discharged industrial wastewater [m^3]	**Treated wastewater [m^3]**	**Total discharged wastewater [m^3]**	***Permitted annual value [m^3](*)***
2001	3,571,575	297,282	3,868,857	***12,097,000***
2002	4,427,582	299,939	4,727,521	***12,097,000***
2003	4,417,581	328,804	4,746,385	***12,097,000***
2004	4,285,390	363,466	4,648,856	***6,000,000***
2005	4,969,195	157,609	5,126,804	***6,000,000***
2006	4,762,647	96,000	4,858,647	***6,000,000***
2007	4,367,000	83,000	4,450,000	***6,000,000***
2008	4,721,442	91,378	4,812,820	***6,000,000***

(*) The values are referred to 4 units for the years 2001-2003 and to 2 units for 2004-2008.
(Source: Slovenské elektrárne, a.s. EMO)

By a preliminary estimate, the operation of Units 3 and 4 should lead to a 100% increase in wastewater, 25 % increase in treated sanitary water and a 105% total increase in discharge, i.e. approximatively 9 million m^3. The assumed volume of wastewater will not exceed the permitted limits for 4 units (12 million m^3).

2.1 Non radioactive liquid effluents discharged to the hydrosphere

Release to the River Hron

As stated in chapter 2.10 (Release of liquid effluents in normal conditions), The decision of the waste water management department of the regional environmental authority in Nitra No 2003/01320 of 8 January 2004 expired in 2007.

New values of indicators of wastewater discharged to the Hron River were specified in a decision of the water management environmental authority in Nitra, OŽP No. 2003/01320 issued on 25 January 2007, replacing the decision No 2003/01320.

Concentration, balance values and collected pollution of pollutants discharged in river Hron during 2008 are shown in Table 53 compared with the valid limits.

The development in the concentration values of chemical indicators of the waste water discharged into the Hron River in mg l^{-1} in the period 2004 – 2008 is given in Table 54.

Table 53 - Comparison of quality and quantity indicators of pollution discharged into the Hron River with limits valid for 2008

Indicator	Permitted limit concentration [mg/l] (excluding pH and T)	Average concentration in the discharged water [mg/]l	Permitted balance values t/year	Achieved balance values of pollution discharged into the Hron [t/year]	Concentration of pollutants in the Horn (upstream the discharge) [mg/l]	Balance value of pollution in the water taken from Hron (upstream the discharge) [t/year]
COD_{Cr}	35	14.47	210	69.64	<10	<48.12
$N\text{-}NH_4$	1.5*	0.42	9	2.021	0.12	0.577
Cl^-	100	39.40	600	189.625	8.76	42.16
BOD_5	12	2.00	90	9.625	2.2	10.58
NEL (non-polar extractable substances)	0.5	<0.1	3	<0.481	<0.1	<0.481
soluble substances RL_{105}	1,500	965.31	9,000	4645.863	215.3	1,036.2
soluble substances RL_{550}	1,000	768.67	6,000	3699.470	154.3	742.618
$P_{celk.}$	1.00	0.39	6	1,877	0.22	1.059
T_{max} [°C]	30	18.70	-	-	-	-
non-soluble substances NL	40	13.80	240	66.417	15.17	73.01
SO_4^{2-}	690	323.75	4,140	1558.15	37.17	178.892
pH	6.0-9.0	8.80	-	-	8.14	-
Hydrazine	0.5	<0.2	3	<0.962	0.022	0.106
Active Cl	0.1	0.05375	0.6	0.258	0.052	0.25
AOX	0.2	<0.1	1.2	<0.481	<0.1	<0.481
$N\text{-}NO_3^-$	16**	10.51	96	50.582	1.77	8.519

** At the time of discharging waste water from neutralization tanks 3.0 mg/l*

*** With a possibility to exceed the value of 22mg/l five times a year. Analyses in particular indicators are performed, in line with the valid decision, 48 times a year except BOD_5, hydrazine – 12 times a year, and AOX, NEI, active Cl – four times a year.*

Collected pollution from the Hron River is analyzed in raw water six times a year, and the given balance values are calculated in the total volume of the collected Hron water.

In 2008, concentration and balance values of the waste water discharged into the Hron Rive were not exceeded.

Table 54 - Development in concentration values of chemical indicators of the waste water discharged into the Hron River in mg/l in 2004-2008.

	2004	2005	2006	2007	2008
COD_{Cr}	14.54	14.32	16.275	15.38	14.47
$N\text{-}NH_4$	0.67	0.26	0.414	0.38	0.42
Cl^-	44.97	37	43.31	42.22	39.40
BOD_5	4.2	5.02	2.7	2.0	2.00
NEL (non-polar extractable substances)	0.16	0.1	0.1	<0.1	<0.1
soluble substances RL_{105}	855	857	992.65	1,115.44	965.31
soluble substances RL_{550}	607	638	710.775	895	768.67
$P_{celk.}$	0.38	0.34	0.358	0.39	0.39
T_{max} [°C]	15.2	11.8	15.33	18.12	18.70
non-soluble substances NL	14.78	13	11.46	11.56	13.80
SO_4^{2-}	328	357.9	424.47	416.96	323.75
pH	8.7	8.68	8.715	8.75	8.80
Hydrazine	0.2	0.17	<0.2	0.04	<0.2
Active Cl	0.05	0.05	0.053	<0.05	0.05375
AOX	0.22	0.207	<0.2	<0.11	<0.1
$N\text{-}NO_3^-$	9.16	8.74	8.834	11.04	10.51

Table 55 shows annual averages of 24-hour samples of the most common pollutants discharged to river Hron during the last five years (2004 – 2008).

Table 55 - Development of balance values of chemical indicators of waste water discharged into the Hron River in t/year in 2004-2008

Effective pollution of discharged waste water t/year					
Indicator	**2004**	**2005**	**2006**	**2007**	**2008**
COD_{Cr}	67.594	75.67	79.05	68.44	69.64
$N\text{-}NH_4$	3.11	1.33	2.01	1.69	2.021
Cl^-	209.06	189.66	210.4	187.88	189.625
BOD_5	19.52	25.7	13.1	8.9	9.625
NEL (non-polar extractable substances)	0.74	0.51	0.485	<0.445	<0.481
Solubles RL_{105}	3,974.77	4,736.4	4,822.29	4,963.708	4,645.863
Solubles $_{550}$	-	3,618.9	3,452.94	3,982.75	3,699.470
$P_{CELK.}$	1.766	1.74	1.74	1.735	1.877
Non-solubles NL	68.71	65.8	55.67	51.442	66.417
SO_4^{2-}	1,524.82	1,834.54	55.68	1,855.472	1,558.15
Hydrazine	0.93	0.87	<0.97	0.178	<0.962
Active Cl	0.232	0.25	0.257	<0.2225	0.258
AOX	1.022	1.02	<0.97	<0.4895	<0.481
$N\text{-}NO_3^-$	42.58	44.8	42.91	49.128	50.582

Small amounts of heat can be released into river Hron through cooling tower blow down. Measurements taken between 1970 and 1982 indicate a maximum river water temperature at Tlmace, upstream of the dam at Veľké Kozmálovce, of 24 °C (VÚVH and SMHÚ, Water Quality of Rivers in Slovakia 1977–1982, Bratislava, 1983).

According to the Slovak Decree No.296/2005, which limits the permissible temperature of non-trout rivers to 26 °C and the maximum river temperature rise to 5 °C, the liquid effluent released to the river is regularly monitored in order to comply with the regulatory limit.

In order to determine whether from the operation of EMO12 and MO34 an effect on the aquatic biota is likely, the concentrations of the key chemicals of concerns have been estimated for the downstream environment for river Hron and compared with reference values suggested by the Canadian Water Quality Guidelines for the Protection of Aquatic Life Canadian Guidelines have been chosen on the basis of Golder Associates experience in conducting Environmental Impact Assessment on this issue.

In particular, due to their environmental concern, the following key parameters have been considered:

- hydrazine;
- residual chlorine;
- $N\text{-}NO_3^-$;
- $N\text{-}NH_4^+$.

For the estimation of concentrations of the chemicals in the downstream environment for river Hron due to the operation of MO34, the following data have been utilised:

- chemical background water quality of the river Hron upstream of the discharge;
- maximum, minimum, and average flow of river Hron below the reservoir;
- chemical concentrations in the current effluent and the total effluent with the four units (EMO12 and MO34);
- current discharge flow rate and total effluent with the four units (EMO12 and MO34);
- water quality guidelines for the protection of aquatic life.

In Table 56 the chemical concentrations of considered parameters measured in river Hron water sample collected upstream of the discharge point and in EMO12 discharge water samples are reported.

Table 56 - Measured concentration of chemical of concerns in river Hron and discharge water samples.

Parameter	Units	River Hron Water	Discharged Water
$N\text{-}NH_4^+$	mg/l	0.109	0.46
$N\text{-}NO_3^-$	mg/l	1.38	7.63
residual Chlorine	mg/l	<0.05	<0.05
hydrazine	mg/l	<0.2	<0.2

The indicated values show that hydrazine and residual chlorine do not present a substantial increment in the measured concentrations in the upstream samples and in the discharged samples. Considering that from operation of MO34 the discharged concentrations of the parameters of interest will be approximately the same of the ones coming from the operation of EMO12, hydrazine and residual chlorine have not been considered for the estimation of likely effects on the aquatic biota.

For the estimation of concentrations of the above mentioned chemicals, the dilution factors of discharged water have been calculated, considering that the discharge low rate of 4 units will be approximately double compared to the discharge due to the operation of two units.

In order to calculate the dilution factor for discharge water, the average, maximum and minimum flow of river Hron below the reservoir, reported in Table 57, have been considered and referred to the effective discharged flow rate for 2 units and estimated discharge flow rate for 4 units (Table 58).

The river Hron flow rates have been chosen in order to take into consideration the most conservative hypotheses.

Table 57 - River Hron flow rates

Profile	Long-term average flow rate [m^3/s]	1-yearly max flow rate [m^3/s]	100-yearly min flow rate [m^3/s]
V. Kozmálovce-Hron	47.16	320	7.78

Table 58 - Effective discharged flow rate for 2 units and estimated discharge flow rate for 4 units

	Discharged flow rate [m^3/s]
Effective value for EMO12 in 2005	0.16
Estimated EMO12+MO34	0.32

The dilution factor for two and for units in case of average, minimum and maximum flow rate of river Hron are reported in Table 59.

Table 59 - Dilution factors

	Dilution factor (/)	
	EMO12	EMO12+MO34
Long-term average flow rate	294.75	147.38
1-yearly maximum flow rate	2,000.00	1,000.00
100-yearly minimum flow rate	48.63	24.31

On the basis of the calculated dilution factor, it has been possible to estimate the concentrations of the considered chemicals in the downstream environment of river Hron.

The estimated values are reported in Table 60, and compared with reference values suggested by the Canadian Water Quality Guidelines for the Protection of Aquatic Life.

Table 60 - Estimated values of the considered chemicals in the downstream environment and reference values

Parameter	Units	EMO12	EMO12 + MO34	Reference values
		long-term average flow rate		
$N\text{-}NH_4^+$	∝g/l	1.56	3.12	-
$N\text{-}NO_3^-$	∝g/l	25.89	51.77	13,000
		1-yearly maximum flow rate		
$N\text{-}NH_4^+$	∝g/l	0.23	0.46	-
$N\text{-}NO_3^-$	∝g/l	3.82	7.63	13,000
		100-yearly minimum flow rate		
$N\text{-}NH_4^+$	∝g/l	9.46	18.92	-
$N\text{-}NO_3^-$	∝g/l	156.92	313.83	13,000

Therefore, the estimated values for the considered chemicals of concerns result lower than the reference values suggested by Canadian Water Quality Guidelines for the Protection of Aquatic.

Release to Telinsky stream

As stated in chapter 2.10 (Release of liquid effluents in normal conditions), the discharge permit for wastewater from the Cifare settling tank to Telinsky stream was issued by the Regional office of Nitra, with decision No. 2003/02664 in date 5.11.2003 and implemented by successive decision No. 2004/00408 issued in date 22.7.2004. The permission is valid up to 31.12.2009. Analyses are carried out 6 times a year on samples composed by mixed samples regularly collected during 8 hours. Limit values should never be exceeded.

The quality and the amount of waste water discharged from the settling tank in Čifáre are given in Table 61 and Table 62. Analyses are made six times a year. The permitted amount of waste water discharged from the settling tank is 252,288 m^3/year. In 2008, in total 141,000 m^3 waste water was discharged from the settling tank.

Table 61 - Comparison of quality indicators of pollution of waste water discharged into the Telinský Stream from the Čifáre settling tank in 2005 - 2008.

Indicator	Permitted limit concentration [mg/l]	Average concentration mg/l			
		2005	2006	2007	2008
$N\text{-}NH_4$	0.5	0.11	0.11	<0.1	<0.1
Solubles RL	2,000	304.00	307.8	313.3	284.3
Non-solubles NL	20	10	<10	<10	<10.3
pH	6.0-8.7	7.85	7.96	8.06	8.23

Table 62 – Comparison of quantity indicators of pollution of waste water discharged into the Telinský Stream from the Čifáre settling tank in 2005 - 2008.

Indicator	Permitted balance values [t/year]	Achieved balance values [t/year]			
		2005	2006	2007	2008
$N\text{-}NH_4$	0,126	0,015	0,025	<0,0123	<0,0141
Solubles RL	504,6	41,30	70,16	38,75	40,086
Non-solubles NL	5,0	1,36	<2,28	<1,24	<1,452

Analyses were made from 8-hour mixed samples in line with the decision.

Release to Širočina stream

The discharge permit for water coming from the drying process of sludge produced during the drinking water treatment to Širočina stream was issued by the Regional Environmental Office in Nitra, with decision No. 2003/01577 in date 19.09.2003.

Analyses are carried out 4 times. Limit values should never be exceeded.

The limit and average values for discharged water in 2004 to Širočina stream are reported for the different examined parameter in Table 63 and Table 64.

Table 63 - Limit and effective values for waste water discharged into the Siročina (2004)

Parameter	Limit value [t/year]	Effective value [t/year]
COD_{Cr}	0,30	0,01
non-solubles - NL	0,40	0,03
Fe	0,006	0,0004
Mn	0,003	0,00003
Cl_2	0,005	0,0001

Table 64 - Limit and average values for the waste water discharged into the Širočina in 2004

Parameter	Limit value [mg/l]	Average annual concentration [mg/l]
COD_{Cr}	30	4
non-solubles - NL	40	10
Fe	0.6	0.15
Mn	0.3	0.01
Cl_2	0.5	0.05

From the above information on discharged wastewater from the Mochovce NPP it is clear that the limits are not exceeded from discharged wastewater on the surface water. During the operation of 4 units it can be assumed that the volume of discharged wastewater will double and the quality of discharged wastewater using the current water treatment technology will not significantly change. Under these conditions the permitted limits for discharged wastewater from the NPP and treated drinking water at Červený Hrádek will be met. Measures will have to be taken at the Čifáre settling tank in order to not exceed the limit values.

2.2 Radioactive liquid effluents discharged to the hydrosphere

The volume of discharged low-activity water from the NPP is approximately 40,000 m^3 annually, which is less than 1% of the total volume of discharged wastewater.

The authorization for the release of liquid radioactive effluent from the installation to river Hron under normal conditions is established by the Decision of the Public Health Authority of the Slovak Republic No. 000ZPZ/6274/2006 of 2 November 2006. The decision is valid until the 1st of November 2011.

This Decision sets the conditions for operation of EMO12 (Table 65) including the yearly limits of radionuclide activity in emissions for Tritium (1.2×10^{13} Bq) and for fission and activation/corrosion products (1.1×10^9 Bq).

In addition, it sets limits for volume activities of liquid discharges to hydrosphere for Tritium (1.0×10^5 Bq/l) and for fission and activation/corrosion products (40·Bq/l).

Table 65 - Yearly limits and volume activities limits for discharging radioactive liquids under normal conditions for EMO12

	Yearly limits	Concentration limit (*)
Tritium	1.2×10^{13} Bq/year	a) 3.0 10^4Bq/l b) $1.0 \cdot 10^5$ Bq/l
Activation/corrosion products	1.1×10^9 Bq/year	40 Bq/l

(*) a) investigative level b) intervention level
(Source: Slovenské elektrárne, a.s. EMO)

Based on the design, the levels (volume and volumetric activity) of low-activity releases assumed for the four reactor units in Mochovce NPP are reported in Table 66 divided according to their origin.

Table 66 - Assumed annual average levels of low-activity and conditionally active releases for four Mochovce NPP reactors units

Source	Amount [m^3/year]	β volumetric activity without tritium [Bq/m^3]	Tritium volumetric activity [Bq/m^3]
Operational building	75,000	3.7×10^3	0
TCCP	22,000	5.5×10^4	0
Regeneration solutions from the steam generator blow-down treatment plant	6,000	5.5×10^4	0
Tritium water	6,400	5.5×10^4	3.7×10^9

(Source: Slovenské elektrárne, a.s. EMO)

The most important source of liquid radioactive effluents from the facility is the blow-down of the primary circuit; the discharged coolant together with the other contaminated waters is led to the waste water purification subsystem, whose aim is to ensure the limitation of the releases of the liquid radioactive substances (tritium and other activation/corrosion products) into living environment.

If the activity of the liquid before the discharge is higher than 40 Bq/l (excluding tritium), wastewater is not discharged to the relevant receptor, but sent back to the radioactive liquid treatment. A description of the waste water purification system may be found in chapter 2.10 (Release of liquid effluents in normal conditions).

In the discharged radioactive effluents the most important contribution (in terms of activity) is due to tritium, a natural occurring (cosmogenic) radioisotope of hydrogen with a very low β- emission (18.6 keV) and a moderately long half-life (12.3 years).

Tritium is produced in coolant of VVERs (as in other LWRs) by two mechanisms:

- Boron activation by neutron capture;
- Ternary fission in fuel and subsequent leakage from the cladding.

The most important contribution derives from the first mechanism. Given that the boron is a strong neutron absorber, it is commonly used in coolant in order to control the fission reaction; tritium is then produced by the following reactions:

1) $^{10}B\ (n\ ,\ 2\alpha)\ ^{3}H$

5) $^{10}B\ (n\ ,\ \alpha)\ ^{7}Li\ (n\ ,\ n\ \alpha)\ ^{3}H$

Tritium activity concentrations over $3.7\ 10^9\ Bq/m^3$ in primary circuit coolant cannot be tolerated for the decrease of the moderating efficiency of the water; therefore a fraction of the primary water is periodically discharged to maintain the tritium concentration below this limit.

Regarding the discharge of tritium, fluctuating values throughout the year can be observed (Figure 33). The fluctuations depend mainly on the concentrations of tritium in the reactors and the method of discharge of primary coolant during the exchange of water.

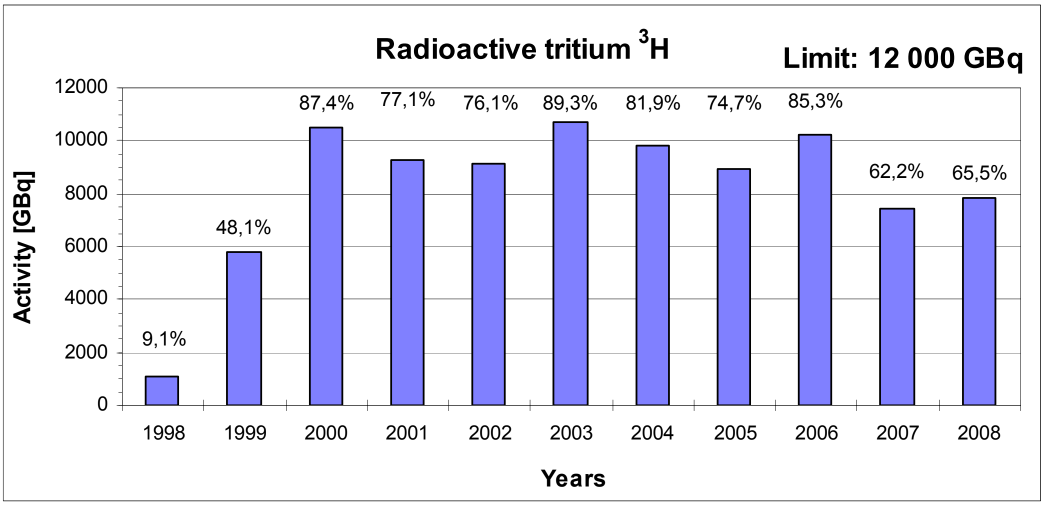


Figure 33 - RA tritium ^{3}H emissions into the hydrosphere and percentage of permitted annual limit

The maximum value of 89.3% of the permitted annual limit (12 000 GBq) was recorded in 2003. Apart from certain fluctuations in the data the overall long-term trend in the amount of tritium discharged to the surroundings over the past few years is positive.

The tritium discharge limit (set by the above-mentioned decision) is valid for operation of only Units 1 and 2; for operation of MO34 the Public Health Authority of the Slovak Republic will issue another limit for discharge of tritium (and other liquid effluents). New discharge limit for MO34 operation will be reasonably of the same entity of the one for EMO12; therefore, it is expected that both EMO12 and MO34 will respect the authorized limits.

Besides tritium, other radionuclides discharged to the hydrosphere are activation/corrosion products (e.g. ^{60}Co) and transuranium/fission products eventually leaking from fuel cladding (e.g. ^{137}Cs).

The maximum value of corrosion/activation and fission products and transuranium nuclides discharged to the hydrosphere for the past 11 years was reached in 2001. The trend in the discharge of these products to the hydrosphere is variable but the percentage of permitted annual limit is always below 6.6% (Figures 34).

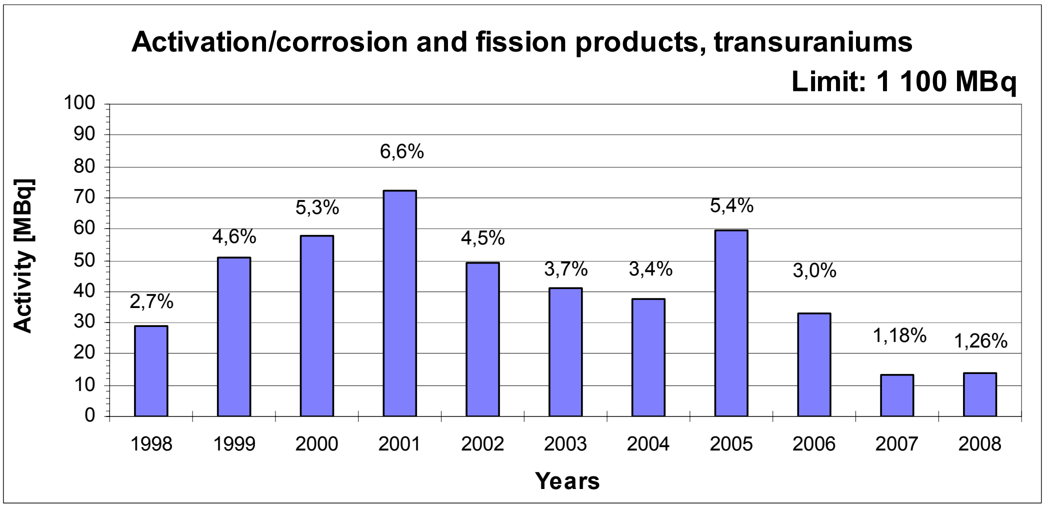


Figure 34 - Fission and activation/corrosion products emissions and percentage of permitted annual limit

The most significant fraction of fission and corrosion/activation generated radionuclides are (in brackets the fractions measured in 2008 are reported): ^{110m}Ag (19.4%), ^{51}Cr (13.4%), ^{137}Cs (13.1%), ^{144}Ce (8.9%), ^{134}Cs (7.5%), ^{60}Co (5.9%), ^{54}Mn (4.5%) and ^{58}Co (4.2%).

Table 67 summarizes the annual amount of discharges to river Hron during the last 11 years.

Table 67 - Activity of the radioactive liquid effluents discharged to river Hron during the last 11 years (1998 – 2008)

	Tritium		Activated/corrosive and fission products		Amount of the discharged water
	Annual limit 1,2E+04 GBq		Annual limit 1,1E+03 MBq		
	Discharge [GBq]	% of the annual limit	Discharge [MBq]	% of the annual limit	[m^3]
1998	1,095	9.1	29.17	2.7	24,751
1999	5,772	48.1	50.63	4.6	47,272
2000	10,484	87.4	57.93	5.3	53,321
2001	9,248	77.1	72.41	6.6	48,637
2002	9,130	76.1	49.36	4.5	46,620
2003	10,714	89.3	40.88	3.7	52,532
2004	9,826	81.9	37.84	3.4	43,830
2005	8,959	74.7	59.58	5.4	40,360
2006	10,230	853	32.75	3.0	22,220
2007	7,458	62.2	13.01	1.18	21,280
2008	7,856	65.5	13.88	1.26	16,800

The radionuclide ^{110m}Ag shows an increasing trend (Figure 35). The negative trend was stopped in year 2006.

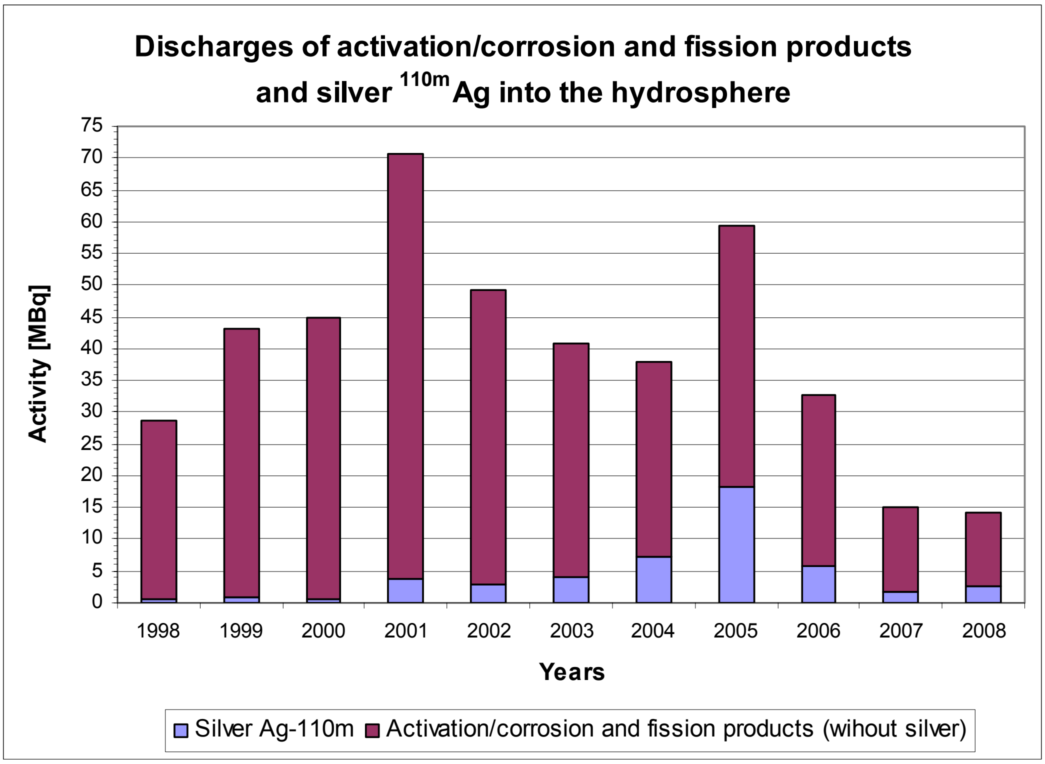


Figure 35 - Emission of ^{110m}Ag and fission and activation/corrosion products into the hydrosphere

As in the case of the aerosol emissions to the atmosphere, the release of ^{110m}Ag is mainly connected with work performed on the equipment in the primary circuit during the outages of the units. The total volume of ^{110m}Ag in emissions after the completion of the outages of the units gradually decreases until the next outage.

With operation of MO34 the discharge activity of the remaining radionuclides except tritium is expected to roughly double. Given the low engagement of the discharge limit (1,100 MBq), the discharged activity will not overcome it, even if the authorized limit will not be increased.

3.0 WASTES

3.1 Non-radioactive waste

Balances of non-radioactive waste for the period 1996 – 2001 and 2002 – 2008 are reported in Table 68 and Table 69 respectively.

Table 68 - Waste balance for the period 1996 – 2001

Year	1996	1997	1998	1999	2000	2001
S (t)	1,113.3	386.55	898.35	1,213.668	1,070	1,206.6
H (t)	24.738	21.721	11.664	35.678	34	41.1
O (t)	1,302.71	332.035	3,840.54	3,876.64	8,470	7,706.4
Total (t)	2,440.748	740.306	4,750.554	5,125.986	9,574	8,954.1

Note: S – special waste, H – hazardous waste, O - other waste

(Source: Slovenské elektrárne, a.s. EMO)

Table 69 - Waste balance for the period 2002 - 2008

Year	2002	2003	2004	2005	2006	2007	2008
S (t)	-	-	-	-	-	-	-
H (t)	67.807	73.12	40.925	50.47	62.991	55.8918	269.417
O (t)	9,603.4	5,402.99	3,282.2	3,993.88	3,884.44	3,994,40	4,425.812
Total (t)	9,671.207	5,476.11	3,323.125	4,044.35	3,947.44	4,050.29	4,695.229

Note: S – special waste, H – hazardous waste, O – other waste

(Source: Slovenské elektrárne, a.s. EMO)

In the period 1996 – 2000, due to the starting of operation of unit 1 (1998) and unit 2 (1999), the total production of waste increased due to the overall production of sludge from the treatment of raw water. Production of other waste was generally the same for the whole period. An increase in the total volume of waste starting from 2005 compared with 2004 was caused by an increase in the generation of sludge from the water treatment. That increase was due to a greater volume of discharged technological water in relation to the increase in the production of electrical energy in 2005.

The increase in the production of electrical energy after starting units 3 and 4 will double the generation of non-radioactive waste, other types of wastes will remain unchanged as waste separation is assumed to be effective.

3.2 Handling with radioactive waste

Radioactive wastes (spent nuclear fuel is not considered as RAW) can be produced either during the NPP operation or during the decommissioning period and can be grouped according to their state:

- gaseous;
- liquid;
- solid.

In whatever state it is, the radioactive waste requires a specific approach to be taken by the Operator during its collection, sorting, pre-treatment, temporary storage, final processing, conditioning and final disposal or release to the environment.

Radioactive gases are mostly released into the air on the basis of a limit specified for each radionuclide. In case that they cannot be released at the time of their production, they are stored for the necessary time period and they are then released into the air after having reached an activity below the release limit values.

NPP Mochovce liquid radioactive wastes are processed as follows: all liquid wastes originating from the operation are subjected to radiological and chemical control and in case that their quality conforms to prescribed limit values it is possible to release them into the environment, otherwise they are reprocessed and controlled again, and where they comply with discharge limits, they are released.

Production of radioactive liquid waste in last 9 years (2000 – 2008) at EMO12 is shown in Table 70.

Table 70 - Production of radioactive liquid waste in last 9 years (2000 – 2008) at EMO12

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Liquid RAW (m^3)	279	308	196	170	140.7	127.5	90.0	65.6	57.7

(Source: Slovenské elektrárne, a.s. EMO)

Starting from the operational experience gained at EMO12, the amount of wastes deriving from the treatment of liquid radioactive substances, which can be expected during the assumed 40-year period of MO34, is reported in Table 71.

Table 71 - Assumed amount of wastes deriving from liquid radioactive treatment during the MO34 operation period

Waste type	Amount [m^3]
Radioactive concentrate	9,025
Low-activity sorbents	122
Medium-activity sorbents	204
Radioactive oils	9.5
Sludges	400
Sediments	8.5

The maximum design based capacity of the liquid radioactive waste processing and conditioning by the combination of bituminisation and cementation is 870 m^3/year for radioactive concentrates and 40 m^3/year for sorbents and sludges which represents a 4 year production of twin reactor units, i.e., the Final Liquid Radioactive Waste Processing capacity is also sufficient for Units 3 and 4.

Solid wastes can be transformed by means of a treatment into a form appropriate for the conditioning and disposal. From the point of view of the conditioning to a matrix appropriate for the final disposal, solid radioactive wastes can be:

- cemented;
- bituminised;
- vitrified; and
- disposed in a high-integrity package set.

Following the processing and conditioning, Units 3 and 4 operation wastes will be disposed in the National Radioactive Waste Repository in Mochovce.

RAW that will not meet the surface disposal acceptance criteria will have to be stored in the Integrated RAW Storage Facility situated on the JAVYS, a.s., site in Jaslovské Bohunice and subsequently disposed in the deep underground geological disposal (once available).

Production of radioactive solid waste in last 9 years (2000 – 2008) at EMO12 is shown in Table 72.

Table 72 - Production of radioactive solid waste in last 9 years (2000 – 2008) at EMO12

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Solid RAW (kg)	3,406	10,427	11,812	14,735	15,176	14,625	19,746	14,595	17,173

(Source: Slovenské elektrárne, a.s. EMO)

Based on experience gained during the operation of EBO V2, as well as of EMO12, the amounts that can be really expected during the assumed 40-year period of MO34 operation are reported in Table 73.

Table 73 - Assumed amounts of solid radioactive waste to be produced during the whole MO34 reactor unit's operation period

Waste type	Amount (kg)
Solid radioactive waste intended for sorting(*)	170,000
Combustible radioactive waste	252,000
Compactable non-metallic radioactive waste	56,600
Compactable metallic radioactive waste	79,920
Wet rags	6,900
Total of solid radioactive waste	565,420

Note: Solid radioactive waste intended for sorting consists of combustible, compactable and non-compactable radioactive waste, the amount data relates to the state prior to sorting.

The assumed amounts of conditionally non-active waste, inserts from HVAC filters and the waste that will be allowed to be released into the environment due to its below-limit activity values is shown in Table 74.

Table 74 - Assumed amounts of solid radioactive waste produced during the 40 year period of MO34 reactor reduction plan units operation

Waste type	Amount
Conditionally non-active waste	232,500 kg
HVAC filter inserts	4,930(*) pieces
Radioactive waste released into the environment	237,500 kg

(*) Assumed amount taking into account the solid radioactive waste production

4.0 NOISE AND VIBRATIONS

Noise from the operation of the Mochovce NPP in the surroundings of the site is negligible. In addition, the closest settlement is approximately 3 km away where the noise levels from Mochovce NPP are practically zero.

Noise measurements have not been made at the nearest residential receptor. However, noise measurements have been made at the external wall of the turbine hall, which is the largest single continuous source. Since the nearest residence is located at about 3 km from the turbine hall, it's unlikely that noise from the plant would be perceptible at this distance.

An increase in the noise levels were determined only locally (inside the site boundaries) on individual machines and would have an influence only on the workers close to the machinery. On the 29.6.2004 noise measurements were performed (protocol of RÚVZ registered at Levice No. 18/281/2004/AP) in order:

- to estimate risk according to Act NR SR 272/1994 Coll. on public health protection;
- to define categories from the point of view of health risk according to Governmental Decree No. 511/2004 on categorization of health risk at work.

The identified workplaces with a certain level of risk are reported in Table 75.

Table 75 - Noise risk factor identified in Mochovce NPP workplaces

Workplace	Profession	Risk factor	Category
TVN fuel station	Technological equipment servicemen	noise	3
Tool shop object 490/1-01	Machine worker	noise	3
	Electrician	noise	3
	Chemist	noise	3

The regional office for public health issued on the 10th of January 2005 Decision No. D/2005/00050 which outlined safety measures for the prevention of occupational illness in Mochovce NPP. It contains specific measures (protective resources, monitoring, improvement of working conditions, and notification of changes which could affect health conditions) and preventative medical check-ups. In addition there is a proposal for the procedures to be taken to organizing other work placements for employees who show negative results during medical check-ups.

The operation of the NPP does not create practically any vibration. Due to the fact that approximately 70% of the construction work at the MO34 is completed there are no significant levels of vibration assumed during the final construction phase.

5.0 RADIATION AND OTHER PHYSICAL FIELDS

During the operation of the reactor, gamma and neutron radiation is generated. Other sources of radiation are the reactor's cooling medium in the primary circuit, active parts of the reactor AZ, spent fuel assemblies deposited at the bottom on the spent fuel pool and subsequently in MSVP and all types of RAW that are collected at the site and temporarily stored therein.

Equipment for the manipulation of these sources of radiation are designed and constructed to meet the relevant hygienic standards and limits for the irradiation of employees at the NPP. In addition, the health of inhabitants in the surroundings of the facility and the environment are protected as well. The adherence to standards and limits is continually monitored. From the point of view of monitoring the environment in the surrounding of the NPP, current arrangements for EMO12 will be kept also for Units 3 and 4, which will have relevant emergency plans elaborated for the material and organizational safeguarding of all the likely emergency situations.

Information on thermal discharge of cooling water to river Hron has been provided in Section B, Part II, chapter 2 (waste water).

6.0 MALODOR AND OTHER OUTPUTS

There are no odors produced in the technological processes at the NPP which would decrease the comfort of the surrounding environment.

Approximately 38% of the thermal energy produced in the reactor is used for the production of electricity. The thermal energy which is not used in other heat consumers in the equipment or buildings at the NPP is released through the cooling towers to the atmosphere or to the water recipient.

Operation of unit 3 and 4 will result in a twofold increase in waste heat release to atmosphere through cooling towers.

7.0 ADDITIONAL DATA

The project, as any other large construction, will contribute to stabilization of economy and to economical development in the region. In fact it will result in a number of positive effects, both providing economic benefits to the immediate and surrounding communities and avoiding greenhouse gases emissions, compared to conventional plants.

C. COMPLEX CHARACTERISTICS AND EVALUATION OF ENVIRONMENTAL IMPACT, INCLUDING HEALTH

I DEFINITION OF BOUNDARIES OF AREA OF CONCERN

The concerned area of the project includes the following regions (Figure 36) that can reasonably be expected to be directly or indirectly affected by the project, or which may be relevant to the assessment of cumulative effects and the effects from future operation of the facility:

- *Site Study Area*: this area, centred on the plant site with a radius of about 3 km, includes facilities, buildings and infrastructure at the Mochovce site, including the licensed buffer zones (Protection zone) for the site on the land. This zone, where it is forbidden to reside permanently, has been set by Decree of Region Health Officer No. H-IV-2370/79 from 15.10.1979 (Map 3 and Figure 36);
- *Local Study Area*: this area is defined as that area existing outside the site study area boundary, where there is a potential for impacts in the unlikely events of abnormal operating conditions. The Local Study Area has a radius of 10 km centred on the Mochovce site (Figure 36);
- *Regional Study Area*: this area is defined as that conservative area within which there is the potential for cumulative and social-economic effects and it approximately corresponds with a 50 km radius area around the site, limited to National borders. The size and configuration of the applied study areas varies by environmental component. Each is described, including the rationale for its determination, in the appropriate subsections (Figure 36).

Even if some of environmental effects of the project, including malfunctions or accidents and some cumulative environmental effects, are likely to involve the Local Study Area or the Regional Study Area, the main additional environmental effects that may occur during operational phase are likely to be observed within the Site Study Area (Protection zone).

Figure 36 - Site Study Area, Local Study and Area Regional Study Area

II CHARACTERISTICS OF CURRENT ENVIRONMENTAL CONDITIONS IN THE AREA OF CONCERN

1.0 GEOMORPHOLOGIC CONDITIONS

The area in the surroundings of Mochovce NPP presents different topographical and geomorphologic characteristics.

The basic topographical structures are as follows:

- Alluvial plains of the Rivers Hron and Zitava;
- Terraces on the right bank of the River Hron;
- Uplands of Zitava, Hron and Ipel;
- Connecting areas between Rybnik and Nova Dedina and between Čifáre and Olichov villages;
- Hills of the southern part of Stiavnica and top part of Velky Inovec and Kozmálovce;
- Hills in the area of Pohronský Inovec surrounding Krivaj and northern part of Stiavnica.

The basic geomorphologic types are as follows:

- Alluvial plain along the rivers Hron and Zitava;
- Undulating plain on the right bank terrace of the river Hron;
- Low uplands in Zitava, Hron and Ipel meadows;
- Top of uplands in hills of Kozmalovce;
- Non-karst plains in the southern part of Stiavnica hills;
- Hilly area in northern part of Stiavnica and Pohronsky Inovec.

The area in the surroundings of Mochovce NPP presents different topographical and geomorphologic characteristics.

2.0 GEOLOGICAL CONDITIONS

Geological conditions are described in terms of:

- geological and structural setting;
- seismic activity;
- soil quality.

The site lies in the Western Carpathians (maps 4A and 4b, and map 5). From the point of view of block formation the Mochovce site is located in the Danube megablock, which is delimitated by deep faults and by the Peripienin lineament at NW, by Vepor-Ráb lineament at SE and by the deep Přerov – Štiavnica fault at NE. The SW boundary is represented by the Danube valley, which follows the fault structure in the NW-SE direction. It is possible to find parallel faults as continuation of the basic fault structure of the Czech Massive in the NW-SE direction of the structure.

Inside this megablock there is a range of tectonic structures. The ones of a lower range are principally parallel to the main limitations.

The NPP lies in a partial structure, Turovce – Levice horst on the western side where there are faults in a NNE-SSW direction (Šuran fault). The area is a part of the Danubian basin, which occurred in the Pliocene by a decrease in the crystalline complex of the intermediate mass on the annexation of the surrounding older inter mountain or intermediate mass of the basin, distributed along the mobile belt of the Central Western Carpathians and the intermediate mass.

The foundations can be dated from the upper Tortonian but the decisive period of its occurrence is the Pliocene. Creation of the basin was accompanied by strong consolidation and final volcanisms, in particular in the area of important deep faults in the underlying rock. The underlying rock is partly made up of Low Carpathian Crystalline complex, partly Kohút unit and tartan series with granitoid intrusions, in particular Variscan. Anticlinoria fatro-tatra crystalline complex is presented in the north. Filling of the depression is made up of a Mesozoic envelope, which occurs in the SW. In the central parts (Komjat depression) Hron synclinorium is the underlying rock.

Younger filling of the basin is made up mainly by Pliocene sediments, then Sarmatian and Tortonian with strong volcanic admixtures. Mottled and lutaceous series made up of clays and calcific clays with sand to sandstones or gravel and agglomerate layers are prevailing. The thickness of the sediment is mostly in the order of hundreds of meters. The total thickness can exceed 1,000 m. The formation has a block style, in Pliocene synclinorium, subjected to strong subsidence in central parts. The significance of the tectonics is low in the Pliocene. The block formation distinguished by horst structures occurring above the buried continuation of the core of the mountain range. Older groups have a more complicated formation but less known.

Data on the types of sediments in the concerned area represents boundary values from drill cores and is included in Table 76:

Table 76 - Data on sediment type in the concerned area

Sediment	Natural moisture [% W]	Measured weight [g·cm^{-3}]	Total permeability [% n]	Effective permeability [%]
Clayey sandy loams, highly plastic (quaternary)	10.6-43.9	2.66-2.76	32.2-55.3	19.0
Clay, sandy clay, highly plastic (neogenic)	8.3-45.4	2.61-2.79	36.5-56.7	13.9
Fine to medium grained sand, clayey (neogenic)	8.6-35.9	2.62-2.70	44.0-50.7	44.0

(Source: EQUIS Bratislava, RNDr. Šujan)

From the point of view of workability, the soil can be classified pursuant to Art. 64 STN 73 3050 “Ground work” General provision into Class 3 to 7 workability.

2.1 Geological and structural setting

The area in the surroundings of Mochovce NPP presents different geological and geomorphological features (map 6).

- Basement of Neogene Formation:

  A thrust nappe forms the majority of the Neogene basement.

- Neogene:

  The area is characterised by sediments related to the different environments of deposition, particularly marine facies (deep and shallow sea) and continental facies (freshwater lake and tropical forest).

- Quaternary:

  Thickness of fluvial deposits is up to 20 m. The Quaternary sediments in upland areas are represented by loess loam of polygene origin to loess of about 10 m thick and dominantly of Wurm age. Proluvial sediments with thickness about 10 m are found in areas of Rybnik, Cajkov and Nova Dedina.

- Engineering geological settings of rocks:

  Engineering geological classification of these soils is silty soil and loess.

- Geomorphological features:

  Wind erosion: the risk of wind erosion occurs only in area of Tekovske Luzany;

  Landslides and slope deformation: the areas surrounding Pohranice, Tesarske Mlynany and Dolny Pial are endangered by landsliding and slope deformation.

  Formation of erosion gullies: The areas surrounding Hostie, Žikava, Chrášťany, Velky Lapáš, Podlužany, Nova Dedina, Bátovce and Hontianske Vrbice are endangered by intensive formation of erosion gullies.

Swelling and shrinking of soil: Risk of swelling and shrinking of soil exists only in the belt of land between Velky Dur and Melek.

Hydrocompaction of loess: The areas in the surroundings of Tesarske Mlynany, Cernik and Lok are endangered by hydrocompaction of loess (sudden collapse due to the increase of moisture and pressure in foundations).

- Resource geology

Lignite deposit: Lignite deposits are located nearby Zlate Moravce in the villages of Obyce and Beladice.

Gas: Accumulation of gas is known in the village of Golianovo.

Limestone: Limestone deposit for production of aggregates is located in Pohranice.

Travertine: Travertine used as ornamental stone is quarried in site located South of Levice.

Clay: Clay deposits for brick production are located in Tesárske Mlyňany, Zlaté Moravce and Levice.

Volcanic rocks: andesite and basalt are quarried in Obyce, Hronsky Beňadik and Rybník.

Pyroclastic rocks: Deposits of tuffs and other pyroclastic rocks are located in Brhlovce and in Male Kozmalovce.

2.2 Seismic activity

Seismic activity in Slovakia is documented in a catalogue of earthquakes compiled by Labák and Brouček (1996) which contains information on more than 650 macroseismic earthquakes from the last 500 years. There has been constant seismic activity in Slovakia even though over the past 100 years there have been no strong earthquakes. It is assumed that this situation will continue in the future.

The following hotspot zones have been identified: Pernek - Modra, Dobrá Voda, Trenčín - Žilina, Komárno and Stredne Slovensko, Spiš and the hills of Slánské. All these zones have had earthquakes of intensity greater or equal to 7° EMS(1)-98.

From the study of seismic history it follows that near Levice there are hotspots that have shown earthquakes with epicentre intensity seldom equal to or greater than 3° MSK(2)--64. In the other hotspots identified in the area of interest most of the observed phenomena did not exceed 6° MSK-64 (source GPI SAS).

From the observation of the map of seismic areas it can be assumed that the monitored area lies in a zone characterized by an intensity of 6° - 7° MSK-64. There have been no records of higher intensity earthquakes at the site or in its surroundings but strong earthquakes at Komarno should be recorded. Using a very conservative approach recommended by IAEA (IAEA 50-SG-S1)(3) the greatest recorded earthquake in history could be 6.5° MSK-64.

Macroseismic intensity in the area can be assumed as 7° MSK-64 and this intensity in Central European conditions correlates to an acceleration of 0.1 g.

2.3 The probability calculation of seismic risk at the Mochovce NPP

The probability calculation of seismic risk at the Mochovce NPP was made pursuant to the document IAEA 50-SG-S1, Rev.1, (1991).

The calculation is based on the following steps:

- compilation of database;
- compilation of seismo-tectonic model;
- specification of amplification for selected characteristics of ground movement;
- calculation of the probability.

There are two significant seismic zones close to Mochovce NPP: Komárno (8° EMS-98) and Central Slovakia (8°-9° MSK-64).

(1) European Macroseismic Scale

(2) Medvegyev-Sponhauer-Karnik Scale

(3) Guidelines on Earthquakes and Associated Topics in Relation to Nuclear Power Plant Siting

In the wider region (radius 150 km) around Mochovce NPP 8 seismic zones have been identified, none of which are in the nearer region (radius 5 km). The hitherto minimal occurrence of macroseismic activity indicates diffuse seismic activity. Fractures with no evidence of an end to their tectonic activity were identified as source zones of seismicity in the nearer region of Kozmálovce, Tekov, Tlmače and Kozárovce.

In the probability calculation of seismic risk attenuation relationships are functions of the characteristics of individual source zones and of ground movement in the area of interest. Due to the fact that direct measurements do not exist, analogue values were used for the probability calculation.

The probability of seismic risk, calculated with the software SEISRISK III, was evaluated for the 16, 50 and 84 percentiles and for average values of horizontal absolute acceleration and horizontal pseudo-absolute acceleration, for 475 and 10,000 years return periods: 475 years return period is used in standard STN 730036 Seismic load of building constructions at the level SL 1 in IAEA (1991), while the 10,000 years return period reflects level SL 2 in IAEA (1991).

The calculated UHS (uniform hazard spectrum) for a 10,000 years return period shows higher values compared to a deterministic spectrum PGA for wave motions of 0.3 seconds period. For wave motions of 0.3 to 2 seconds period the calculated UHS shows lower values compared with deterministic spectrum acceleration.

Analysis of seismic activity in the abovementioned structures was made by J. Hok, A. Nagy, M. Suhaj and J. Hefty in the work "*Analysis of the potential geological fractures in the close surroundings of Mochovce NPP from the point of view of possible activity*", EQUIS November 2006.

For the evaluation of the probability of seismic risk the mapping work was re-evaluated and new geophysical measurements were performed (resistance probes and magnetometers), as well as geodetic GPS measurements.

No phenomena of tectonic displacement of the quaternary sediments were detected. The boundary of potential quaternary activity can be considered as the southern boundary of neovulcanite on the line Tlmače-Rybník.

The Holocene period can be described as a quiet tectonic period over the whole area around the NPP.

Monitoring of seismic activity in Mochovce NPP and its surroundings is performed (since 1996, with fixed connection of 7 stations since 1998) in conformity with Safety Guidelines 50-SG-S1, Rev.1, (1991) *Earthquakes and Associated Topics in Relation to Nuclear Power Plant Siting*: these guidelines require a seismic database of regional and local data to be compiled for evaluation of the seismic risk at the site.

A regional network is made up by the GPI SAS monitoring stations, Modra, Šrobárová and Vyhně. The seismic network of Mochovce NPP allows the detection and localization of earthquakes of Local (Richter) Magnitude ML>1. The monitoring network was gradually modified between 2002 and 2005.

Between 1 December 1996 and 31 December 2006 there were 2,465,165 phenomena identified from the Mochovce NPP network, of which 12,060 (0.49%) were seismic phenomena. From these there were:

- 4,631 regional seismic phenomena (38.4%);
- 17 local (0.14%);
- 7,412 blasting (61.46%).

Between 2000 and 2006 there were 17 regional earthquakes within 50 km of which three were ML 3.4 (23 September 2004), ML 1 (Štůrovo) and ML 1.4 (Komárno), the others were below ML 1 (which is, in principle, below the detectable level). Earthquakes registered between 1950 and 1995 by the GPI SAS network are mainly from Levice with a calculated ML 3.8 from 1991.

Larger historical earthquakes all occurred elsewhere in Slovakia:

- Central Slovakia (1443): Kremnica, Slovenská Lupča;
- South Slovakia (1783): Komárno;
- North-west Slovakia (1858): Žilina;
- Western Carpathians (1906): Dobrá Voda.

Each of these earthquakes is connected with a seismogenic structure in the upper part of the Earth's crust. The depth of the foci is typically about 10–20 km.

A large number of reflection-seismic profiles were chosen and measured when investigating the geological conditions for selecting and preparing the site of the Mochovce nuclear power plant. Subsequently, the seismicity of the area was examined further in connection with the siting and construction of the regional radioactive waste repository, close to the power plant. This analysis included:

- analysis of maximum observed macroseismic effects;
- statistical estimation of known macroseismic fields in central Europe;
- construction of a map of maximum expected macroseismic effects;
- general seismostatistical calculation of seismic hazard, using the McGuire approach; and,
- estimation of seismic hazard including local changes in damping from macroseismic effects.

The seismic hazard at the site of the former Mochovce village, estimated on this geological and seismological basis is characterized by a maximum intensity of 6° – 6.5° MSK-64, with a return period of once in 10,000 years. Although this reflects a generally low risk relative to other regions of central and eastern Europe, due to the regional geological structure, the location of the plant itself on a hillside outcrop of the andesite formation above the village serves to diminish further the local intensity associated with any given earthquake event. Microzoning suggests that the equivalent calculation for seismic risk on the dense volcanic rocks beneath the site of the nuclear power plant is 1° MSK-64 less than that on the sedimentary strata beneath the village.

According to IAEA Safety Standards, two levels of ground motion hazard should be evaluated for each plant sited in a seismic area. Both hazard levels should generate a design basis earthquake corresponding to seismic level 1 and seismic level 2, following the procedures outlined by IAEA Safety Standards and according to the target probability levels defined for the plant design.

It is generally accepted that seismic level 2 corresponds to a level with a probability of being exceeded in the range 1×10^{-3} to 1×10^{-4} (mean values) or 1×10^{-4} to 1×10^{-5} (median) and seismic level 1 corresponds to a level with a probability of being exceeded of 1×10^{-2} (mean value) per reactor per year.

In the plant design seismic level 2 is associated with the most stringent safety requirements, while seismic level 1 corresponds to a less severe, more probable earthquake level that normally has different safety implications. Regardless of the exposure to seismic hazard, a seismic level 2 design basis earthquake should be adopted for every nuclear power plant for the design of safety classified items.

The annual probability of exceedence of seismic level 2 recommended is 10^{-4}/y for the mean peak ground acceleration.

Seismic ground motion for Mochovce NPP is based on site specific *Probabilistic Seismic Hazard Analysis* reviewed by IAEA in 2003.

At the beginning, by means of a deterministic study of seismic hazard, the value of the horizontal PGA was assumed to be 0.1 g for the area. Anyway, as a result of the probabilistic analysis required by IAEA, the horizontal PGA for the Mochovce area has then been evaluated to be 0.143 g.

The probabilistic assessment, including the expansive geological and seismological researches and the available registry of earthquakes in the areas of interest, have been developed until 2003, when the subsequent IAEA mission confirmed correctness of assessment process. In the final report of this Mission it has been observed that all works have been carried out in accordance with previous mission recommendations.

Following the request from the NRA SR, the horizontal PGA for MO34 has been set equal to 0.15 g, which is currently the binding value. This value is also in accordance with the new international recommendations as indicated in the IAEA Manual (DS422) on evaluation of seismic hazards for nuclear installations (art. 2.12).

2.4 Soil quality

The construction and commissioning of Mochovce NPP had been, before the commissioning of the units 1 and 2, one of the most frequently discussed ecological problems in the Slovak Republic. Therefore, the Ministry of Environment of the Slovak Republic decided a program of measurements and of the pre-operational conditions of environment in terms of the natural and induced radioactivity in the area of Levice – Mochovce on the area of 480 km^2. The survey was supported by the fact that it was performed by URANPRES s.r.o. Spišská Nová Ves company, which had no direct relation to the construction of the nuclear power plant.

The concentrations of the natural radionuclides K, U and Th in the soil had been used to determine the background dose rate.

For the Slovak Republic the value of dose rate is 63 nGy/h; for the examined area the value of dose rate is a bit higher, 70.18 nGy/h, this is caused mainly by the relatively higher Th concentration.

The concentrations of radionuclides that can be found in the soil are comparable with natural background concentration for soil. The principal radionuclides detected in the Local Study Area are:

- ^{137}Cs, artificial;
- ^{40}K, natural;
- ^{238}U, natural;
- ^{232}Th, natural.

The presence of Cs, as reported in literature, is mainly due to anthropogenic activities such as nuclear tests and nuclear abnormal accidents (Chernobyl fall out).

The mass activity of principal radionuclides in soil, detected during pre-operation of Unit 1 and 2 of Mochovce NPP during the period 1995-1999, is shown in Table 77.

Tables 105 and 106, reported in Section C, part II, chapter 17.1.2 of present report, provide a summary of radioactivity levels in the existing environment from 2005 to 2008 in Regional, Local and Site Study Area. A more comprehensive list of measured parameters is reported in Annex 4.2.

Table 77 - Principal radionuclides in soil detected during pre-operation of Unit 1 and 2 of Mochovce NPP during the period 1995-1999

Radionuclides	Mass Activity (Bq/kg)
^{137}Cs	0.2-4.0
^{40}K	450-600
^{238}U	20-35
^{232}Th	20-40

(Source: Slovenské elektrárne, a.s.)

2.4.1 Soil pollution

Soil is polluted on the leeward (eastern) margin of the villages Levice, Tlmace and Zlate Moravce by basic emissions (soot). The extent of the pollution is around several tens of hectares.

A relatively narrow belt of soil along the roads Nitra - Nova Bana, Nitra - Levice and Kalna nad Hronom – Zeliezovce is polluted by lead. As regards the NPP site, considering that non-industrial areas are kept as garden or asphalted roads, soil and rock pollution in the area is negligible.

3.0 SOIL CONDITIONS

Soil types in the area are as follows:

- Soil of non-carbonate alluvial plain sediments in a narrow strip along the recent river Hron;
- Black soil of non-carbonate alluvial plains in two isolated sites on the left margin of the alluvial plain of the river Hron, between Tlmace and Hronské Kľačany and between Levice and Jur nad Hronom, and in the alluvial plain of the river Zitava between Vrable and the southern border of the area;
- Degraded black soil on loess in the right bank terrace of the river Hron from Male Kozmalovce to the southern border of the area and in the alluvial plain of Kadan Brook in Golianovo village;
- Gley soil of non-carbonate alluvial plain sediments in the alluvial plain of the river Zitava, between Obyce and Vrable, and in the alluvial plain of the river Sikenica below Krškany village;
- Brown soil on loess in the uplands along Zitava, Hron and Ipel (only east from Levice);
- Gley brown soil on loess and on polygenetic soil at the foot of the hills of Stiavnica, between Rybnik and Nova Dedina and Devicany, along the edge of the Hron uplands, between Besi and Volkovce, between Velky Lapas and Pohranice, and along the left bank of the river Sikenica, from Batovce to the south;
- Illimerized soil on loess loam of low thickness covering Tertiary sediments in the area of Velký Dur-Melek, Kozi and Kozmalovce hills;

- Illimerized brown soil on loess loam in the area of Lipnik-Tekovské Nemce and Devicany- Batovce;
- Saturated brown medium heavy soil covering weathered material composed of volcanic rocks in the hills of Pohronsky Inovec and Stiavnica.

Value of soil within the area is as follows:

- High value soil is present along the right bank terrace of the river Hron;
- Highly productive soil is found in the alluvial plain of the river Zitava, in the southern half of the Zitava upland, along the western and eastern margins of the upland of Hron and along the western margin of the Ipel uplands;
- Productive soil is present in the northern half of the Zitava upland, along the edge of the upland of Hron and on the remaining part of the upland of Ipel;
- Good value forest soil characterises the Pohronsky Inovec and Stiavnica hills.

Vulnerability of soil to erosion is as follows:

- Not vulnerable in the alluvial plains of the rivers Hron and Zitava;
- Low vulnerability along the eastern and western margin of the uplands of Hron, in Pohronsky Inovec and Stiavnica hills;
- Medium vulnerability along the edge of the upland of the Stiavnica hills, in the southern and northern margins of the Zitava upland and in the Stiavnica hills;
- High vulnerability between Pozba and Velky Dur in the uplands along Hron, in the Zitava region between Pana and Velky Lapas up to Topolcianky and along the eastern margin of the upland up to Vrable and along both banks of the river Sikenice in the Ipel uplands.

4.0 CLIMATIC CONDITIONS

The information about the meteorological conditions in the locality of the nuclear power plant have been processed according to IAEA documents, which determine requirements, conditions, and procedures for the fulfilment of safety criteria.

Data on meteorological observations and measurements have been used from the Mochovce locality, from meteorological stations of the SHMÚ in the time from 1981 to date.

The climate in Slovakia is influenced predominantly by its position in Central Europe, by the topography of the Western Carpathian Mountains and the Alps and by the prevailing westerly zonal atmospheric circulation. The south-west and south part of the country belongs to the moderate C climate region with mild winters (according to Köppen) and the remaining part to moderate (boreal) D climate region with colder winters (January mean temperature T < -3 °C).

The area of Mochovce NPP is situated on the south-western border of the Štiavnica hills The meteorological station Mochovce is operated by the SHMÚ and is equipped and located according to the recommendations of the World Hydro-meteorological Organization. The meteorological station in Mochovce (whose geographical coordinates are: φ = 48° 17 ′ 22″ N, λ = 18° 27′ 22″E, H = 261 m above sea level) has been active since 1 April 1980 (has had 4 location changes, from 206 m to 261 m above sea level). Surveys have been performed at the current location since 6th June 1991. (Mochovce, crossroads, φ = 48°17 ′22″ N, λ = 18°27′22″ E, H = 261 m above sea level, height of the manometer vessel is 269.66 m).

Temperature conditions

The period 1981÷1996 has been characterized in the majority of the territory of Slovakia by high summer air temperatures, especially in the years 1992 (the average air temperature in Mochovce in August was 24.9 °C) and 1994 (average temperature for July 23.1 °C) and by decrease of the amount of precipitation. This trend in the temperature regime continued also after the year 1996. The average annual air temperature in Mochovce (1981÷1996) was 9.3 °C (Table 78).

Table 78 - Monthly temperature values from the Mochovce station for the period 1999-2002 (ºC)

Year	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Year
1999	-1.0	-0.6	6.4	11.5	15.4	18.0	20.7	18.6	18.3	9.6	3.0	-0.8	9.9
2000	-3.0	2.2	4.5	13.3	17.1	20.0	18.4	22.0	14.8	13.0	7.9	1.8	11.0
2001	0.2	1.9	5.7	9.7	16.8	16.8	20.5	21.2	13.1	12.5	2.5	-5.7	9.6
2002	-1.4	3.9	6.7	10.2	17.2	19.3	21.9	20.2	14.2	8.7	7.1	-1.3	10.6

(Source: climatic yearbook SHÚM 1999-2002)

Humidity conditions

The relative humidity of the air is an indicator of the climate which varies with air temperature, the cloudy cover and precipitation. The annual variation of the relative air humidity is approximately opposite to that of the air temperature and reaches its characteristic maximum in December (87%) and minimum in April (65%). The average annual relative air humidity in Mochovce (1981÷1996) is 75%.

The volume of water vapour in the air depends on the evaporation, atmospheric circulatory exchange of gaseous materials and their temperature-humidity properties. The water vapour pressure, similarly to the air temperature, reaches its minimum in January (4.9 hPa) and maximum in July (15.3 hPa). The average annual pressure of the water vapour is 9.6 hPa.

Atmospheric precipitations and snow

The average annual precipitation in Mochovce (1981÷1996) was 575 mm. The highest average precipitation was in May (71 mm) and the lowest in February (31 mm). The maximum recorded monthly precipitation was 186.7 mm in June 1999 and the minimum, without precipitation, in February 1998. The highest daily precipitation of 93.0 mm was recorded on 25 August 1994. The average number of days per year with precipitation ≥0.1 mm was 136.0 and with precipitation ≥ 1.0 mm, 87.1. The average number of days with frozen precipitation (e.g. snow, snow + rain) was 41 days. The average number of days per year with a blanket of snow is 43.8 and the depth is 40 cm.

Table 79 - Monthly rainfall from the Mochovce station for the period 1994-2004 (mm)

Year	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Year
1994	48.2	6.0	19.9	93.6	76.7	56.1	14.1	161.6	77.6	96.4	33.9	24.5	708.6
1995	45.3	45.3	50.5	81.7	87.6	114.0	14.5	67.9	65.3	1.2	34.4	48.7	656.4
1996	45.0	28.3	15.5	88.7	115.6	63.8	69.9	86.2	62.2	26.9	45.5	32.6	680.2
1997	20.1	25.8	8.8	45.7	49.2	64.5	109.1	16.9	12.9	49.8	117.8	18.1	538.7
1998	17.7	0.0	12.3	72.5	44.2	33.7	50.8	38.7	134.6	95.0	37.1	22.8	559.4
1999	13.2	46.9	29.4	56.8	32.3	186.7	141.7	37.4	4.1	37.8	49.9	48.1	684.3
2000	36.0	27.9	84.9	57.0	23.7	9.3	59.0	9.7	48.9	25.5	92.4	49.5	523.8
2001	49.8	21.7	48.7	27.6	60.4	15.0	61.7	83.1	122.0	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
2003	46.8	8.2	0.8	20.8	28.0	17.3	97.0	29.2	20.4	71.4	31.1	24.0	395.0
2004	62.1	43.4	50.8	89.0	89.0	118.9	23.1	52.5	43.4	44.3	52.5	39,6	708.6
	402.8	293.0	344.5	677.2	710.2	741.6	689.1	672.5	645.9	531.7	582.2	378.9	6669.6

(Source: climatic yearbook SHÚM 1994-2004)

Sunshine and cloudy weather

Cloudy weather influences the amount of sunshine and, on the other hand, the sun's radiation influences the air temperature and humidity. The average annual duration of sunshine (in 1981÷1996) was 1954.4 hours with the largest values in the summer months (July 280.6 hours) and the smallest in winter (December 54.2 hours). The average number of days without sunshine is 67.2. The beginning of winter is the period with the cloudiest weather (December 73%) and the end of the summer with the least (August 45%). The average annual cloudy weather is 58%, while the yearly average number of clear days is 50.5 and of cloudy days is 106.3.

Air pressure

The movement of air in the atmosphere results from uneven distribution of the air pressure on the earth surface. The average annual air pressure is 989.6 hPa. The absolute maximum of air pressure has reached 1017.1 hPa and the minimum was 947.1 hPa. The highest monthly average air pressure is in January (992.8 hPa), the lowest is in April (986.4 hPa).

Wind conditions

The average annual wind speed is 2.8 m/s, with average speed peaks from the directions E (3.7 m/s) and NW (3.4 m/s). The higher average annual frequencies are registered for the directions NW (22.5%) and SE (21.4%). The maximum wind speed in this region is up to 35 m/s (mainly from the direction NW), hurricanes and tornados do not occur in this locality.

According to the Czechoslovak State Standard ČSN 730035 modification d-9/1982 – Supplement VI, the locality of Mochovce belongs to the III wind area.

Table 80 - Average wind velocity from the Mochovce station for the period 1994-2004 (m/s)

Year	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.
1994	2.9	3.5	3.1	3.4	2.5	2.8	2.1	2.2	2.7	3.5	3.6	2.9
1995	3.8	3.2	3.1	3.4	2.9	2.5	2.1	2.1	2.9	2.3	3.4	3.6
1996	3.9	4.2	3.7	3.3	3.1	2.6	2.5	2.4	3.0	3.4	4.1	2.9
1997	2.5	3.1	2.7	3.6	3.7	3.1	2.8	2.4	2.8	2.5	4.6	4.0
1998	3.6	3.3	3.1	4.5	3.1	2.7	3.0	2.3	3.6	3.3	2.7	3.1
1999	3.0	3.2	3.8	3.1	2.9	3.2	2.8	2.3	3.5	4.4	3.6	4.0
2000	3.1	3.3	3.8	4.5	2.8	2.8	3.3	2.6	3.2	4.2	5.9	3.4
2001	4.8	4.0	4.5	3.5	3.2	3.1	3.4	3.1	3.5	3.1	3.0	2.5
2002	2.2	3.2	3.5	3.7	3.8	3.1	3.3	3.2	2.5	3.6	4.7	3.5
2003	2.8	3.2	2.8	3.9	3.2	2.4	2.7	2.4	3.1	3.7	5.1	5.1
2004	3.5	3.8	3.8	4.0	4.2	2.3	2.8	3.0	3.0	4.6	4.6	3.6

(Source: Climatic Observation Yearbook SHMU 1994-2004, SHMÚ Bratislava).

Table 81 - Wind direction from the Mochovce station as a percentage for the period 1994-2004 (%)

Year	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1994	72	15	84	34	121	158	75	18	29	12	13	4	40	47	193	92	88
1995	54	6	66	37	108	160	89	16	30	10	21	13	24	64	182	99	116
1996	73	21	90	34	156	156	89	25	24	11	23	11	21	60	173	94	37
1997	60	18	70	46	117	138	80	11	18	15	21	15	25	69	243	127	21
1998	31	12	52	36	113	155	69	23	21	24	30	23	39	82	239	80	66
1999	21	17	67	37	100	177	94	27	23	13	15	15	24	66	231	98	71
2000	19	11	33	39	79	214	127	21	27	28	22	17	17	67	224	98	53
2001	33	16	49	47	68	186	98	24	29	12	19	15	30	60	233	124	57
2002	31	16	98	58	117	178	78	23	25	21	22	10	16	59	194	86	63
2003	42	15	63	64	63	199	94	25	18	13	21	11	19	47	204	133	64
2004	32	17	38	47	46	207	104	22	20	16	21	22	32	73	220	144	37

(Source: Climatic Observation Yearbook SHMU 1994-2004, SHMÚ Bratislava)

Table 82 - Average monthly wind velocity from the Mochovce station for the period 1994-2004 (m/s)

Year	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1994	2.7	1.7	2.2	2.3	4.2	4.8	2.8	3.4	3.1	2.5	2.1	2.5	2.0	2.2	3.1	2.7
1995	2.7	1.7	2.3	2.2	4.4	4.9	3.3	2.9	2.9	1.9	2.8	1.6	1.9	2.8	2.8	3.6
1996	2.4	1.8	2.4	1.9	5.1	5.1	3.1	3.2	2.4	3.2	1.8	1.9	1.7	2.5	2.8	3.1
1997	2.4	1.6	1.8	1.9	4.9	4.4	Š.2	4.0	2.8	2.6	2.9	2.2	1.7	2.4	3.2	3.4
1998	2.4	1.4	1.8	2.4	4.6	4.7	3.8	3.3	2.6	3.0	3.3	2.1	2.0	3.2	3.1	3.4
1999	2.1	1.5	2.3	2.5	4.4	5.6	3.6	4.1	2.8	2.8	2.7	2.2	2.3	2.9	2.9	3.4
2000	2.1	1.6	2.2	2.2	3.5	6.2	3.6	3.4	4.0	3.6	2.7	2.1	2.2	2.8	3.3	3.2
2001	2.2	1.8	2.1	2.4	4.4	5.6	3.8	3.8	3.6	3.0	2.6	2.5	1.9	2.8	3.4	3.6
2002	2.1	2.3	2.3	2.5	4.7	5.4	3.6	3.6	3.6	3.2	2.6	1.6	1.8	2.7	3.3	3.1
2003	2.9	1.9	1.9	2.2	3.5	5.8	3.8	3.8	3.2	3.2	2.8	2.3	2.2	2.6	3.4	3.2
2004	2.1	2.1	2.1	2.6	3.2	5.8	4.2	4.2	3.5	2.5	2.7	2.5	1.9	2.5	3.4	3.0

(Source: Climatic Observation Yearbook SHMU 1995-2004)

Stability of the atmosphere

The vertical stability of the atmosphere is an important parameter for the evaluation of the dispersion of pollutants into the atmosphere. Usually, the stability for the purposes of dispersion studies is defined in categories. The Pasquill-Uhlig method was used to evaluate the stability categories in Mochovce during the period 1981÷1996.

The calculated probabilities of occurrence of the individual categories show that the stability category in Mochovce is:

- F, very stable, in winter time (December, January and February);
- D, neutral, in spring time (March, April and May) and autumn time (October and November);
- C, slightly unstable, in summer time (June, July, August and September).

4.1 Program of meteorological measurements

The meteorological programme connected with the operation of the Mochovce NPP includes the meteorological observatory and measurements in the surroundings of the site. The equipment and activities in the area are part of the monitoring and processing infrastructure of the SHMÚ and ensure the processing, checking, archiving and distribution of data, the preparation of diagnostic and prediction products, climatologic processing and exchange of data with the global telecommunication system of the World Meteorological Organisation.

Program of meteorological measurements in the locality

The program of meteorological measurements and the meteorological observatory in Mochovce are consistent with the tasks as a part of the monitoring infrastructure of the SHMÚ.

The main tasks of the meteorological observatory at Mochovce NPP are the following:

- monitoring of meteorological parameters needed to evaluate the dispersive ability of the atmosphere during normal operation and accidental conditions at the NPP;
- monitoring of meteorological parameters needed to evaluate climatic effects of heat and water emissions from the cooling towers;
- monitoring of meteorological parameters and phenomena which can influence the operation of the power plant.

The meteorological station in Mochovce has on its land a 40 m high meteorological pylon. On the pylon are the devices for the measurement of the wind speed and direction and of the air temperature and humidity. In the 1980's the mono-static sodar Vaisala was put into operation in the locality of Mochovce. In the 1990's a REMTECH sodar was installed, the operation of which was ended in the year 2005. The REMTECH sodar - that continuously measures wind speed and direction, vertical motions, turbulence, thermal structure, and mixing depth - uses the emission of a strong acoustic pulse in the audio band to detect the doppler frequency shift of the received backscattered echo. This backscattered echo signal results from turbulence in the atmosphere. The signal frequency shift and its relative strength are processed to derive the value of the monitored parameters.

As mentioned above, the meteorological station is part of the network of the national meteorological service and it has made meteorological measurements since 1 April 1980.

At the meteorological observatory in Mochovce the following meteorological parameters have been measured from the beginning:

- air temperature;
- air humidity;

- direction and speed of the wind;
- cloudy weather;
- meteorological sightings and phenomena;
- atmospheric precipitation;
- sunshine;
- state of the soil;
- air pressure;
- soil temperatures (from 1988);
- hard freezing of the soil (from 1988);
- water evaporation (from 1991).

Besides these measurements the sun’s radiation is measured. The observation of the parameters needed for the evaluation of atmosphere stability is carried out at hourly intervals. The stability categories are determined by the Pasquil-Uhlig method.

Since March 1997 an automatic meteorological station VAISALA MILOS 500 has been in operation at the site, providing permanent values of the following meteorological parameters:

- air temperature (2 m, 5 cm);
- air pressure;
- air humidity;
- direction and speed of the wind;
- global radiation;
- balance of radiation;
- atmospheric precipitation;
- sunshine;
- soil temperature (at depth of 5, 10, 20 and 50 cm).

The location of the meteorological station and the installation of equipment and devices have been carried out according to the recommendations of WMO.

5.0 AIR

5.1 Air quality

The atmospheric environment related to radioactive substances is described in Section C, Part II, chapter 17 and in Section B, part II, chapter 1 of present report.

Until 1999, there were performed measurements of regional air pollution and quality of rainfall waters by the Meteorological Observatory of the Slovak Hydro-Meteorological Institute being a part of Slovak regional stations national network in evaluated zone of the Mochovce power plant. Between 2000 and 2002, there were performed no measurements in the Meteorological Observatory of the Slovak Hydro-Meteorological Institute.

The imission situation of the region can be assessed on a base of results of measurements performed at the regional station of the Slovak Hydro-Meteorological Institute in Topoľníky, which is located in plain landscape of the Danubian Lowland. Results measured at this station were comparable with results measured at the Mochovce station during previous years.

In 2002, measured concentrations of basic polluters represented less than 20% of the critical level value (15 µg/Nm^3) for SO_2 as S and 31% of the critical level value (9 µg/Nm^3) for NO_2 as N, that are usually recommended for agricultural vegetables.

The average yearly levels of polluters measured at the Topoľníky station didn't exceed even permitted limit values according to the Public Notice No 705/2002 Coll.

Regional concentration level for sulphur dioxide in Topoľníky was 2.92 µg/Nm^3 SO_2 as S, which corresponds to 5.84 µg/Nm^3 SO_2. In accordance with the Public Notice No 705/2002 Coll., this is lower value than the Lower Limit for vegetation limit value assessment. In other words, the air quality shall be assessed in the regime 3 under the Lower Limit of the pollution of 8 µg/Nm^3 SO_2.

Following the emission limits under the Lower Limit of the assessment can be considered as fixed, while it is well possible to replace the direct measurement in zones out of agglomerations by model calculations, expertise estimations and indicative measurements.

There are more sources of basic polluters emissions in the Mochovce NPP surroundings interest zone, that take a part on several actual as well as potential, either local or regional, problems (rainfalls acidification, air quality decline, soils acidification etc.).

In frame of 79 districts of SR, the Levice district involving the essential part of the Mochovce NPP surroundings occupies the 43rd position for basic harmful substances production, the 33rd position for SO_2, the 43rd position for NO_2, the 33rd position for solid combustibles and the 38th position for CO production.

In terms of releases of non-radiological chemical substances, the Power Plant, as an NPP, is not a significant emitter to conventional air pollutants including NO_x, SO_x, CO_2 and particulate.

Avoided CO_2 and conventional air pollutants

It has to be highlighted that the Project has a beneficial effect on the terrestrial environment compared to alternative electrical generating plants that result in SOx, NOx and other emissions.

As it is well known, electricity produced by NPPs leads to the avoidance of CO_2 emissions into the atmosphere; this is a very useful contribution to the fulfilment of requirements listed in the Kyoto Protocol on reduction of greenhouse gas emissions.

With reference to year 2005, the energy produced by EMO12 was 6,240 GWh, and taking into account the average specific CO_2 emission factor (for efficient coal thermal plants) of approximately 800 kg/MWh, the avoided emission was equal to 5,000,000 t of CO_2.The same reduction will be achieved with the future operation of MO34.

6.0 WATER CONDITIONS

6.1 Surface water

Mochovce nuclear power station is located in the Podunajská pahorkatina (Podunajské Hills) on the southwest margin of Štiavnické vrchy (Štiavnica Hills) in the upper reaches of Telinský Brook at an altitude of 242 m a.s.l.

The western part of the locality is included in the basin of the Nitra River, while the eastern part falls in to the Hron River basin. Telínský Brook, which passes through the protection zone of Mochovce nuclear power station, is part of the basin of the Žitava River.

Data of the monitoring of the tributaries of the Telínský Brook are available up to 1992 and during the monitored period no culminating flow were registered.

As far as the types of run-off regime are concerned, there is a scale from the temporary snow regime in the region of the high mountains, up to a rain-snow regime in the region of hills and lowlands.

The basin of the Hron and its tributaries has a long history of destructive floods, but records of them are mostly absent. From those existing, there are data about the flood of March 1784, as well as a mark indicating the highest level of water on the city wall in Banská Bystrica. The first existing comprehensive information concerns the flood of 1960. The flood of the Slaná River in 1972 had the character of 100 year return time flood, and the flood in the Hron, Ipel, Slaná and Rimava and their tributaries in 1974 was even larger, in fact it was the most extensive in the twentieth century.

Flood situations prevail in the spring period (February – April) on the Hron River. In this period, flush waves are generated by the snow thawing or by rain and snow combined. The occurrence of the annual culminating inflows in the water-measuring station Banská Bystrica – Hron in the period 1931 – 1995 in the months of February – April represents no less than 55% of the all-year occurrence of these culminations. The spring flow waves usually have a larger volume, while the summer (rain) waves are of a smaller volume and larger culminating flow, which need not to be an issue in the case of long-lasting rains. The most considerable flow waves from the point of view of the culmination and the volume occur after the rain in the autumn months. The most important culminating flows of the Hron are shown in Table 83:

Table 83 - Most important culminating flows of River Hron

Station	Date	Quantity [m^3/s]	Q-norm [m^3/s]	H-max [cm]
Brezno	22.04.1931	136		
	26.07.1960	162		
	22.10.1974	220	7.4	
Banská Bystrica	26.07.1960	379		
	22.04.1960	310		
	22.10.1974	560		
Brehy	22.10.1974	1,050	45.9	480
	03.12.1976	905		446
	23.02.1977	820		425
	12.03.1981	800		419
	14.04.1994	483		363
	04.04.1996	488		368
	15.07.1999	448		351
	13.08.2002	435		331
	19.03.2005	593		414
	30.03.2006	473		358

Note: *Q-norm: average annual flow in the period of 1961 to 2000*

The following values are given for the flood warning or the promulgating of a 3rd grade flood emergency:

- Brezno: 180 cm
- Banská Bystrica: 310 cm
- Brehy: 380 cm

Statistical review of the number of days in a year with 1st, 2nd and 3rd grade flood activity (Flood Emergency - FE - at 6.00) in the hydro-prognosis stations of RS Banská Bystrica in the period of 1990 – 2008 is reported in Table 84.

Table 84 - Number of days with flood activities at RS Banská Bystrica in the period 1990-2008

Year	Number of days with 1st, 2nd and 3rd grade FE at 6.00 o'clock			
	WATCHFULNESS	EMERGENCY	ALERT	Total number of days in year with 1st to 3rd grade FE
1990	2	0	0	2
1991	5	2	0	7
1992	6	0	0	6
1993	0	0	0	0
1994	14	5	2	21
1995	25	1	0	26
1996	18	5	1	24
1997	2	0	0	2
1998	0	0	0	0
1999	17	10	4	31
2000	9	0	1	10
2001	1	1	0	2
2002	7	5	1	13
2003	0	0	0	0
2004	0	0	0	0
2005	13	3	1	17
2006	18	3	0	21
2007	2	0	0	2
2008	2	0	0	2

Data concerns the whole region including the whole region falling under Regional Center Banská Bystrica of the Slovak Hydrometeorological Institute.

Morphological changes in the channel of the Hron were caused both by the natural development of the channel and by modifications due to anthropic activities. The erosion activity during floods is the most important, and generally speaking a new construction impairs the existing regime of the transport of sediments and the equilibrium state created before.

6.1.1 Calculation of water consumption for the operation of EMO

In the balance of water consumption in the operation of 4 units of EMO, data obtained during the previous operation of unit 1 and 2 of EMO were used. The values of actually consumed water were used to calculate the water consumption for 4 units of EMO in the designed full power.

Table 85 - The volume of water consumed in 2001-2008 in unit 1 and 2 of SE-EMO

Year	Water taken from the river Hron [m^3]	Electric energy production [MWh gross]	Specific water consumption [m^3/MWh gross]
2001	16,788,751	5,391,342	3.11
2002	18,218,200	5,870,235	3.10
2003	19,286,611	6,238,525	3.09
2004	17,615,583	5,482,865	3.21
2005	19,313,417	6,239,944	3.09
2006	18,949,001	6,320,254	2.99
2007	19,994,286	6,828,737	2.93
2008	20,626,000	6,890,967	2.99

Table 86 - The volume of water discharged into Hron in 2001-2008 from unit 1 and 2 of SE-EMO

Year	Water discharged into the river Hron		Produced electric energy
	[m^3]	[m^3/MWh gross]	[MWh gross]
2001	3,868,857	0.72	5,391,342
2002	4,727,521	0.81	5,870,235
2003	4,746,385	0.76	6,238,525
2004	4,648,856	0.85	5,482,865
2005	5,126,804	0.82	6,239,944
2006	4,858,647	0.77	6,320,254
2007	4,450,000	0.65	6,828,737
2008	4,812,820	0.70	6,890,967

The quantity of rainwater and industrial water and water from sources other than the river Hron is included in the discharged water, too.

Table 87 - Calculated consumption of water for unit 1 and 2 at nominal power

The maximum monthly water consumption in production 631 627 MWh	For 2 units	2,268,000 m^3
The flow corresponding to a maximum monthly consumption	For 2 units	0.847 m^3/s
Specific water consumption	For 2 units	3.59 m^3/MWh
The average annual water consumption in production 3,468,960 MWh in the unit*	For 1 unit	10,753,776 m^3
	For 2 units	21,507,552 m^3
The flow corresponding to the average annual consumption	For 2 units	0.682 m^3/s
Long-term average water consumption	-	3.1 m^3/MWh

*Calculated from the relation N_{nom} x number of hours in the year x operation ration of power 0.9 x long-term average specific water consumption 3.1 m^3/MWh.

Table 88 - The calculated water consumption for 4 units at nominal power

The maximum monthly water consumption in production 631 627 MWh	For 1 unit	2,268,000 m^3
The flow corresponding to a maximum monthly consumption	For 4 units	1.694 m^3/s
Specific water consumption	-	3.59 m^3/MWh
The average annual water consumption in production 3 468 960 MWh in the unit*	For 1 unit	10,753,776 m^3
	For 4 units	43,015,104 m^3
The flow corresponding to the average annual consumption	For 4 units	1.364 m^3/s
Long-term average water consumption	-	3.1 m^3/MWh

*Calculated from the relation N_{nom} x number of hours in the year x operation ration of power 0.9 x long-term average specific water consumption 3.1 m^3/MWh.

In case of temporary water needs greater than the maximum permitted value of intake 1.8 m^3/s, these will be covered by water from the accumulation reservoirs (2 tanks of 6,000 m^3 each).

6.1.2 Analysis of the deficit of water in the river Hron in the operation of four units of EMO

The Velké Kozmálovice reservoir is formed by a dam situated 73.500 km from source of River Hron. The reservoir has been filled intensively by sediments from the time when the water construction was put into operation (1988). The total volume of the reservoir dropped by approximately 39% as a consequence of the sedimentation of fine grained material.

The staff of Water Research Institute sampled sediments from the bed of the reservoir in five profiles. Sediments were collected from the upper horizon to a depth of up to 40 cm. Samples grain was analyzed by laser device in VÚCHT Bratislava.

Most of the samples from the reservoir had dust particles (grain size is 0.008 – 0.062 mm), the proportion was 75-87%, proportion of clay particles (grain size is 0.0005 – 0.004 mm) 5% and the proportion of sandy particles (grain size is 0.031 – 2 mm) 8-20%.

Authorization for the management of water is issued to all four units of JE EMO and is legally without a time limit.

On intake of surface water, the decision of District Environmental Office Banská Bystrica no.1094/2/177/405.1/93-M is issued, dated on 6th July 1993, **on average intake of 1.5 m^3/s, what represents 47,304,000 m^3/year the maximum permitted intake of 1.8 m^3/s.**

Authorization for the intake of surface water from the River Hron is incorporated in the Operational regulation VD V. Kozmálovce, approved by KÚ ŽP NR[3].

On discharge of waste water, a decision of KÚ ŽP NR[4] no.2007/00029 is issued, dated on 25th Jan 2007, allowing the discharge quantity for **2 units of 6,000,000 m^3/year**, and for **4 units** in a quantity of **12,000,000 m^3/year.**

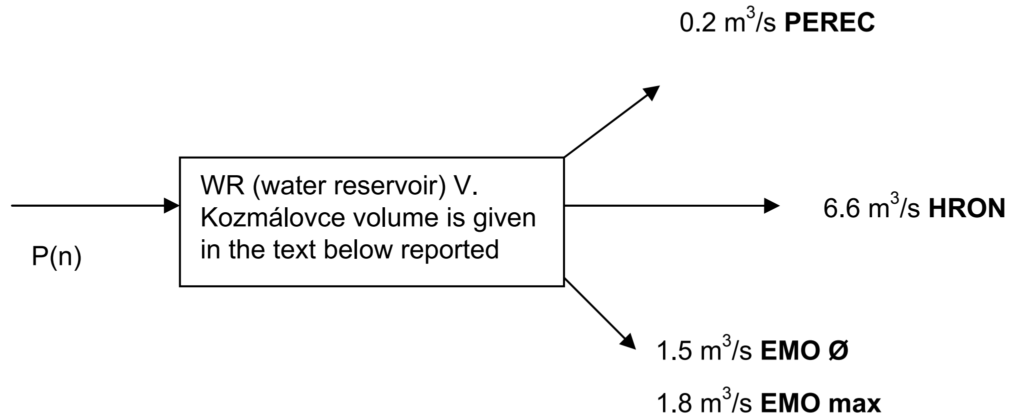
Water supply to all 4 units of SE-EMO is permitted and assured by the water permits, issued by the appropriate water management authority the Regional Environmental Office Nitra. This state authority agreed also on Operational regulation for the dam V. Kozmálovce, where manipulation of water is permitted in the following minimum quantities:

Hron: 6.6 m^3/s;

Perec: 0.2 m^3/s;

SE-EMO: 1.8 m^3/s.

[4] KÚ ŽP NR – Regional Environmental Office Nitra



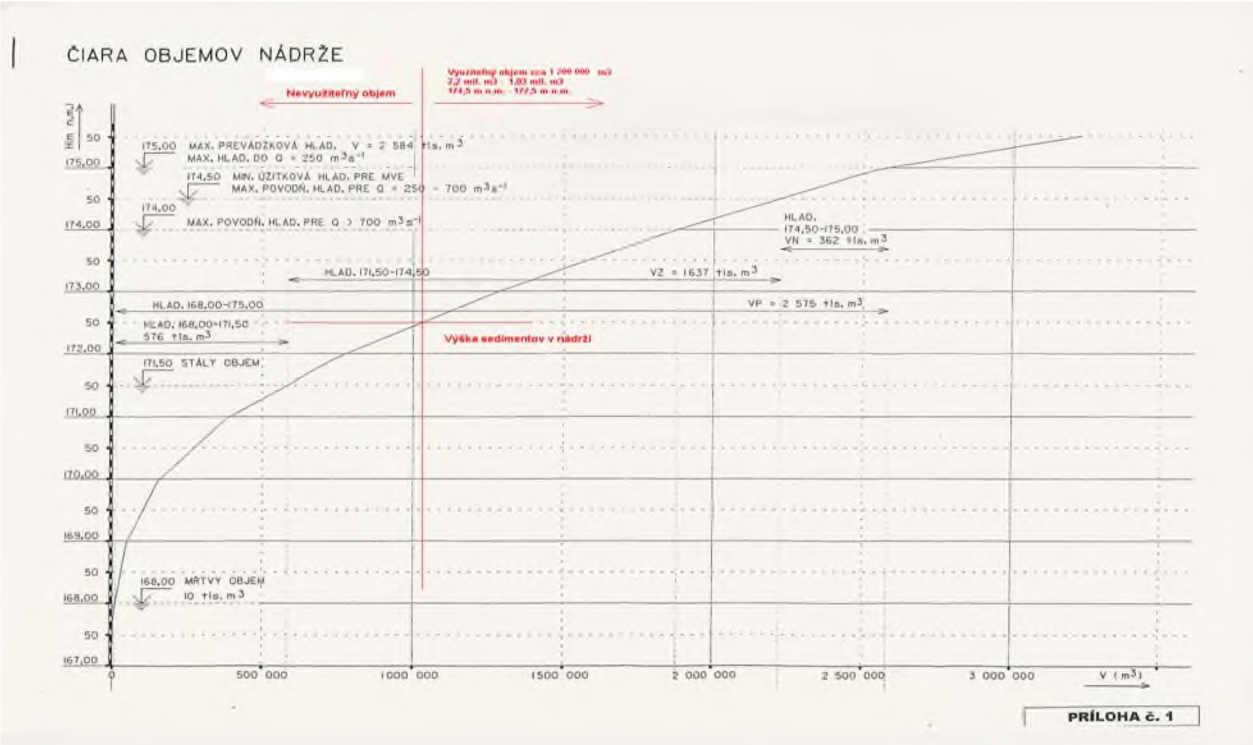
The excessive flow not being used by the NPP, Perec or the small water power station (SWPS) is driven through Veľké Kozmálovce dam to the Hron channel. The SWPS can abstract and let flow only the water that is not used by the NPP. The outflow to Perec is realized through a special object or through the SWPS and other outlets. Water abstraction by the NPP is realized by a special object.

Discharge of the minimum residual flow into the Hron and Perec has priority against all other water abstraction.

Characteristics of hydro construction Veľké Kozmálovce, volume curve of the reservoir, historical measurements and calculations of net volume

V. Kozmálovce Water Work was put into operation in 1988 according to the designed parameters, which are part of Operational regulation of the dam V. Kozmálovce approved by the Regional Office Nitra, department of environment.

The quantity of sediments was measured until 2004. In May 2004, the level of the dam V. Kozmálovce was reduced to minimal operational level 171.50 m a.s.l. Only in this level reduction, it was confirmed that the dam V. Kozmálovce is largely clogged with sediments. On the basis of the level reduction, an estimated Volume line was incorporated to the original volume line of the reservoir (Figure 37), designed in the annex in red, in the original Volume line of the reservoir.



Legend
čiara objemov nádrže – volume line of the reservoir -
nevyužiteľný objem – nonutilizable volume
využiteľný objem cca – utilizable volume app.
m.n.m. – m a.s.l.
max. prevádzková hlad. – max. operational level
min. úžitková hlad. pre – min. utility level for
max. povodň. hlad. pre – max. flood level for
tis. – thousand
výška sedimentov v nádrži – sediments height in the reservoir
stály objem – stable volume
mŕtvy objem – dead volume
príloha č.1 – annex no.1

Figure 37 - Volume line of sediments in the dam of V. Kozmálovce.

Administrator of the water dam, SVP, š.p., on the basis of measurements and sediment movement, has now prepared a project to reduce sediment flow to the dam V. Kozmálovce and to clean the reservoir. Currently, the reservoir is cleaned and it is planned to mine approximately 70 000 m^3 sediment from the reservoir in the first stage in 2009. Subsequently, the sediments will be cleaned from the bed of the recess places of regulating constructions; it is in the approval process.

During the period of operation of hydro construction, about 1.2 mil. m^3 sediments were accumulated in the reservoir according to measurements made in 2001. Further measurements of the sediment volumes were carried out in July-September 2004, according to which the volumes of water in the reservoir were calculated in the range of min. operational levels of 171.50 m a.s.l. to max. permitted level of 175.50 m a.s.l.

Table 89 - The volume of water in water reservoir V. Kozmálovce

Level in the reservoir	Level (m a.s.l.)	Volume in 2001 [mil. m^3]	Volume in 2004 [mil. m^3]
Min. operational	171,50	0,101	0,151
Max. operational	175,00	1,666	1,773
Max. permitted	175,50	1,995	2,113

The comparison of the volume of the reservoir in 2001 and 2004 shows that volume increased in 2004. The increase has been caused by mining of the sediments from 2001 to 2004 in the place of intakes for a nuclear power plant Mochovce and under the road bridge Tlmače.

Table 90 - The planned reservoir volume

Level in the reservoir	Level (m a.s.l.)	The planned reservoir volume [mil. m^3]
min. operational	171,50	0,585
max. operational	175,00	2,584
max. permitted	175,50	3,230

Water for the power plant is taken by water intake structure on the right weir of the reservoir. The handling of water intake is procured by operation personnel of the power plant.

The reservoir parameters are:

Minimal operational level:	171.5 m a.s.l.;
Maximal operational level:	175.00 m a.s.l.;
Maximal permitted level:	175.50 m a.s.l.;
Safe level:	172.00 m a.s.l.;
Quotas of the bottom edge of intake:	170.50 m a.s.l..

Data source: Operational regulation for water work Hať Veľké Kozmálovce on the river Hron km.73,500.

In place of water intake structure within a radius of 50 m, it is recommended to maintain quotas of the bed in the height max.169.00 m a.s.l., what would be about 1.5 m lower than the quotas of the bottom edge of the water intake structure.

Due to clogging of the dam V. Kozmálovce by sediments, we consider a utilizable volume between the heights 172.3 m and 174.75 m (usually kept level) 1 230 000 m^3, and this value is used to calculate the number for the cover of the deficit of the dam V. Kozmálovce.

Historical flow-rate and evaluation of water flow deficit in Hron

From the "Daily flows of Hron for the period 1 Nov 1930-31 Oct 2005" (that contains 27375 entries of daily flows), the number of occurrence of the lowest flow rates was selected ranging from 10,700 m^3/s to 7,700 m^3/s throughout the observed period. Therefore, no flow occurrence higher than 10,700 m^3/s is listed in the Table 91.

Table 91 - Number of occurrence of the lowest water flow in Hron for the period 1 Nov 1930-31 Oct 2005

Selected lowest flow for the period 1.11.1930 -31.10.2005 in the interval [m^3/s]	Number of occurrence for the observed period P_n		Probability of occurrence [%]
	In the interval	Total from 7,700 m^3/s	
10,601 – 10,800	1	209	0,004
10,401 – 10,600	4	208	0,015
10,201 – 10,400	4	204	0,015
10,001 – 10,200	5	200	0,018
9,801 – 10,000	13	195	0,037
9,601 – 9,800	13	182	0,047
9,401 – 9,600	31	169	0,011
9,201 – 9,400	10	138	0,037
9,010 – 9,200	20	128	0,073
8,801 – 9,000	22	108	0,080
8,601 – 8,800	27	86	0,098
8,401 – 8,600	18	59	0,066
8,201 – 8,400	14	31	0,051
8,010 – 8,200	11	27	0,040
7,800 – 8,000	15	16	0,055
7,700	1	1	0,004

Annual minimum run-off, number of days with extracted minimum and duration of outflow of minimum residual flow in the years 2000 – 2007 can be seen in the Table 92.

Table 92 - Minimum outflows from the Veľké Kozmálovce reservoir

Year	2000	2001	2002	2003	2004	2005	2006	2007
Minimum outflow from reservoir (m^3/s)	6.600	6.600	7.500	6.600	6.600	6.600	6.600	6.600
Number of days with minimum	1	2	-	24	18	2	6	13
Uninterrupted duration of minimum (days)	1	1	-	15	7	1	5	7

It can be seen that from the Veľké Kozmálovce reservoir it was necessary to withdraw a minimum residual outflow in seven out of eight years analyzed. Even in the later years the annual minimum outflow was considerably below Q_{364} in the dam profile. A comparison of the total number of days with the outflow minimum and the time of non-interrupted duration of the outflow of minimum residual flow in particular years is also interesting. This analysis was included in the above Table 92.

The year 2003 was exceptional because in September the duration of the uninterrupted outflow of minimum residual flow was more than 2 weeks. In 2004, the minimum period was a week in January, and in 2007 it was in July and in the beginning of August. Since 2003, a trend of decline is evident in the average annual flow of the Upper Hron, and also an increase of the number of days with minimum outflow.

In the water permits from the water work, the maximal intake 1.8 m^3/s is permitted. We consider a minimal flow (sanitation flow) 6.6 m^3/s in Hron and 0.2 m^3/s in the river Perec. In total, a minimal inflow to the water reservoir V. Kozmálovce 8.6 m^3/s is needed, without reducing the reservoir level caused by the intake for EMO.

This flow occurred 59 times during the period 1 Nov 1930-31 Oct 2005. The probability of flow occurrence lower than 8.6 m^3/s is 0.27%.

The table shows the water deficit for selected quantity of water and number of days during which the water reserve is exhausted in the water reservoir when the inflow to the water reservoir V. Kozmálovce is less than 8.6 m^3/s. We consider a utilizable volume of 1,230,000 m^3.

Table 93 - Number of days to cover the water consumption in the deficit in the inflow

P_v **Flow for calculation [m^3/s]**	8,4	8,2	8,0	7,7
Deficit [m^3/s]	0,2	0,4	0,6	0,9
Probability of flow occurrence ≤ P_v	0,11	0,1	0,06	0,004
P **Number of days to cover the consumption from water reservoir in the given deficit**	71,2	35,5	23,7	15,8

(P = 1 230 000 m^3: (24 x 60 x 60 x flow deficit) = number of days to cover)

The power plant has a plan of measures ready for the total cut off of supply of raw water from the water reservoir in V. Kozmálovce. In this case, the water supplies would be sufficient directly in the power plant for the necessary heat dissipation during 10 days in the mode of units' outage. If we fail to restore the water supply from the water reservoir, it would be necessary to ensure the water by other means in a quantity of about 35 m^3/h.

6.1.3 Conclusions

The analysis of water consumption in the operation of all four units shows that both the average permitted intake - 1.5 m^3/s - which represents 47,304,000 m^3/year and the maximum permitted intake - 1.8 m^3/s, listed in the valid decision, will be respected.

The volume of water in water reservoir V. Kozmálovce will be sufficient for the needs of water of 4 units in the operation. However, it is necessary to continuously monitor the reservoir because of the deposition of sediments.

6.2 Groundwater

Hydrogeological conditions of the area of interest depend on the geological-tectonic formation, morphological and climatic conditions.

The alluvial sediments of the Quaternary, with their good porosity, contain the most productive aquifers. The thickness of the gravels and sands in the alluvial valley of the river Hron to the south of Slovenská brána reaches 20 m.

The territory of Mochovce NPP belongs to the Hron uplands and Hron floodplain (Map 7).

There is relatively little knowledge of the hydrogeological conditions to the north, west and east of the NPP. In the surroundings of the NPP investigation work has taken place in the past but mostly with the aim of determining the geological engineering characteristics. From the hydrogeological point of view the territory of the Hron uplands can be described on the basis of investigation work performed in the framework of the construction of the RAW repository, which lies to the NW of the NPP and the construction of its monitoring system. This work can be used to describe the hydrogeological conditions as below described.

Water in the quaternary layers does not form a continuous aquifer. It is however not possible to eliminate atmospheric rainfall accumulating in periods of increased rainfall mainly where the loamy surface covers clayey underlying rock. Taking into consideration the low permeability of the quaternary loams and the morphology of the terrain, most of the rainfall runs off by surface drainage and accumulates on the surface in terrain depressions. From the point of view of the impact of the NPP on its surroundings the main significance is placed on the groundwater in the Neocene sediment. In the area of interest there are Sarmatian sediments of semi-permeable and impermeable layers – aquifers, semi-aquifer and aquitards. Lenticular development of aquifers, frequently crossing aquicludes and several fissures create a hydraulic barrier, which either limits the inflow of groundwater or on the contrary permits it. The main aquifer is called aquifer H which is a layer of fine grained to silty Sarmatian sandstone.

In the underlying rock of aquifer H there are two more aquifers named P1 and P2. These systems have an unconfined groundwater level and the piezometric level is higher than aquifer H. For an assessment of the impact of penetration of wastewater to the groundwater the most important data are on the extent of the underground drainage, velocity and groundwater flow direction and the porosity and the permeability of individual layers. Taking into consideration the data from the investigation work performed in the area of the RAW depository, the following values of were recommended:

- basic drainage from aquifer H: Qz_H approximately 3.0 dm^3/s;
- drainage from aquifers P1 and P2: $Qz_{P1, P2} = 0.5\ dm^3/s$.

The hydrogeological characteristics of aquifers H, P1 and P2 are reported in Table 94.

Table 94 - Hydrogeological characteristics of aquifers H, P1 and P2

Parameter	Aquifer		
	H	P1	P2
Hydrological conductivity, k_f (m/s)	$40.0 \cdot 10^{-6}$	$18.2 \cdot 10^{-6}$	$12.3 \cdot 10^{-6}$
Filtration velocity, v_f (m/s)	$26.4 \cdot 10^{-8}$	$12.0 \cdot 10^{-8}$	$8.12 \cdot 10^{-8}$
Actual average velocity of groundwater flow, v_{sk} (m/s)	$26.4 \cdot 10^{-7}$	$12.0 \cdot 10^{-7}$	$8.12 \cdot 10^{-7}$
Horizontal hydrodynamic dispersion, D_{hx} (m^2/s)	$26.4 \cdot 10^{-8}$	$12.0 \cdot 10^{-8}$	$8.12 \cdot 10^{-8}$
Vertical hydrodynamic dispersion, D_{hy} (m^2/s)	$12.9 \cdot 10^{-7}$	$8.70 \cdot 10^{-7}$	$7.16 \cdot 10^{-7}$

Hydrogeological conditions in the west and southwest of the NPP (in the area of Hron floodplain) are different from the uplands. The Neocene is represented by several clayey complexes, in which sandy and sandstone layers occur only sporadically and have practically no hydrogeological significance.

Quaternary fluvial deposits of the Hron create a favourable environment for flow and accumulation of unconfined groundwater. It follows from the previous (1965) hydrogeological investigations performed in the area of Levice, Tlmače, Malé and Veľké Kozmálovce, Nový Tekov and Kálná n/Hronem and the more recent (1981) hydrogeological investigation that took place during the construction of the dam in Veľké Kozmálovce in the framework of the construction of the Mochovce NPP, the whole of the right bank of the Hron floodplain in the surroundings of Nový Tekov have hydrogeologically favourable conditions. These correspond with the geological formation and granulometric composition of the rock. It is clear that the largest volume of groundwater is bound to the highly permeable fluvial complex of the Hron gravels. The granulometric composition is an assumption for good accumulation and circulation of groundwater in the quaternary gravel. Primary contact of silty and sandy gravel sediment with the recipient is a condition for hydraulic connection of groundwater with the surface water of the Hron. Groundwater recharge is bound by bank infiltration from the recipient. For various heights of the surface and groundwater levels in the given part of the area of interest, it is not possible to eliminate the case of variable drainage and recharge of groundwater by surface water flow in relation to rainfall activity, which results in seasonal variation of the water level of surface watercourses.

In the studied area water resources S-1 to S-10 (Map 2) have been built, which are operated by ZsVAK in Levice.

The groundwater flow direction in the given location was determined prior to the construction of the above-mentioned resources. The groundwater flow direction is in conformity with the direction of the Hron valley. The hydraulic situation at the site is probably influenced by changes in the level of the Hron and the pumping of water resources. Therefore these hydroisohypses have been considered as one of the possible situations.

On the basis of the investigation of the area, the knowledge on geological, hydrogeological and tectonic conditions in the area of interest, and the use of older investigation wells for the control of groundwater at the NPP and the surroundings it is possible to highlight the following:

- In the area of the NPP site infiltration to the groundwater under the NPP will be monitored using the designed wells RK-11, RK-12, RK-13, RK-30, RK-31, RK-32, RK-33 (Map 7);
- hydrogeological conditions (occurrence and distribution of aquifers, occurrence and flow direction of groundwater etc.) were studied in detail at the RAW depository: for the monitoring of the hydraulic characteristics and conditions in the groundwater at the site (beyond the RAW depository) it is possible to use two wells MON-6 and MON-7;
- Hydrogeological conditions and hydraulic characteristics of the Hron floodplain and adjacent areas are only known from older work performed in this area: in the future it will be possible to request information on the actual radiation situation on the basis of the results of monitoring of dedicated objects (wells in the surroundings of the wastewater separator HG-1 to HG-8, wells at the RAW depository site marked MON and SKR (under the administration of JAVYS (Nuclear Decommissioning Company) and wells S1 to S10, which serves as water resources for the group of water mains in this area).

6.3 Groundwater protection zones

Regulation 29/2005 of the Slovak Republic establishes the procedures for defining water resource protection zones, water protection measures and technical modifications to water supply resource protection zones. Pursuant to the Regulation 29/2005 there are 2 important classes of protection zone.

According to article 2 paragraph 1 of the Regulation the 1st class protection zone is defined as:

- a groundwater resource zone established for the protection of the territory against negative influences or threats to the water resources in its immediate surroundings and for the protection of abstraction equipment against damage.
- the boundary is established around the object (borehole, well, spring) at a distance of at least 10 m. The boundary is suitably expanded at the site to take into account equipment connected with the abstraction and the supply of water to the consumers.

According to article 3 paragraph 1 of the Regulation the 2nd class protection zone is defined as:

- a groundwater resource zone established for the protection of the volume, quality and health safety of the groundwater in parts of its infiltration area or over the whole of the groundwater catchment area;
- for water resources in inter-granular rock environments it is established on the basis of an expert assessment of the terrain, in particular on the cleaning, absorption and elimination abilities of similar cover and rock environments;
- 2nd class protection zones lie within a radius of 5 km from the source.

Protection zones of groundwater of 1st class are frequently around water sources in almost all the localities.

Protection zones of groundwater of 2nd class are located:

- in the alluvial valley of the Hron within the line connecting Levice, Podluzany, Cajkov, Tlmace, Novy Tekov, EMO, Kalna nad Hronom and Levice;
- west of the locality of Jur nad Hronom;
- south of the locality of Zlate Moravce in the foothills of Pohronsky Inovec;
- around Čierne Kľačany, from Kolinansky hill up to Zoborske hills.

According to the information given by the environmental department in Levice the water resource at Nový Tekov is currently not used. According to the information from the water utilities company ZsVAK (South Slovakia water and sewerage) in Levice and ZsVAK in Nitra all of the water resource protection zones remain valid in their original measurements for strategic reasons.

6.4 Springs and headwater areas

In the wider surroundings of the NPP (up to 40 km) there are the following mineral and thermal springs and geothermal wells.

- Mineral springs: Santovka;
- Thermal springs: Margita and Ilona;
- Geothermal wells (boreholes): Podhajska well is widely used; Horny Ohaj and Pohranice wells are not used at present.

6.5 Level of contamination of surface water and groundwater

Surface waters quality in the area is potentially affected by discharges of polluted or insufficiently cleaned municipal water, as well as by the washing of agrochemical substances from surrounding fields. Groundwater quality is mainly affected by the river Nitra. Among other things it contains chemical elements and compounds such as iron (Fe), manganese (Mn), mercury (Hg), ammonia (NH4)+X, chlorides and hydrogen sulphide (H_2S).

Groundwater influenced by the river Hron is potentially contaminated by iron, manganese, aluminium, ammonia and humic substances.

The groundwater in the neovulcanites and their surroundings is relatively clean.

Results of the monitoring of water discharged from the RAW facility to Telinsky stream in 2006 are included in the following tables 95 and 96.

Table 95 shows a comparison of the qualitative indicators with the limit concentrations. The limit values of indicators in water discharged from surface water outflow which were set in the water authority's decision were not exceeded.

Table 95 - Comparison of qualitative indicators with limits for water discharge from the RAW facility

Indicator	Measured values		Permitted limit concentration
	min.	max.	
pH	7.8	8.1	-
Conductivity [μS/cm]	160	250	-
tritium [Bq/l]	0.81	1.63	4,690
^{60}Co [Bg/l]	0.013	0.026	5.6
^{137}Cs [Bg/l]	0.012	0.019	5.7
$^{239+240}$Pu [Bg/l]	<0.001	<0.008	0.139
^{90}Sr [Bg/l]	0.008	0.013	61.0
Total beta [Bq/l)]	0.11	0.33	-

(Source: Slovenské elektrárne, a.s.)

Table 96 - Percentage valuation of total activity of individual radionuclides in water from surface outflow at the RAW facility to LaP

Radionuclide	LaP [Bq]	Discharged activity [Bq]	LaP Filling [(%]
^{3}H	$1.88 \cdot 10^{10}$	$5.61 \cdot 10^{6}$	0.03
^{137}Cs	$2.28 \cdot 10^{7}$	$9.31 \cdot 10^{4}$	
^{60}Co	$2.24 \cdot 10^{7}$	$1.05 \cdot 10^{5}$	
^{90}Sr	$2.44 \cdot 10^{8}$	$6.40 \cdot 10^{4}$	0.03
^{239}Pu	$5.56 \cdot 10^{5}$	$1.16 \cdot 10^{4}$	2.10

(Source: Slovenské elektrárne, a.s.)

In groundwater, surface water and drainage water the activity of individual radionuclides ranges as follows:

^{3}H	< 2.2 [Bq/l]
total beta activity	< 1 [Bq/l]
^{137}Cs	< 0,026 [Bq/l]
^{60}Co	< 0,024 [Bq/l]
^{90}Sr	< 1 [Bq/l]
^{239}Pu	< 0,01 [Bq/l]

Ten soil samples were taken in conformity with HMG sample collection in 2006. The values of measured activity of radionuclides are included in the following Table 97.

Table 97 - Range of values of measured activity of RN in soil samples at the RAW facility

Radionuclide	Measured values	
	min. [Bq·kg^{-1}]	max. [Bq·kg^{-1}]
^{40}K	180	512
^{137}Cs	0.150	0.650
^{238}U	10.3	52.2
^{232}Th	14.7	44.3
$^{239,240}Pu$	0.190	0.260
^{241}Am	0.210	0.260
^{90}Sr	2.70	4.10

(Source: Slovenské elektrárne, a.s.)

As reported in section 2.10, liquid effluents coming from operation of Mochovce NPP are in compliance with Regulatory Limits.

7.0 FAUNA AND FLORA

7.1 Original community of the area

The original community of the area is represented by the oak-hornbeam Carpathian forest (map 8).

From the banks of the River Hron up to the top of Pohronsky Inovec and Stiavnicky Hills, there are:

- riparian woodland willow-poplar (sectors Velke Kozmalovce - Kalnica and Vysne nad Hronom - Jur nad Hronom);
- lower riparian woodland (floodplains of Hrona and other streams in the lower parts);
- oak-hornbeam forest of Pannonia (in the lines of Devicany – Drzenice - Nova Dedina – Podluzany - Male Kozmalovce – Čifáre – Vrable – Babindol - Velky Lapas);
- carpathian oak-hornbeam forest (in the vicinity of the riparian woodland);
- oak forest (on the higher parts of the summit to the north of the following communities);
- oak xerothermophilous forest pontic-pannonian (hills on the south of Vrbovec brook);
- beech florid forest of foothills (under Pohronsky Inovec and SW part of Stiavnicke Hills); and
- beech florid forest (top parts of Pohronsky Inovec hills and NE part of the territory of Devicany).

With the exception of the last two communities with beech forest, all the other communities are characterized by exceptional richness of species.

There are several thousand (3-4) animal species and several hundreds of species of plants.

The reasons for the enormous richness of species of the riparian and oak forest include the richness of the nutrients in the soil, relatively high humidity, the crowns of the trees not preventing the penetration of sunshine, and also the stability of the basic ecological conditions for the existence of organisms (light, temperature, humidity, air circulation, relations between species).

The original communities of the area were characterized by:

- closed cycles of development (including phases of origin, growth, ripeness, withering and decomposition) and the considerable length of time of cycles (150-600 years);
- casual changing of phases within the community (after the phase of ripeness could come the phase of origin or the phase of decomposition);

- complexity of the nutrient pyramids including the top predators (e.g. wolf, lynx); and
- presence of large hoofed animals (e.g. elk, bison, etc.) with considerable influence on the existing community due to the habits of biting of branches, peeling of bark, crushing of young trees, wallowing in mud, etc..

Approximately 5-8% of the studied area is covered by wetlands. Several types of communities are present: from the deep and moving waters of the rivers Hron and Zitava up to the reed growths of the blocked stream branches.

The streams created several types of communities, some of them unstable and simple, and some stable, complicated and rich in species, like the riparian woodlands. The impact of the waters was dynamic, with the same passage being a sterile eroded bank and at other times a riparian forest in the phase of ripeness.

The bigger streams gradually filled their valleys with sediment and created relatively large alluvial terrains in which they meandered. The plain of the Hron was 8 km wide under Slovenska Brana, while the Zitava valley reached up to 3 km at Vrabel.

Transverse barriers were not present, so no obstacles were found by those particular species of fishes that go up the rivers to reproduce. Before the construction of the Zelezna Vrata dam on the Danube, great sturgeons appeared in the river Hron.

On the other hand there were no steppe communities.

7.2 Secondary communities in the area

Approximately 5,000 years ago, the area of the upper Hron and Zitava became the home of the first peasants. They established their villages on the terraces of the rivers and started with deforestation. The free surfaces were covered by grass or by arable soil for crops.

In the Middle Ages the rate of deforestation accelerated due to the growth of the number of people and the necessity for more fields. In the first phase of the New Ages there was further acceleration because of the need for wood for mining.

The deforestation of the studied area caused the creation of a so-called steppe. From the south, new species of plants and animals arrived which were adapted for a steppe ecosystem, for example partridge or hedgehog. There were hundreds of such species.

The stability of basic ecological conditions was again a cause for a considerable taxonomic abundance. The agrocenosis of the area lasted practically up to the beginning of the 20th century. After the technical development of agriculture with the use of artificial fertilizers, pesticides and combustion engines the conditions generally started to deteriorate. On one hand the productivity of agroecosystems increased, but it was only at the cost of increasing ecological instability and vulnerability to hazards.

The impact of modern man on the forests caused their withdrawal from the original localities, and today they cover only a small part of the area, generally the places with soil inappropriate for agricultural or industrial activities. Forestry with the cultivation of forests (based not only on its extraction) is only 200 years old.

Today the oak communities suffer under the negative impact of acid rain. The occurrence of these rains depends on the remote sources. This negative ecological factor is combined with changes in the weather, above all with drought. It causes physiological weakening of wood. It can be more easily attacked by fungi propagated by insects. Over the last few years, however, the concentration of contaminants is decreasing and illness of the oaks is not so frequent.

The other unfavourable factor is the penetration of invasive wood species – white acacia. It already forms large growths which have a negative impact on the biodiversity of the forest community and quality of the countryside.

The riparian forest in the large valleys of rivers in the area were mostly removed and replaced with meadows and fields. In places where the riparian forest remained (in a band along the Hron from Stary Tekov up to the southern limit of the area) it was finally modified by the planting of Euro American poplars, with a decreased biodiversity.

These plantations of poplars along the river Hron are influenced by drawdown of the watertable, which is the consequence of the regulations of the watercourse. This is the reason why the state of the forest is not very good and why it has a low productivity.

The regulation caused the reduction of the volume of the water ecosystems and also led to their low productivity. Their biodiversity and ecological quality is also affected. Instead of the original sand or gravel, the bottoms and banks are now covered by a layer of mud. This mud results from dead water plants which grow in the eutrophic water with an excessive content of nutriments.

7.3 Protected, rare and threatened species

Several species in the area are actually in “red books” or on the lists contained in the annexes of Slovak Act No. 543/2002 Coll. on the protection of nature and landscape.

Their survival is dependent on the existence of appropriate places for nutrition, shelter and conditions for reproduction.

Good examples of positive development of nature protection are the reappearance of the imperial eagle or the brown bear.

The return of the imperial eagle to the Hron basin and the successful reproduction resulted from protective actions as well as from the better conditions for the survival of the species. The brown bear can be seen in the forests near the village of Devicany near the NE limits of the area.

Other cases of the occurrence of rare and protected animals can be mentioned, e.g. lynx, savage cat, otter, lesser spotted eagle, eagle-owl, grass-snake, etc..

The concerned area and its surroundings can be mapped by the following gene pool locations:

- Chríb (190 m a.s.l., cadastral territory of Kozárovce) – andesite island outcropping from the Holocene drift of the Hron, former meadow,
- Kusá hora (274 m a.s.l., cadastral territory of Rybník nad Hronom) – remains of xero-thermophilic oak on the left bank of the Hron in the area of Slovenska brána,
- Skala (239 m a.s.l., cadastral territory of Kozárovce) – the gene pools are located in the upper part and the craggy hills above the railway track,
- Veľká Vápenná – Starý vrch (240-280 m a.s.l., cadastral territory of Nový Tekov) – vineyards, mowed orchards and thermophilic oak, amount of traditional fruit trees (mulberry, service tree, quince),
- Martinec (203 m a.s.l., cadastral territory of Mochovce, Nemčiňany, Nevidzany, Malé Vozokany, Červený hrádok) – wet meadows by Podegarsky stream on the northern boundary of the forest coppice of Kozí chrbát,
- Klčovisko (260 m a.s.l., cadastral territory of Mochovce) – small areas of forest steppe vegetation in areas of sub-xerophylic oak, outcropping bedrock,
- Dobrica (320 m a.s.l., cadastral territory of Mochovce) – rock steppe and forest steppe on the eastern slope to the right of a stone quarry. Of value are the abandoned orchards and vineyards overgrown with black oak,
- Andesite cliff above Čifárska reservoir with forest steppe communities, and
- Willow-poplar coppice in the alluvium of the Podegarsky and Rohožnicky streams.

7.4 Protected, rare and threatened communities

Secondary communities and communities with habitats strictly linked to the characteristics of the area (xeroterms) mainly constitute the protected, rare and threatened communities.

Both types of communities are included in the protected regions pursuant to Slovak Act No. 543/2002 Coll. on the protection of nature and landscape.

Wetland communities

The Sikenica stream is not regulated (up to Krskany). It has natural growths on the banks and its water is not contaminated. The presence of otters is the evidence of the outstanding quality of the stream.

The River Zitava is not regulated, with the exception of the section of Zlate Moravce up to Horny Ohaj. The water quality is worse than in the Sikenica, but even the Zitava has natural bank growth. Otters are also present.

Forest communities

The most developed forest communities are protected according to the Slovak Act No. 543/2002 Coll. on the protection of nature and landscape. The exception is represented by NR Krivin.

Steppe communities

Steppe communities are in part under regional protection. The community arose as a result of the agricultural activity of low intensity (extensive pasture, meadows with poor yield etc.). This activity is no longer profitable and therefore the owners of the land have since left. This is an issue throughout Europe.

Significant migration corridors

In the river Hron and its immediate surroundings are 2nd grade migration corridors.

Important animal migration corridors in the concerned area and its wider surroundings:

- aquatic supra-regional bio-corridor: Hron and adjacent waterside coppice,
- terrestrial supra-regional bio-corridor: Gbelce – Patianska cerina – Zudrok – Včelár,
- proposed regional bio-corridor: Patianska cerina – Čifársky háj – Kozí chrbát – Rohožnická hôrka – Slance,
- proposed regional bio-corridor: Patianska cerina – Podkamenie – Veľká Vápenná – Skala – Štiavnické vrchy,

- proposed local bio-corridor: Čifársky háj – Kozí chrbát,
- proposed local bio-corridor: Plešovica – Zadný vrch – Rohožnícka hôrka,
- proposed local bio-corridor: Klčovisko – Bôbové,
- proposed local bio-corridor: Čifársky háj – Podkamenie.

8.0 LANDSCAPE

The landscape around the Mochovce site comprises the boundary of Podunajsky lowlands and southern slope of the Pohronsky Inovca and Štiavnický hills. The dominant natural phenomenon is Slovenská brána, made up of the foothills of the Pohronskej pahorkatiny and southwestern slope of Štiavnický hill, through which runs the River Hron. The immediate surroundings are made of the Veľké Kozmálovce reservoir which serves as a water catchment for utility water for Mochovce NPP. The character of the whole location was influenced by the construction of SE-EMO during which parts of the relief of Kozmálovskej vyšky were altered.

9.0 PROTECTED AREAS

Protected areas are regulated by Act No. 543/2003 Coll. on the protection of nature and landscapes.

The selection of ecologically precious segments of landscape under protection was a strong philosophy of the political system in Czechoslovakia up to 1989. This land can be characterized as economically unusable and is among the protected land. Examples are Krivina or Horsianskej Doliny (map 8).

Other important areas of protection are characterized by the presence of intensive agricultural activities (CHA Levice pond, Golianov pond, – fish raising), or by the presence of protection structure (PR Zitava floodplain).

Protected regions

- The Štiavnicke vrchy Hills

A protected region located in the forested part of the Stiavnicke vrchy Hills from the banks of the river Hron (territory of Rybnik, Psiare and Hronsky Benadik) towards the northeast. A 2nd grade regional protection has been defined here pursuant to Article 13 of the Act. The area is covered mostly by oak forests (and partly also by protecting forests) of half-natural composition on the Tertiary magmatic rocks. There is also penetration of trees of false acacia. The northern limits of area are formed by beech forests. Several specimens of lynx have been documented and bears have been spotted in the northern part.

- The protected region Ponitrie

The protected region Ponitrie includes Zoborske vrchy Hills and Tribec Mountains. It only reaches the studied area in the territory of Jelenec, Ladice and Velcice. A 2nd grade regional protection has been defined here pursuant to Article 13 of the Act.

The area is formed by oak forests.

Protected areas

Within the studied area the protected areas are:

- Ponds of Levice;
- Historic parks.

Nature reserves

Within the studied area the nature reserves areas are:

- NR Krivin;

- NR Kusa hora;
- NR Sandorky;
- NR Zitavsky luh.

National nature reserves

Within the studied area the national nature reserves areas are:

- NNR Horsianska Dolina;
- NNR Patianska Cerina.

10.0 TERRITORIAL SYSTEM OF ECOLOGICAL STABILITY

The terrestrial system of ecological stability (TSES) legally categorizes the evaluation of the state of the landscape (in particular their biotic formation). The basic TSES documents are the **General supraregional TSES for Slovakia** (1992), regional TSES documentation for the former Slovak districts (1993-1995) and the National Ecological Network of Slovakia (1996).

The territorial system of environmental stability (TSES) is embedded in Act 543/2002 Coll. on nature and landscape protection in a purely declarative form.

A large territorial unit plan for the Nitra region was approved in a governmental decree of the Slovak Republic issued in 1998, as a regional TSES (Map 10).

The following significant regional bio-centres were defined: Stiavnicke vrchy, NPR Horsianska dolina and the oak tree forests including NPR Patianska cerina. Regionally significant bio-corridors include the Hron, Podluzianka and Sikenica.

Recently local TSES projects were conducted within the framework of the land planning documentation conducted for some of the cities situated in this area. These include suggestions for the measured needed to be taken to maintain and increase the ecological qualities of major TSES elements.

These cities and towns are: Pohranice, Ladice, Dolne Obdokovce, Velka Lapas, Maly Lapas, Vrable, Zlate Moravce, Topolcianky, Tesarske Mlynany, Kozarovce, Rybnik, Cajkov, Nova Dedina, Zemberovce, Brhlovce, Levice, Hronske Kosihy, Hronske Klacany, Novy Tekov, Maly Cetin, Cechynce, Travnica, Bardonovo, Podhajska, and Horna Sec.

11.0 POPULATION

11.1 Demographic data

Data about the number of the residents on 31 December 2008 have been provided by the Statistical Institute of the SR.

The area within 50 km of Mochovce NPP is part of 17 districts. The 17 districts belong to four regions: Nitra, Banská Bystrica, Trenčín and Trnava.

In Table 98 the municipalities and the number of inhabitants are shown together with the ratios of the populations within 50 km of the Mochovce NPP.

Table 98 - Municipality and inhabitant distribution in the area of Mochovce NPP

Region	District	Number of municipalities		Number of inhabitants		Ratio of the population up to 50 km [%]
		up to 50 km	in the district	up to 50 km	in the district	
Banská Bystrica	Banská Štiavnica	15	15	10,547	10,547	100
	Krupina	28	36	6,843	7,776	88
	Veľký Krtíš	4	71	675	13,494	5
	Žarnovica	18	18	6,375	6,375	100
	Žiar nad Hronom	19	34	14,480	19,567	74
Nitra	Komárno	12	41	10,405	35,881	29
	Levice	88	88	35,492	35,492	100
	Nitra	57	57	84,070	84,070	100
	Nové Zámky	55	61	35,601	40,456	88
	Šaľa	13	13	23,890	23,890	100
	Topoľčany	48	53	27,995	28,566	98
	Zlaté Moravce	32	32	13,226	13,226	100
Trenčín	Bánovce nad Bebravou	11	43	2,659	20,453	13
	Partizánske	23	23	24,263	24,263	100
	Prievidza	12	52	7,093	50,664	14
Trnava	Galanta	7	35	1,957	16,306	12
	Hlohovec	11	24	4,036	22,424	18
Total		**453**	**696**	**309,607**	**453,450**	**68**

(Source: Statistical yearbook SR, 2008)

In order to determine the parameters characterising the population distribution the area within 50 km of Mochovce NPP has been divided into the following 4 annular sectors:

- Sector 1: 0-5 km annulus;
- Sector 2: 5-10 km annulus;
- Sector 3: 10-20 km annulus;
- Sector 4: 20-50 km annulus.

The number of inhabitants belonging to each of the four sectors is shown in Table 99.

Table 99 - Number of and inhabitants in the annular sectors

Sector	Number of municipalities
Sector 1	4
Sector 2	22
Sector 3	70
Sector 4	366
TOTAL	**462**

(Source: Statistical yearbook SR, 2008

In sector 4 there is also a part of the territory of the district of Zvolen which does not have any built-up areas, so the Zvolen district is not included in the list of districts within 50 km around the plant.

In the 50 km area the settlements with the largest number of inhabitants are Nitra (84,070 inhabitants), Nové Zámky (40,456 inhabitants), Levice (35,492 inhabitants), Topoľčany (28,566 inhabitants), Partizánske (24,263 inhabitants), Šaľa (23,890 inhabitants) and Žiar nad Hronom (19,567 inhabitants).

There are also 19 municipalities with the status of "town" within the 50 km zone. In Sector 1 there are no towns, in Sector 2 there is only one town (Tlmače), in Sector 3 there are 3 towns and in Sector 4-15 towns.

11.2 Settlements, activities

11.2.1 Manpower

The construction of MO34 will have an effect on employment rates with a manpower comprising of a wide range of specializations and qualifications (civil engineering, machine building, knowledge of mechanical installations, pipe production and assembly, electrical engineering, use of instruments, software specialists etc.) and levels of skill (from non-qualified to highly specialized personnel). This is significant for the economy of the area around the power plant and leads to a large number of local personnel being employed for the construction of the NPP; it will also be an opportunity to preserve and develop professional qualifications at a local level which will be a benefit to the rapidly growing Slovak economy.

In addition, the positive influence of this new source of employment will be felt by the manpower from a wider area (which will be hired for specific activities i.e. skilled or specialized employees). As a result of the increase in the number of people employed and living in the surroundings of the NPP there will be an increase in related employment created as a result of the increase in purchase power of NPP personnel.

Due to the presence of the NPP all social and physical infrastructure already exists.

Regarding the local manpower, more than 3300 persons are supposed to be employed during the whole period of the work (i.e. from 2008 to 2013), from which a large number will come from towns and villages surrounding the NPP. The region has sufficient resources for the provision and accommodation of the required manpower.

The construction began in 2007 and will be completed by 2013. The total labour requirements in this period will be approx. 25.000.000 man hours.

11.2.2 Age structure of inhabitants in the assessed area

Age structure of inhabitants in the affected villages has a less favorable composition than the Slovak average. It has fewer inhabitants at a pre-productive age and a higher portion in a productive or post-productive age. Data from census of 2001 are given in Table 100.

Table 100 - Age structure of inhabitants in relevant villages (2001)

Village	Pre-productive age	%	Productive age	%	Post productive age	%
Kalná nad Hronom	317	15.1	1,550	73.8	233	11.1
Malé Kozmálovce	60	14.9	270	67.0	73	18.1
Nový Tekov	116	13.7	612	72.3	118	13.9
Starý tekov	209	14.3	1,016	69.7	232	16.0
Tlmače (Lipník)	509	12.5	3,084	75.7	479	11.8
Veľký ďur	166	13.2	884	69.9	214	16.9
Čifáre	95	15.1	428	67.8	108	17.1
Nemčiňany	102	14.3	476	66.8	135	18.9
Total	**1,574**	**13.7**	**8,320**	**72.4**	**1,592**	**13.9**

(Source: Statistical yearbook SR, 2008)

11.2.3 Economic activities of inhabitants

The economic activities in affected villages as well as in the wider surrounding of the Mochovce NPP are positively influenced by the construction and operation of the site but on the other hand there have been significant social changes in the last several decades. In this period there was significant restructuring in production and services and subsequent changes in economic activities of the inhabitant in the whole region. The following Table 101 shows composition of economical active inhabitants.

Table 101 - Composition of economical active inhabitants in affected villages (2001)

Village	Inhabitants	Economical active inhabitants			Total of active inhabitants in %
		Total	Males	Females	
Kalná Nad Hronom	2,073	1,042	542	500	50.3
Malé Kozmálovce	402	160	94	66	39.8
Nový Tekov	835	376	200	176	45.0
Starý Tekov	1,479	708	397	212	47.9
Tlmače (Lipník)	4,305	2,386	1,238	1,148	55.4
Veľký Ďur	1,305	584	327	257	44.8
Čifáre	591	281	169	112	47.5
Nemčiňany	784	349	181	168	44.5
Total	11,774	5,886	3,148	2,639	49.99

(Source: Statistical yearbook SR)

Transformation of the economy in the Levice region is characterized by a decrease in jobs and migration of inhabitants away from their villages, towns, district and region. Unemployment in 2001 was 23.31% and 16.97% in 2006. A lack of jobs in villages and towns results in migration of inhabitant to other villages and towns out of the district.

11.2.4 Industrial production

Most of the affected territory lies in the Levice district. Marginal parts of the affected territory are located in the districts of Nitra and Nové Zámky where industrial activity is negligible.

The most important industrial activity is Mochovce NPP itself, which plays a significant role in industrial production and services for Slovak industry. The town of Tlmače has a developed machinery industry. Other industrial centers are Levice and Vrable which are located 10-15 km from the Mochovce NPP. Smaller industrial operations are located in Kalná nad Hronom and Santovka. Very small production units are also located in other affected villages.

Construction activities are mainly concentrated in the completion of MO34. Building activities in smaller affected villages in the area are less extensive.

11.2.5 Agricultural activities

Agriculture is the most common activity in the affected territory. The area has a good potential for growing practically any crop. Most types of agricultural land exist: arable land, hop-yards, vineyards, gardens, orchards, and grassland. The area is characterized by a high percentage of arable land in comparison with other types. Grassland is mainly located at foot of hills (Štavnické hills) and other areas with lower productivity of soil, slopes and soil with high moisture, but they are also on mountain slopes and in narrow strips along rivers. Vineyards are located on sunny slopes and orchards on various slopes. Orchards are usually connected with village houses. The crops are usually represented by cereals, maize, sugar beets, and cereals used for livestock. The livestock consists mainly of cows, sheep and chickens. Irrigation systems are located in Želieznovice and Velké Kozmálovice.

11.2.6 Forest industry

The forest is part of Podunajska hills without grassland, Grass land of Podunajska hills and Stiavnické hills. Wood species are represented by oak, poplar, acacia, beech and other deciduous species. Deciduous trees take up % of the coppice. In addition, there are - pine, spruce and fir. Forest industry is predominately made up of mining activity, followed by growing activity and other forest industries. Part of the forest in the affected territory has a protective function, which is mainly focused to protection and utilization of the forest as a natural environment particularly valuable due to its authenticity (Patianska cerina and others). Recreational functions are mostly in the outer edges of the forests often where it is connected to orchard and vineyards. Forest industry in state forests is ensured by state owned forestry companies (Levice) and private forestry organizations.

From the point of view of agricultural regionalization, the territory belongs to a breeding area of deer and other small game. There is also a genetic fund of fallow deer.

11.2.7 Services and civic amenities

Services and civic amenities in affected territory correspond to the size (inhabitants) and development trends. In communities of fewer than 500 inhabitants (Malé Kozmálovce) the range or services and civic amenities is limited by the number of users and their effectiveness. Other larger communities in the affected territory have wider range of services and civic amenities, including basic education, cultural and sporting needs. More developed amenities (education, health, culture, sport and recreational activities etc.) are available in Levice, Tlmače and Vráble, which are not far from the villages in the affected area.

11.2.8 Recreation and tourism

Recreation and tourism in the affected territory can be considered as medium developed. In the affected territory and its immediate surroundings are small water reservoirs which are used for agriculture. In the affected territory there are many cabins, vineyard cottages, gardens and vineyards used for tourist accommodation. Veľké Kozmálovce reservoir and the River Hron are used for water sports activities as well as Bagroviská and Ramená streams (Horná Seč). There are angling opportunities in rivers ponds and reservoirs. There is a horse rearing center in Nový Tekov (and also in Jura nad Hronom, Mýtné Ludany, outside the affected territory). Cycle tourism is not well developed depends on the development of rural tourism. There is a motocross track in the village of Rybník.

Other recreational and tourism opportunities can be found in the wider surroundings of the affected territory. Geothermal water can be found in the region e.g. in Levickej kryhe. This water is used in the thermal baths in Santovka, Margita and Ilona. Other potential sources of geothermal water are in Želiezovec.

11.3 Infrastructure

11.3.1 Transport and transport areas

The Mochovce NPP requires transport communications for a constant flow of raw materials and waste created during its operation and for the transport of employees. The current road and rail communications are used for the majority of material flow. The transport of utility water from the river Hron and drinking water is ensured by pipelines. Transport of liquid waste to the sludge pit in Čifáre is also provided by a pipeline.

Road transport

Communication network is concentrated to the regional town of Nitra and to individual provincial towns Levice, Nitra, Nové Zámky, Zlaté Moravce and Žiar nad Hronom. The main transport routes respect the relief of the terrain and provide the following transport directions:

- Sereď - Nitra - Zlaté Moravce - Nová Baňa;
- Trnava - Nitra - Levice – Sebechleby;
- Galanta - Šaľa - Nové Zámky – Šahy;
- Dunajská Streda - Komárno – Štúrovo;
- Komárno - Nové Zámky - Nitra - Topoľčany – Prievidza;
- Štúrovo - Kalná nad Hronom – Žarnovica;
- Šahy - Kalná nad Hronom – Vráble.

Classification of the roads is in accordance with the Slovak standard STN 736101.

The most important communications in the close vicinity of Mochovce (within 20 km) are 1st class roads No. 51 Trnava - Nitra - Vráble - Levice, and No. 65 Nitra - Banská Bystrica. Another important route is No. 64 Topoľčany - Nitra - Nové Zámky. The direction from east to west is less assessable with a less dense distribution of municipalities than the direction from north to south.

The land is properly connected to international roads. The site is connected to international road No. 65 (a part of which coincides with International E-road E571) through a stretch of approximately 33 km of road I/51. In north-south direction the region is connected to international roads No. 75 and No. 77 by the road I/51 and I/65 Trnava, Sereď, Nitra, and Zvolen.

Links to the other regions in north-south direction are provided by the road I/66 from Hungary to Zvolen through Sahy and the road I/76 Štúrovo - Levice - Tlmače.

Links in east – west direction in the region is secured by the road I/63 Štúrovo - Komárno- Bratislava.

By means of the road I/64 passing in north – south direction, a link to Hungarian highway network is provided about 9 km from Komarom town through bridge on Danube River.

Transport road 176 Kalná nad Hronom, Tlmače, Hronský Beňadik is linked to road 165 Nitra, Zlaté Moravce, and Zvolen that is a part of European road E571. In west – east direction the other transport roads are constructed, such as road 175 Nové Zámky, Tekovské Lužany, Lučenec, road 151 Nitra, Levice, Krupina, Zvolen and road 166 from Hungary to Zvolen through Šahy and road 176 Štúrovo, Levice, Tlmače.

Railway communication

The main railway in the described area is the line No. 130 Bratislava – Galanta - Šaľa - Nové Zámky - Štúrovo, which continues to Hungary. Significant railway nodes are Trnovec nad Váhom, Palárikovo, Nové Zámky and Šurany.

Other significant lines in the wider area are:

- Nové Zámky - Šurany - Zlaté Moravce;
- Komárno - Nové Zámky - Nitra - Topoľčany – Prievidza;
- Komárno – Bratislava;
- Leopoldov - Lužianky – Kozárovce;
- Galanta - Šaľa - Nové Zámky;
- Bratislava - Nové Zámky – Štúrovo;
- Zvolen - Levice - Nové Zámky.

The area has a good connection in west – east direction, because it is located on southern urban planning axis of the Slovak Republic, presented by the arterial railway line No 141-150 Leopoldov - Kozárovce - Zvolen – Košice that is fully electrified on the territory of the area. The area has a direct connection on Kozarovce station provided by railway line No 130-150 from Bratislava through Palárikovo, Šurany and Levice to Zvolen. The links of the area with other regions in north – south direction are provided by railway line No 152 Štúrovo - Šahy - Zvolen.

Mochovce NPP is also connected to a dedicated railway branch. The construction of this railway branch to serve MO34 was permitted by the railway construction permit No. 8460/1986-13/4 issued by the Railway Administration Authority in Bratislava on 31 October 1986. As regards operation of the railway serving the Mochovce NPP, SE is authorised to operate both the railway and the transport on the railway.

The railway connection of Mochovce NPP is shown in Figure 38.

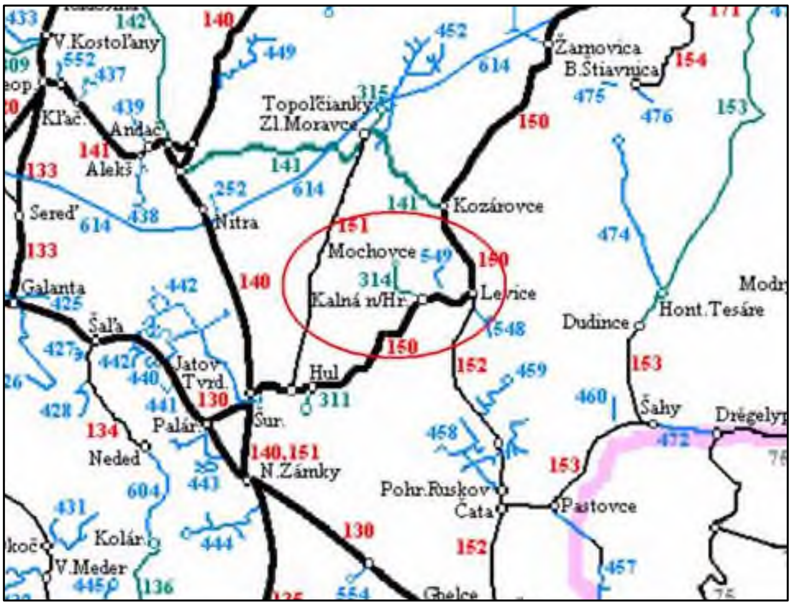


Figure 38 - Mochovce railway connection

Utility distribution

Within 20 km of the power plant there are transit, international and domestic oil and gas pipelines, and utility distribution.

Gas distribution

Gas distribution is made up of transit, interstate and domestic lines which ensure the supply of natural gas to local towns.

Transit gas pipeline passes over the border line of 20 km area of Mochovce NPP nearby Mytne Ludany, then to Dolna Sec, Horna Sec, Kalna nad Hronom, Lok, Melek, Pana and Velky Cetin. Transit gas pipeline has automatic isolating valves installed nearby to Plastovce and Stary Hradok. Aboveground parts of the gas pipeline are constructed at Mytne Ludany – bridge over water course Sikenica and at Kalna nad Hronom – bridge over Hron river.

Compressor stations of transit gas pipeline are constructed at Mytne Ludany, Tehla and Ivanka pri Nitra.

Interstate gas pipeline enters to 20 km area at Brhlovce, goes to Krškany, Hronské Kosihy, Tlmače and branches out to Tesárske Mlyňany, Žirany and to Hronský Beňadik, Tekovskú Breznicu and Novú Baňu.

Domestic gas pipeline enters to 20 km area at Babindol, goes to Malé Chyndice, Tesárske Mlyňany, Zlaté Moravce and Topoľčianky.

Minimum distance from the line part of transit and interstate gas pipeline to area of Mochovce NPP is about 7 km.

The gas distribution is operated by Slovenský plynárenský priemysel.

Oil distribution

The oil pipeline in the Slovak Republic is operated by Transpetrol a.s. Bratislava which transports the crude oil by oil pipelines of DN 500 and DN 700 from suppliers to the Czech Republic and to processing centre of Slovnaft a.s. Bratislava. Oil pipelines with diameters of 500 mm and 700 mm pass over the territory of 20 km area of Mochovce NPP simultaneously.

Nearest pumping station is a Pumping station No 4 in Sahy located about 45 km by the most direct route from the area of Mochovce NPP, Units 3&4, the next one is the Pumped station in Bucany (Trnava district).

On the territory of the related area in Sahy – Tupa branches out Druzhba oil pipeline (Transpetrol a.s. Bratislava, Pumping station No 4 Sahy - Tupá) and goes over the territory in two lines: in direction to Vrable and in direction to Sala. Both lines of the oil pipeline cross over the territory of 20 km area of Mochovce NPP, Units 3&4 at Jur nad Hronom, while the line of Vrable direction goes approximately to Bajka, Horný Pial, Iňa, Tehla, Melek, Paňa, Čechynce and the line of Sala direction goes to Ondrejovce, Dolný Pial, Trávnica, Maňa, and Mojzesovo.

On operated stage of the oil pipeline are installed isolating valves (ball closure) on pipe DN 500 or DN 700 at Malý Cetín by bridge over Nitra river 2 x GU 5,7; Vráble by bridge over Žitava river 2 x GU 5,7; Cabej - Čápor GU 5,7; Branč 2 x GU 5,7; Veľké zálužie 2 x GU 7 and GU 5;Zelenice 2 x GU 5,7; Horný Pial 2 x GU 5,7; Bajka 2 x GU 5,7; Jur nad Hronom GU 5,7; Demandice 2 x GU 5,7; Tupá GU 5,7.

Minimum distance of the oil pipe line – its line in Vrable direction from the area of Mochovce NPP, Units 3&4 is about 9.5 km.

Utility pipelines

Utility pipelines are used for long distance transport of diesel and petrol. From the town of Jur nad Hronom they continue to the north towards Horná Seč, Veľké Kozmálovce, Tlmače, Hronský Beňadik, where it braches out towards Tesárske Mlyňany and Kľačany (region of Hlohovec).

Valve shafts of the utility pipelines are located in the towns of Tupá, Demandice, Jur nad Hronom, Tlmače, Slepčany, Čechynce, Ivanka pri Nitre, Júrsky Dvor, and Veľké Zálužie.

Fuel storage is located in the towns of Kľačany and Hronsky Beňadik. The minimal distance of the utility pipelines is approximately 7 km from the power station. The utility pipelines are operated by the company Slovenský produktovod a.s.

External electrical system

EMO12 are currently in operation and the power output is fed to the nearby 400 kV distribution plant at Veľký Júr, which is connected to the surrounding distribution plants through four 400 kV lines. One line leads to the 400 kV distribution plant at Levice, one line leads to the 400 kV distribution plant at Križovany and one to the 400 kV distribution plant at Horná Ždaňa. Reserve power supply for units 1 and 2 is connected to the 110 kV distribution plant at Veľký Ďúr, which is connected to the distribution plant at Levice through 110 kV lines. The Levice distribution plant is a 400/110 kV transformer station with two 250 MVA transformers. The transformers serve as an initial source for the Mochovce NPP which is also supplied by the adjacent region.

The transmission grid 400/220 kV is part of the interconnected energy system CENTREL, which was established on 11 October 1992 among Hungary, Poland, Czech Republic, and Slovakia. This system works in synchrony with the energy system of western Europe UCPTE.

11.4 Social Analysis

11.4.1 Relation between environmental and social aspects

EIA is generally understood to be an instrument of preventive environmental policy. It should provide an adequate information basis for decision-making on activities affecting the environment.

Relationships between society and the environment have radically changed in the past decades. In the past the natural environment was considered to be influenced by culture, behaviour and institutions. Today, the relations between nature and society are reversed. Now it is not the environment that influences society but the latter that, thanks to science and technology, has subdued nature. In this sense EIA is not only a technical or administrative procedure: it is above all a social and cultural action, one of the greatest efforts made by society to exploit nature more rationally and to control its own modes of growth. The idea in EIA is to make the decisions that have important environmental consequences as rationally as possible, but also to offer the general public a possibility to check decisions or, better, to participate in the evaluation and decision processes. EIA on the whole assumes a sociological relevance.

Together with the EIA, social impact assessment has become a key component of planning and decision-making in the EU. Agency planners and decision-makers have recognized a need for better understanding of the social consequences of projects, programmes and policies.

The work of SIA (Social Impact Assessment) and community involvement is as central to project success as any other factor and involves the proper management of the relationships with local community people.

Basically, SIA contains an analysis of:

- social and socio-economic aspects;
- social perception;
- media reports.

The Mochovce NPP is an existing facility in an established and stable community. All necessary construction permits have been granted. Accordingly, a detailed socio-economic assessment is not required.

11.4.2 Public information on nuclear power in Slovakia

This EIA Report focuses on the public communication policy adopted by SE, a.s. and ÚJD, in order to ascertain the level of knowledge and the perception of the project by local communities, as the first step of the social perception analysis.

Nuclear Regulatory Authority (ÚJD)

Independently of nuclear installation operators, ÚJD allows the public and the media to check the data and information on the nuclear installations. It also provides the public with information on nuclear safety, including on the management of radioactive wastes, spent nuclear fuel, nuclear materials, control and record-keeping thereof as well as on further fuel cycle stages.

The right to information in the SR has been guaranteed by the Constitution and other instruments on human rights since the early 1990's. The passage of Act No. 211/2000 Coll. (free access information Act) provided the citizens with a statutory way to obtain needed information. This Act along with Act No. 541/2004 Coll. constitutes a legislative framework for public relations. *"The level of public relations in a democratic society is one of the crucial factors of nuclear power engineering acceptability both at the present and in the future.*" (Report on activities of Nuclear Regulatory Authority of the SR and safety of nuclear installations in the SR in 2000).

Operators are required under the Atomic Act No. 541/2004 Coll. (Art. 27 (4)) to inform the public about incidents, accidents, measures to protect health and activities required to be taken upon such incidents or accidents.

As early as 1995 the foundations were laid for the concept of broad public information on ÚJD activity and on the safety of nuclear installations by opening ÚJD's Information Centre. The Centre provides communication with the public and the media. The Information Centre was extended in 2000.

Information that has most frequently been made available concerns the following areas:

- Safety documentation on the Bohunice NPP V-1 (WENRA, IAEA Missions);
- ÚJD decisions (consultation, sending);
- NPP environmental impacts;
- ČSKAE and ÚJD norms;
- ÚJD interactions with neighbouring countries;
- Spent nuclear fuel and depleted uranium;
- RAW reprocessing and disposal;
- Completion of MO34;
- AEA, OECD/NEA, ENS activities;
- Pressurized water reactors, reactor vessel, results of ÚJD inspections;

- ÚJD guidelines and other management acts;
- Slovak Republic's National Report on nuclear safety;
- ÚJD classified information;
- Granted licences for activities under the Atomic Act; and
- NPP containment and terrorism.

Communications and information consist of:

- press conferences;
- appearances and interviews on television and radio;
- broadcasting of videoclips to the public; and
- communication with Mochovce and Bohunice Civic Information Committees.

SE, a. s.

Information on nuclear power for the public is provided by SE, a.s., through its dedicated structures.

The operators of the Mochovce and Bohunice V2 NPPs provide those interested, schoolchildren in particular, with information and data on the nuclear installations, ionising radiation, climate changes, sustainable development, etc. Information is structured for various ages of visitors at the Information centres, and site tours of both power plants are available. The premises of the Bohunice V2 and Mochovce NPPs have 10,000 to 12,000 visitors each annually from across Slovakia as well as abroad.

An important role at the Bohunice and Mochovce sites is played by external lectures about nuclear energy given at various occasions This responsive and transparent communication is assisted by the corporate monthly "Slovenska energetika". There also two nuclear-focused newspapers: the regional monthly "atom.sk" for the general public, and another one for employees of nuclear power plants "atom plus", both with coverage of Bohunice and Mochovce NPPs, distributed free of charge in the plant surroundings. The Information centre release a number of other printed publications (leaflets and brochures), which are available for visitors. In an open and comprehensible manner this information gives the general public an understanding on the most recent development in the area of the nuclear power plant safety, as well as on nuclear energy in general. Internet and intranet websites of Slovenské Elektrárne (www.seas.sk) provide thorough and comprehensive update of all areas of the Company's activities.

11.4.3 Communication and Local Public Representatives

In the early 1990's SE, a.s. recognized the need for open communication with the public. In 1991, as a result of this need, it established the *Information Centre* in Mochovce NPP was established.

At the same time a *Mochovce Regional Interest Association of Municipalities* (ZRZM), initiated by mayors of the Vrable region, was established in order to gain legal and financial support for common solutions to environmental impacts of Mochovce NPP operations, but also to guarantee protection of legal rights and interests of the municipalities, development of local government functions, and co-ordination of regional policy.

ZRZM included any municipality whose territory is located in (or extends into) the 20-km protection area of the Mochovce NPP.

In 1997, 4 municipalities in the 5 km protection area (Novy Tekov, Male Kozmalovce, Kalna nad /Hronom, Nemcinany) recognized a need to state the claims for higher financial support for them, being located nearest to the power plant. At the beginning this issue was not considered by ZRZM but later the ZRZM split into protection zones I and II.

Communications and information exchange between Mochovce NPP and ZRZM takes place in the following ways:

- NPP representatives are invited to the General assembly and the Board meetings, where they provide qualified update on the power plant operation and safety aspects, as well as company social responsibility activities and events;
- thematic study trips for mayors from ZRZM (France, Germany, Hungary, Czech Republic, Spain, Finland, etc.) organised by SE, a.s.; and
- atom.sk monthly sums up important corporate and power plant developments and is distributed to every municipal office in the 20-km region of Mochovce and Bohunice NPP for free.

In 2005, the Civic Information Committee of Mochovce NPP was established with the aim of promoting the information about nuclear through third-party persons. The Committee comprises 16 well-known and trust-worthy public figures from the region, and gets together regularly (no less than twice a year) to exchange information with the power plant management.

11.4.4 Consultation on current study

The Mochovce NPP is an existing facility in an established and stable community. All necessary construction permits have been granted. Accordingly, at this stage of the Project, a detailed socio-economic assessment is not required.

Nonetheless, as mentioned in previous paragraphs, the public is widely informed onto current operations of Mochovce NPP. Public communication and participation will continue throughout the completion of units 3 and 4 and operation of all 4 units.

Moreover, in order to provide information to stakeholders and wider public on EIA, Slovenské Elektrárne has prepared a Public Consultation and Disclosure Plan (PCDP). The PCDP covers the following issues:

- brief description of the Project;
- legislative requirements;
- appraisal of influences to environment in SR:
  - the process of influences appraisal to Environment;
  - appraisal process participants;
  - public rights in appraisal process;
- brief description of EIA process;
- the plan of public integration:
  - public hearing and public meetings;
  - submitted documents, presentations and web pages.

The scope of the PCDP is to provide for early engagement and for sharing information and consulting during the EIA process with members of the public and stakeholder who may be affected by or interested in the project.

The implementation of the PCDP will ensure that adequate and timely information is make available to people potentially affected by the project, and other stakeholders, and that these groups are given sufficient opportunity to set out their opinions on the EIA with regard to the project.

11.4.5 Public attitude surveys

The main sources of information regarding the public level of knowledge and the perception of nuclear power, particularly for Mochovce NPP, are represented by:

- *Country Nuclear Power Profile*, by IAEA 2002;
- *Perception of NPP Mochovce by inhabitants of I and II Protective zone*, by Department of Geography and Regional Development of the University of Constantine Philosopher in Nitra, 2004;
- *Attitudes and perception of the company SE, a.s. by the population inhabitants of Slovakia*, survey conducted by GfK, 2004 and 2007;
- *Eurobarometer; and*
- *Public poll performed by Markant Agency for JAVYS, a.s.*

The above mentioned documents provide information at various levels, starting from a single opinion on the use of nuclear energy to a poll on the perception of Mochovce NPP by inhabitants of protective zones, and even a poll on the perception of nuclear energy and NPPs in the whole SR.

Country Nuclear Power profile 2003

The preparation of the *Country Nuclear Power Profile* was initiated within the framework of the IAEA's programme on assessment and feedback of NPP performance. It responded to a need for a database and a technical document containing a description of the energy and economic situation, the energy and the electricity sector and the primary organizations involved in nuclear power in IAEA Member States.

The 2003 edition updates the country information to the end of 2001 and covers background information on the status and development of nuclear power programmes in countries having operating nuclear plants and/or plants under construction as of 1 January 2002. It reviews the organizational and industrial aspects of nuclear power programmes in participating countries for the same period and provides information about the relevant legislative, regulatory and international framework in each country.

The main issues related to present nuclear power policy (e.g., moratorium, public acceptance, open market, privatisation, safety and waste management issues, role of the government in the nuclear R & D, human resources development, economic and financing issues, and impact of nuclear power in avoiding CO_2 emissions, etc.) are considered.

Regarding social issues and public acceptance, it provides the results of a survey carried out in Slovakia of public opinion on the use of nuclear energy as shown in Figure 39. The data are based on the results of a standard survey by a Gallup's questionnaire method on a selected sample of 1,037 persons from the population above 18 years of age in 1995. About 46% of the selected population was indicated to be in favour of nuclear power and 44% was against.

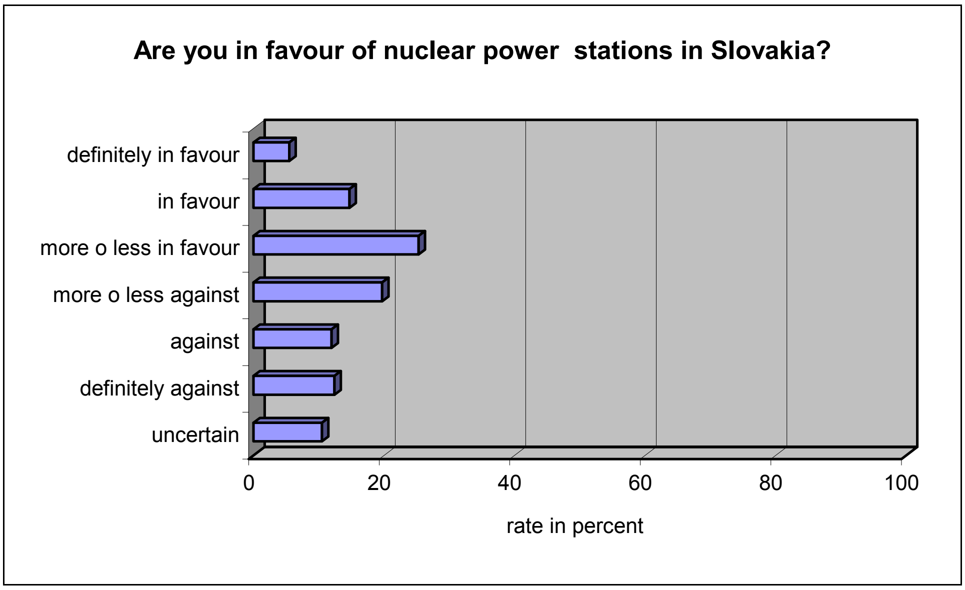


Figure 39 - Results of survey on the use of nuclear energy

Perception of Mochovce NPP by inhabitants of the Protective zone I and II

In 2004, the Department of Geography and Regional Development of the University of Constantine Philosopher in Nitra carried out a survey of the perception of Mochovce NPP by inhabitants of Protective zone I and II.

The survey focused on:

- Level of knowledge of Mochovce NPP;
- Level of knowledge of the SE's monthly "SE, a.s., News Mochovce ";
- Perception of threat;
- Opinion on completion of MO34;
- Opinion on the future of NPPs in the SR;
- Opinion on usage of nuclear power; and
- Level of knowledge of environmental impacts.

The survey was divided into 3 phases. The first one was a preliminary phase which included preparation of a questionnaire in close cooperation with the Mochovce NPP Infocentrum and a tour of Mochovce NPP with the aim of obtaining feedback on the effectiveness of the given information.

The second phase of the survey involved 32 settlements municipalities, including the towns of Levice and Vrable (Table 102). In this survey 10% of the working inhabitants were questioned (1,149 totally in villages, altogether 1,149 people, 250 in the towns of Vráble and Levice, and 121 in Tlmače) so that the total of 1,770 people expressed an opinion in response to 25 questions related to Mochovce NPP.

Evaluation of the received information received (statistical and graphical) was the scope of the final phase of the survey.

Table 102 - Facts on survey on perception of Mochovce NPP by inhabitants of the I and II Protective zone

Number of municipalities/villages	*Number of inhabitants*	*Area in km²*	*Number of respondents*
32	74,800	450.6	1770

Figure 40 shows the positive opinion of respondents concerning the completion of Mochovce NPP.

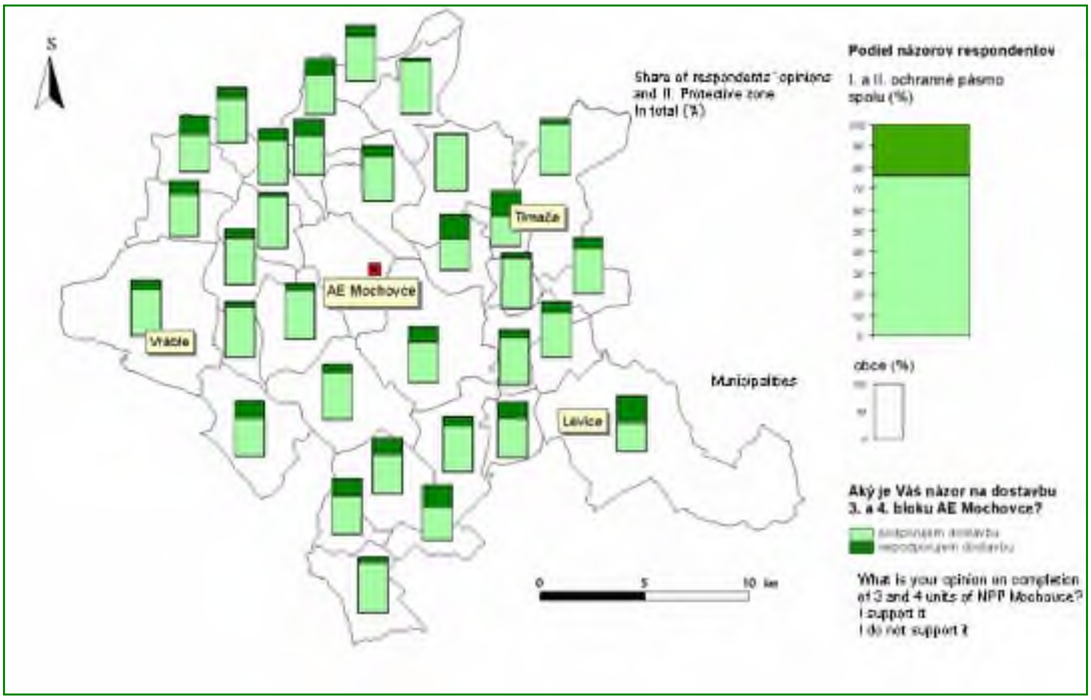


Figure 40 - Results of the survey on the opinion on completion of Mochovce NPP

Attitudes to and perception of the company SE, a.s. by inhabitants of the Slovak Republic

In 2004, GfK Agency group, specialized in market and consumer research, carried out a survey on attitudes and perception concerning the company of SE, a.s. by inhabitants of the SR.

The poll focused on:

- implications of nuclear energy;

- opinions on pros and cons of nuclear energy;
- opinion on the extent of a threat from the NPPs in the SR;
- perception of nuclear energy as a source of electricity generation energy production;
- opinions on the share amount of the electricity energy generated in produced by means of NPPs;
- respondents' opinions on the protests against nuclear energy;
- opinions of the respondents on the safety of the Mochovce NPP safety;
- information about completion of the remaining parts of Mochovce NPP; and
- opinions about completion of the remaining parts of Mochovce NPP.

The sample was made up of 1,000 persons in with the age intervals of 19÷69 (adults) and 14÷19 (students).

Figures 41 and 42 illustrate some responses to specific issues in the polls.

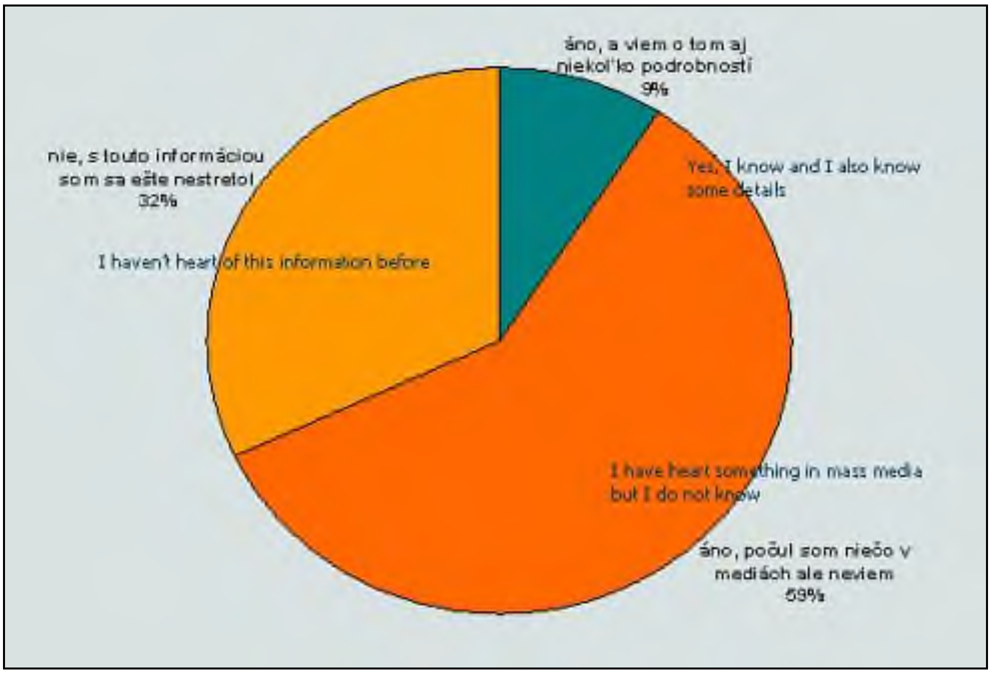


Figure 41 - Information about completion of the remaining parts of Mochovce NPP

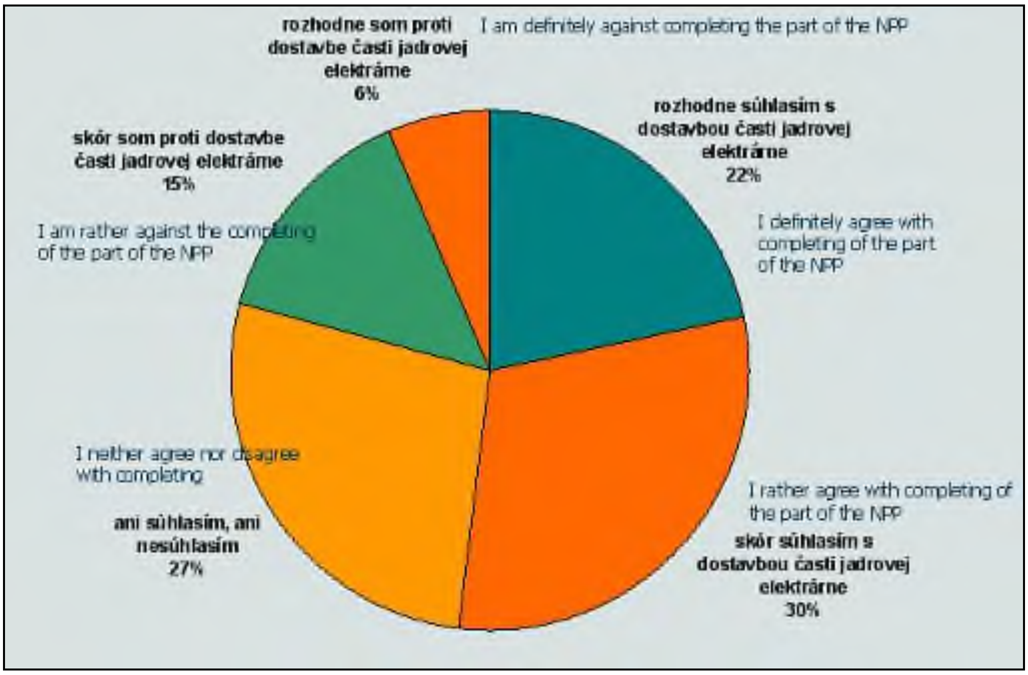


Figure 42 - Opinions about completion of the remaining parts of Mochovce NPP

Another further survey on “Acceptability of Nuclear Power by the Public of the Slovak Republic and Brand Awareness of Slovenské Elektrárne” was carried out by GfK Agency group in the spring of April 2007. The main survey objective was to find out about opinions and attitudes of the Slovak population about nuclear energy and nuclear power plants in Slovakia, and compare the selected findings with the results of the 2004 survey.

The analysed target groups are shown in Table 103.

Table 103 - Analysed target groups

Adult population (N=650)	Secondary school students (N=350)	Inhabitants of the JE Mochovce NPP buffer zone (N=300)
age of 19–69 years	age of 15–19 years	age of 15–69 years

Figures from 43 to 45 illustrate some responses to specific issues in the polls.

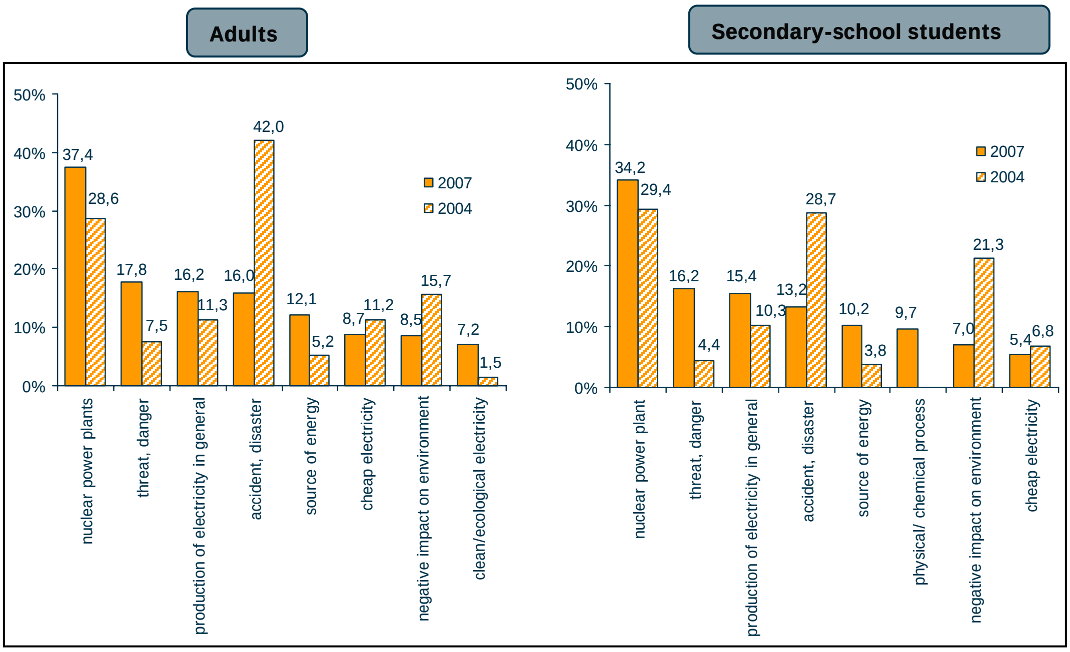


Figure 43 - Nuclear power implications Associations with Nuclear Power (comparison 2007/2004)

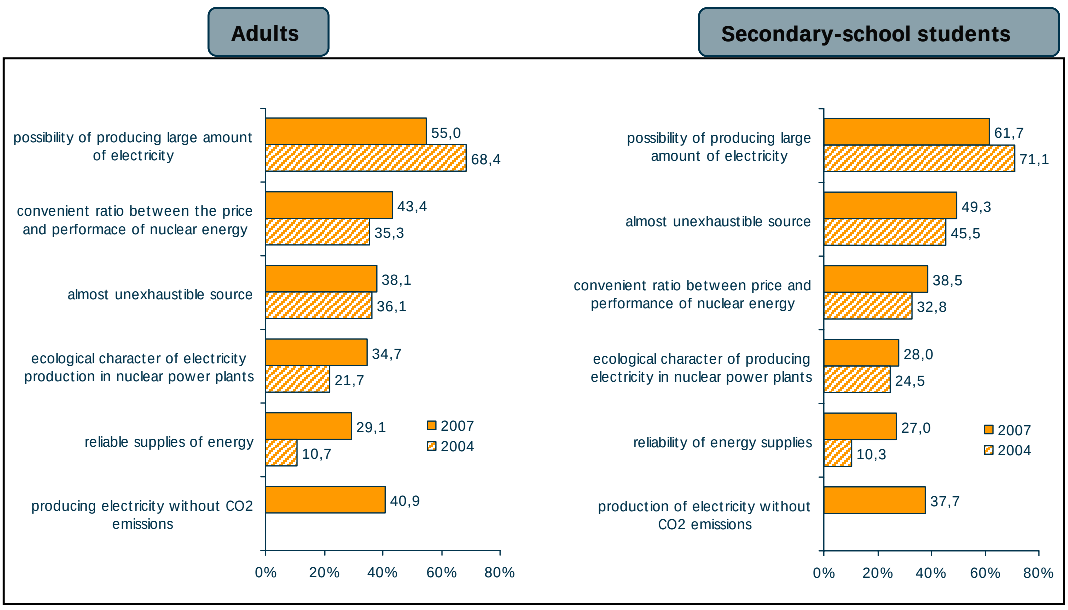


Figure 44 - Strengths of Nuclear Power strengths (comparison 2007/2004)

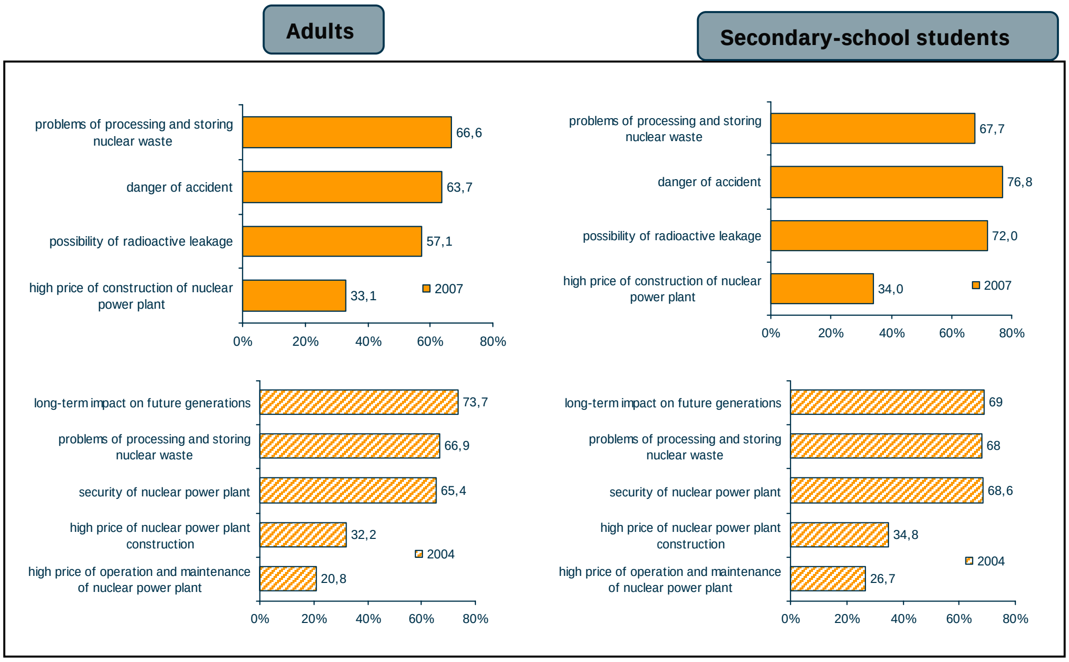


Figure 45 - Weaknesses of Nuclear Power (comparison 2007/2004)

Compared with the year 2004, the 2007 survey shows that:

- associations connected with a specific accident and disaster decreased by more than a half, mainly among the adult population, however, the feeling of potential threat and danger has considerably increased;
- the rational aspects of nuclear power production have increased slightly;
- environmental fears have decreased;
- general awareness of completion of the remaining units of the Mochovce Nuclear Power Plant has increased slightly; despite the fact, that general awareness of the population near Mochovce NPP regarding the completion of MO34 is almost 100%, almost two thirds do not know any other details, in 2007; and
- completion of MO34 has generally strong support of the public – almost 90% in the plant's 10-km area, almost 70% in Slovakia.

Figure 46 shows population opinions on MO34 completion (GFK, 2007 survey) and Figure 47 shows the opinion on the future use of nuclear power in Slovakia (survey by Markant, 2008).

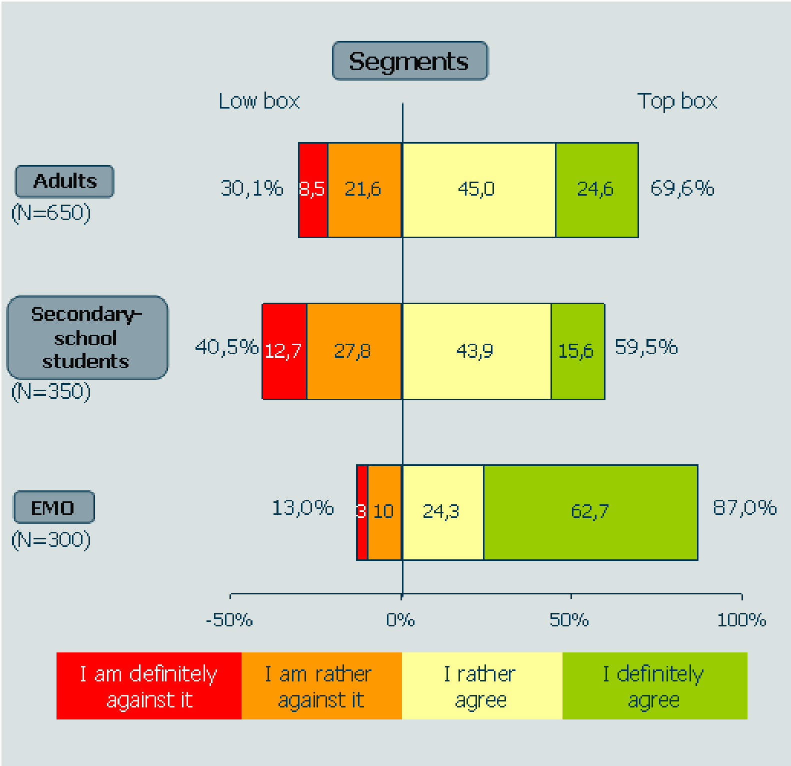


Figure 46 - Opinions on Completion of the Remaining Parts of the Mochovce Nuclear Power Plant (2007 survey)

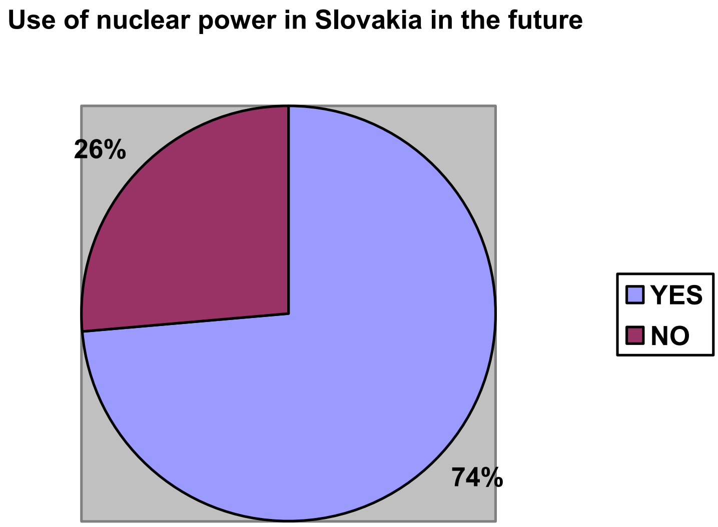


Figure 47 - Opinion on the future use of nuclear power in Slovakia (survey by Markant, 2008)

12.0 CULTURAL AND HISTORICAL LANDMARKS AND SIGHTS

All the territories beyond the Danube River have represented a strategic crossing area among different cultures and people during the centuries.

Archaeological findings from the time of Junger Stone Age (2000 B.C.) have been documented at Tlmace town, while the Bronze Age and the Iron Age are documented in the territory of Slovenska brana. The excavation in 1902 of the Mammoth remains near Besa town still holds the place of the best preserved mammoth remains in Slovakia.

At the beginning of the 8th Century B.C., in the early Iron Age, Scitian people are documented in the Danubian valley among territories of Slovakia and Hungary, according to Herodotus.

Later, in the 1st Century B.C., the Danubian region is dominated by Celts, whose most important urban settlement was on the top of the hill of Bratislava (a Celtic coin dated 1st Century B.C. was found in the excavations of the old town).

At the end of the 2nd Century B.C. the Celtic kingdom was cancelled by the invasion of two different people: Dacians from south east and Germans from north.

The Danube River became the natural border of the Roman Empire, called “Limes Romanus”, while the inhabitants of the regions beyond the river were barbarians. In the Ages of Traianus and of Marcus Aurelius famous battles took place in this area, documented in the embossment of the two imperial marble columns in Rome.

The 5th Century represents the end of the roman domination, as new ethnic migrations characterize this period.

Slavs arrival (from north east) marks the beginning of a new age of cultural domination, which has been going on up today. In the 7th Century a state formation of Slavs is documented as the Samo Empire, from the name of its leader, with an important urban settlement in Nitra.

Nitra was the capital as well of the subsequent state formation, named the Great Moravian Empire, whose Prince Pribina, at the beginning of the 9th Century, dominated over a large territory corresponding to central and west Slovakia, Czech Republic and some regions of Poland, Hungary and Germany. He showed great wisdom as a statesman and did actually change the history of Slovakia, by allowing the first Christian church in Nitra to be consecrated. The witness to the Christianity of the Slavs is mentioned in a document dated 870 A.D. (Conversione Bagoariorum et Carantanorum) while the exact site of the first church in Nitra has not yet been located.

The 9th Century was also significant for the arrival in Slovakia of the two Byzantine missionaries Cyril and Methodius, who developed the first Slavic alphabet and translated the first liturgical texts into Old Slavonic.

In the 11th Century Slovakia was annexed to the rising Hungarian reign, whose King Stephen I was catholic and clearly involved with the politics of the Church of Rome. In this period several churches and monasteries were established in

Slovakia, thanks to the presence of Benedictine Order who took up the organization of ecclesiastical life. The two oldest and most important monuments of this age were both related to this Order: the monastery of St Hyppolite on the slope of Zobor hill (Nitra), and the still existing monastery of Hronsky Benadik, first consecrated in 1075 and rebuilt in 14th Century in gothic style.

Terrible attacks by Avars and Tartars in the 13th Century forced the monasteries to be fortified, giving the region a new cultural landscape, improved by the presence of several castles on the top of the hills. Most of them are in ruins today, but still retain the importance of a defensive chain against external attacks, wanted by King Bela IV.

The Renaissance in Slovakia bloomed with the Hungarian King Mattia Corvino, who provided Bratislava with a famous University and patroned some of the most important artists of the 15th Century.

Between the beginning of the 16th and the end of the 17th Centuries the territory of Slovakia was crossed by two different, but equally strong problems for the Asburgo monarchy: Turkish invasions and Luther Reformation.

As a result of the religious wars, which deeply impressed the territory of Slovakia as well as all over Europe, the arrival of Jesuits is to be registered, called by the Asburgo in order to stop the Lutheran wave. Some of the most important historical landmarks in the region of Levice (church of the Archangel Michael; church of the Holy Cross; chapel of St Mary of the Sevenpains), Nitra (church of the Holy Trinity) and Zarnovica (chapel of the Holy Blood in Hronsky Benadik) date back to the 18th Century baroque period.

The history of Slovakia between 19th and 20th Century follows the events of the Austro-Hungarian monarchy and the contemporary rising of the Slavic nationalism.

No landmarks or monuments of relevant significance for this report are to be mentioned.

13.0 ARCHEOLOGICAL LOCALITIES

Even if no landmarks or monuments of relevant significance in reference to the project activities have been identified, a description of the historical landmarks within 20 km range from the power plant, into the districts of Levice, Zlate Moravce, Nove Zamky and Zarnovica is presented below.

Levice region

Urban relics in the region include the commemoration zones of Levice town and Stary Tekov. Cultural relics include the Roman Catholic Church of saint Josef in Levice whose main altar dates back to 1883 and it has a painting of saint Josef. Side altars of God's Hearth of Jesus and the Unbefouled Hearth of Mary date back to the 19^{th} century along with newer statues of saints. In addition there is the classicistic rectorial church of Saint Michael the Archangel, built from 1773 to 1780 by the Esterházy family, and the Calvinistic church with a baroque–classicistic column, erected in 1786, with the statue of Unbefoulded Virgin Mary.

A classicistic Evangelic church was consecrated in 1843 and lengthened by a rectangular room and a tower. The altar painting of Jesus is an artwork of the painter J. August. There is a newly built Church of Saint Spirit on the housing estate Rybnik.

The Evangelic church, built 1785, is the town's dominating feature. It is a significant bearer of the Christian history in Slovakia.

Other significant landmarks are the Roman Catholic Church of the Saintly Cross, the Chapel of Saint Cyril and Metodej, the Bell-tower at Kamenec, the Chapel Kaplnka sv. Urbana, the Chapel of saint Josef on cemetery at Gondov, the Chapel of the Sevenpains Virgin Mary (in the process of restoration) and the statue of Saint Jan Nepomucky.

Among the important landmarks in Rybnik belongs the Classicistic church built 1771, late-classicistic Chapel of Saint Jozefa /1856/ and The Chapel of Saint Urban. Rybník is the birthplace of Benedikt Szollosi - the author of the first catholic hymnal - Cantus Catholici. From an ethnographic point of view the town is interesting by typical style of period costumes and conventions.

The dominating features in the town of Besa are the Church of Saint Anna from 1770, the Church of reformed Church from 1963, the palace of culture and the Train station building. It is also to be mentioned the Roman Catholic rectorial authority near the Church of Saint Anna.

Levice Castle is the most important relic of Levice town. It was built during the second half of the 13^{th} century on steep rocky ledge, extending to vast swamp fed from Hron and Podluziansky potok waters.

The highest authority of Roman Catholic Church, Baroque Castile of Esterházy, built in 1734 and rebuilt in Classicistic spirit at the beginning of 19^{th} century, was severely damaged during the WWII.

The Synagogue in Levice is a romantic classicistic building built in 1857. It is a hall-type Jewish house of worship with a gallery for women. There is a richly decorated triangular font on the entrance with plastic ornaments and heightening, which shows the Ark of the Covenant.

Among the archaeological locations it has to be remarked Plave Vozokany. The first worships were held under well-known Plavovozokanska hruska (pear tree). This 300 hundred years old tree is registered in the Register of the protected trees of Slovakia. It can be found in a private yard.

Tlmace town habitation was documented by archaeological findings from the time of Junger Stone Age, it means around 2000 years B.C.. The Housing development with the cancelled ceramics, the Halstat's cemetery of the podolian culture and the Latens housing development originated at that time. Strategic importance of Slovenska brana territory did not drop down even later on during the Bronze Age and The Iron age. New fortified settlements or big fortresses on the left shore of Hron (Castle Kusa hora and Krivin) are the proof. Agrarian backup of those fortifications were constituted by lowland unsecured settlements.

One of the most important events in the history of Besa town is the Mammoth remains excavation at 1902. The Mammoth remains were laying 3.40 – 4.55 m deep and they measured around 7 m. There was more minute findings of mammoth remains during the 20th century at the near villages (Travnica, Podhajska), but not even close of that importance as the 1902 Besa finding, which held the place of the best preserved mammoth remains in Slovakia until 1960.

Zlate Moravce region

Urban relics in the region include the commemoration zone of Zlate Moravce town, the architectonic landmark in Topolcianky. Cultural landmarks in Zlate Moravce, the Church of Saint Cross in Nova Bana. The Church of Saintly Cross in Kalvaria was built in classicistic style at 1826 and rebuilt at 1956. The road leading to this church is bordered with the chapels symbolizing The Way of the Cross.

In Male Vozokany a period mansion is now been rebuilt and it is used as a hotel, recreational facility and coffee shop.

There is folk architecture in Obyce and Ladice towns and significant parks in Tesarske Mlynany and an arboretum in Topolcianky. There is an extensive British park on the north side of the Topolcianky, into which several of the national cultural landmarks have been set.

The town museum in Zlate Moravce orientates itself to Horne Pozitavie. It was established on May 12th, 1896, but its collection was moved together with the library to Nitra in 1924. In 1951 the collection moved again to Bojnice.

Archaeological discoveries of the 13 to 16 century castle remains in the present mansion yard in Topolcianky.

Nitra region

There are cultural landmarks in this region in Kolínany and Lucnica nad Zitavou which was established in 1960 by uniting the villages of Martinova and Vajka nad Zitavou. Two late baroque landmarks from the 14th Century can be found here - the mansion and the Roman Catholic Church. Folk architecture includes the church of Saint Trinity (1734), built on gothic foundations. There is a museum in Kolínany.

Nove Zámky region

The highest authority of Roman Catholic Church is in Travnica. Travnice is famous for five mansions. The oldest one Kunovsky belonged to the Balogh family. The building is classicistic, rebuilt several times and adjoins the church. The last owner Rudolf Tarisch had it thoroughly rebuild at 1928. Today it serves as the location of the Pediatric Medical Institute of Surany and it is under the ownership of the municipality of Surany

Zarnovica region

Cultural landmarks include Orovnica town, the Church of Saint Jan Bosco built in 1935 and the WWII memorial. In the town of Hronsky Benadik is located the Monastery of Saint Benedikt from the 11th century which is the second oldest monastery in Slovakia. This National Cultural Landmark is the most popular cultural landmark the region. The Church of Saint Egidius, built in 1209 in a Roman style, is registered as a cultural landmark. There is a number of precious exhibits to see here as well as at the monastery. The baroque chapel of Saint Blood was built in 1713 on the rocky hill above the town.

Various significant statues include the Calvary, Saint J. Nepomucky from 1874, the statue of the Madonna from 1895, the statue of Saint Anna from 1803, the statue of Saint Benedikta from 1880, the statue of Saint Urban from 1768, and the statue of Virgin Mary at Psiare.

Nova Bana has various churches and chapels including the Church of Saint Alzbeta from 1391, the church of the birth of the Virgin Mary built at the second half of the 14th Century, the Church of the Saintly Cross built in 1826, the church at Stara Hut from 1814, the chapel of the Virgin Mary from 1863, and Banicka chapel from 1822.

14.0 PALEONTOLOGICAL LOCALITIES AND IMPORTANT GEOLOGICAL LOCALITIES

Neither paleontological localities nor geological localities of interest are currently known to be present in the area of interest.

15.0 CHARACTERISTICS OF EXITING POLLUTION SOURCES AND THEIR ENVIRONMENTAL IMPACTS

The characterisation of existing source of environmental pollution, if any, was conducted within each environmental component.

16.0 COMPLEX EVALUATION OF CURRENT ENVIRONMENTAL ISSUES

The methodology followed in the present study for the assessment of the environmental impacts, described in Section C, part VII, takes into consideration likely effects of the Proposed Activities on the interested environmental components.

Impact assessment methodology highlights, if it is the case, the likely cumulative effects for all the environmental components.

The results of impact assessment are reported in Section C, part IIII of the present Report.

The current environmental baseline is reported in Section C, part IIII of the present Report.

17.0 OVERALL ENVIRONMENTAL QUALITY – SYNTHESIS OF POSITIVE AND NEGATIVE FACTORS

17.1 Monitoring of Radioactivity in the Environment

In accordance with the Radiation Monitoring Plan in the vicinity of Mochovce site EMO/2/NA-052.01-02, the NPP controls its radiological impacts on the environment and on inhabitants. Monitoring activities are aimed at documenting that radiological impacts, for example exposure of inhabitants and concentration of isotopes from emissions are below the limits presented in the Annex No. 3 to the Decree of the Government No 345/2006 on Basic Safety Requirements for Health Protection of Workers and population from Ionizing Radiation (and L&P laid down by ÚJD) and that the impacts are as low as reasonably achievable – ALARA.

Samples of air, soil, water, and food chain (feed, milk, agricultural products, etc.) in the area with the radius of 20 km around the plant are regularly measured and assessed by the SE ERML (Environmental Radiation Monitoring Laboratory, in Levice). All radioactive potential impact of emissions and effluents to the atmosphere as well as to all hydrosphere components (surface water, potable water, continuous bottom sediments, etc.) on the power plant vicinity are monitored.

SE, a.s. presents annually complete reports on Monitoring of Radioactivity in the SE– EMO Environment. In the reports, analysis of data is based on the pre-operation (the section related to the statistic processing of results) and operation period from the past years. In fact, the measurements of samples were done even prior to commissioning of power plant so that to acquire referential values to be compared with values measured during operation and after the end of the plant's life-time.

In Table 104 is reported the typical annual plan of the radio-ecological controls and, in Figures 48, 49, 50, and 51 are reported the maps of the sampling/measuring points of soil, in situ gamma spectroscopy, sediments and milk, water (surface, drinking, and underground), SDS (Stable Dosimetry Station) location and TDS (Teledosimetry System) location (see Design Framework, section *Measures during normal operation*).

Detailed results from the monitoring program of the radioactivity in the environment are provided in Annex 4.2 "Report of monitoring of radioactivity in the SE-EMO environment (years 2005 till 2008)".

Monitoring results demonstrate that impacts of EMO12 during standard operation are close to zero in spite of a high sensitivity of the equipment applied and it can be supposed that the contribute from MO34 will follows this trend. The way of operating the systems of gaseous and liquid emissions treatment and their permitting ensure the emissions maintained ALARA principle and demonstrate that the radiological impacts of the plant operation on the environment and on exposure of inhabitants were not only below the limits specified, but they were practically undetectable.

Tritium and ^{90}Sr values measured in surface waters (river Hron) comply with the Mochovce NPP project values and with the legal requirements (the Decree of the government of SR No. 296/2005, by which the indicators of permissible pollution level of surface waters – tritium - are set forth) too. Results from monitoring of the air, soils, agricultural products, from thermoluminiscent dosimeters or ionization chambers did not reveal impacts of Mochovce NPP operation on the background values of radionuclides in the Mochovce NPP environment (consisting of terrestrial radionuclides - ^{238}U, ^{232}Th, ^{40}K, ^{7}Be and anthropogenic radionuclides - ^{137}Cs, ^{134}Cs, ^{90}Sr produced during nuclear tests in the air and during the Chernobyl disaster) either.

In spite of these conclusions, some values exceed the values of investigation levels. Investigation levels, which are defined as the sum of the arithmetic average and three times the value of the standard deviation of the measured values of the parameter for the previous two years, could be affected by sampling conditions (particularly the meteorological ones) of these years significantly and also could be affected by the possibility of measuring devices factor in the increase of measured values. Conclusion of the investigation is that the few exceeding is likely of a statistic nature and is not of any environmental consequences.

The assessment of primary effects of radiation on non human biota is screened form consideration for two reasons:

1) monitoring shows very low or non detectable radioactivity level in non human biota (see Annex 4.2);

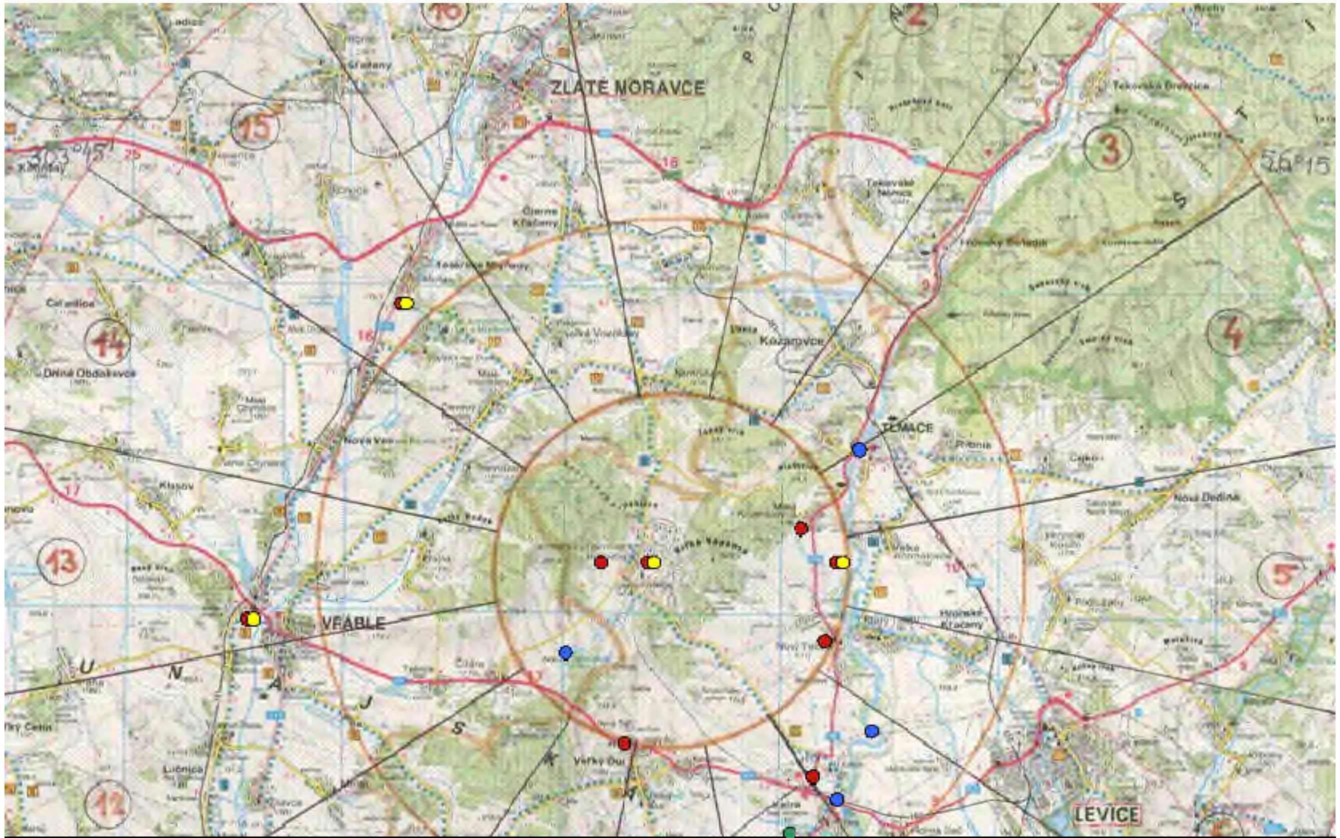
2) Slovak law does not require forced standard for the exposure of non human biota.

Table 104 - Overview of operation monitoring plan – (year 2005)

Monitored part of the environment (facility)	Setting (measurement)	Number of samples (measuring) points	Frequency of analyses (measurements)
Ionization chamber	Input dose from γ radiation in the air	14	monthly
Ionization chamber (dam V. Kozmálovce)	Input dose from γ radiation in the air	1	six-monthly
TLD	Input dose from γ radiation in the air	15	monthly
Aerosols	Gamma	15	Weekly
	Total beta activity	15	Weekly
Fall-out (collected near SDS)	Gamma	15	quarterly
	Total beta activity	15	quarterly
Soils (6x SDS)	Gamma	6	six-monthly
	Strontium	6	annually
Sediments	Gamma	4	quarterly
	Strontium	4	annually
Surface water	Gamma	8	quarterly
	Strontium, tritium	8	quarterly
	Total alfa, beta	2	quarterly
Drinking water	Gamma	5	quarterly
	Strontium, tritium	5	quarterly
Underground water (discharge pipes)	Gamma	4	six-monthly
	Strontium, tritium	4	six-monthly
Drills RK (SE - EMO)	Gamma	17	six-monthly
	Strontium, tritium	17	six-monthly
Components of the food chain	Gamma	16	annually
	Strontium	16	annually
	Tritium	1 - 2	annually
Milk	Gamma	1 - 2	Weekly

Monitored part of the environment (facility)	Setting (measurement)	Number of samples (measuring) points	Frequency of analyses (measurements)
	Strontium	1	monthly
Fish	Gamma	1	annually
	Strontium	1	annually
Meat	Gamma	1	annually
	Strontium	1	annually
Snow	Gamma	1	when it occurs
	Strontium, tritium	1	3 times per year
IN SITU Measurement	Gamma	5 localities	six-monthly
Soils IN SITU	Gamma	5 localities	six-monthly
	Strontium	5	annually
Grass IN SITU	Gamma	5 localities	six-monthly
TLD (RÚ RaO)	Input dose from γ radiation in the air	5	monthly
Ionization chamber (RÚ RaO)	Input dose from γ radiation in the air	5	monthly
Fall-out SDS (RÚ RaO)	Gamma	1	quarterly
	Total beta activity	1	quarterly
Underground water (bore holes RÚ RaO)	Gamma	6	quarterly
	Strontium, tritium	6	quarterly
Surface water (RÚ RaO)	Gamma	2	quarterly
	Strontium, tritium	2	quarterly
Sediments (RÚ RaO)	Gamma	2	quarterly
	Strontium	2	once a year
Soils (RÚ RaO)	Gamma	4	quarterly
	Strontium	4	once a year
Grass	Gamma	4	six-monthly

Monitored part of the environment (facility)	Setting (measurement)	Number of samples (measuring) points	Frequency of analyses (measurements)
(RÚ RaO)	Alpha spectrometry	4	six-monthly
	^{14}C	4	six-monthly

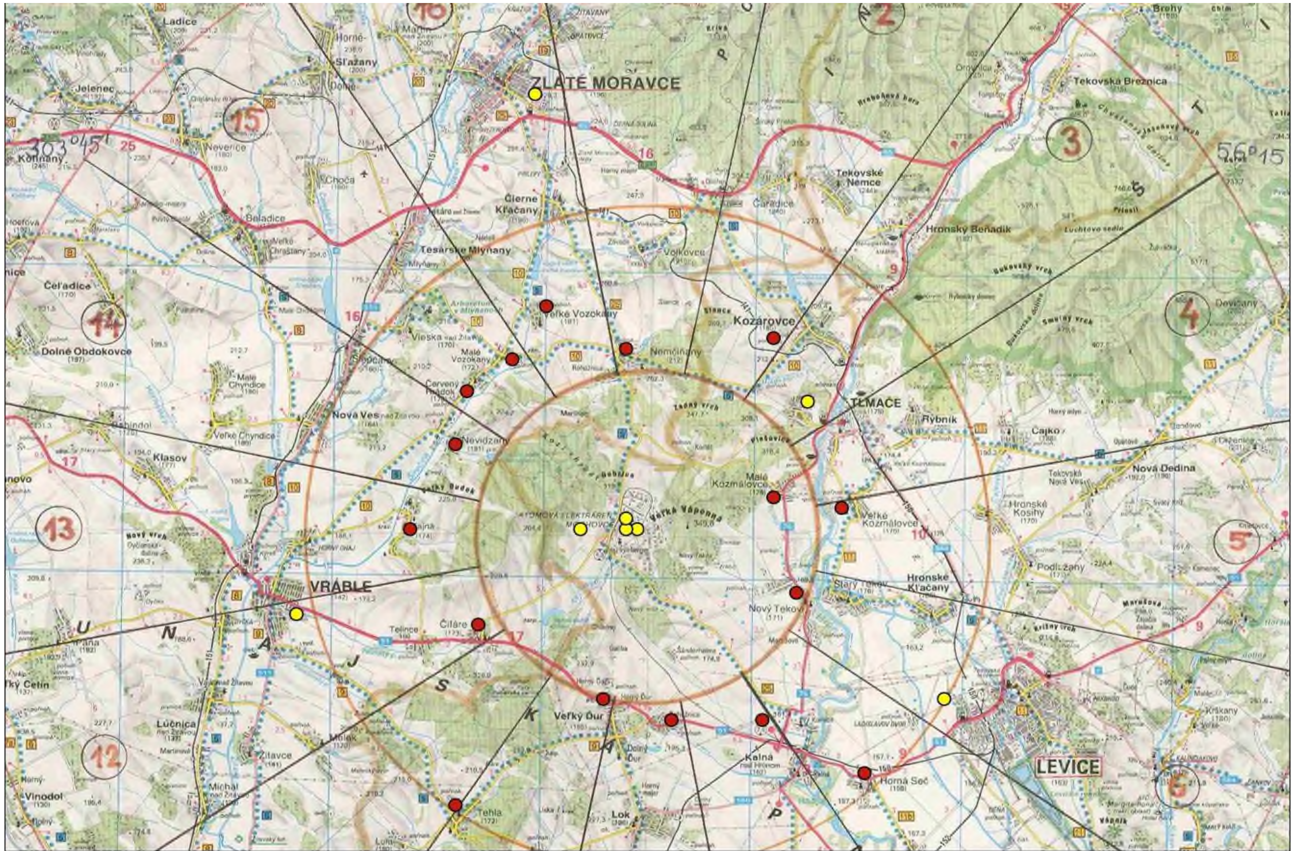


Soil – Kalná, N. Tekov, M. Kozmálovce, H. Ďur, RÚ RaO (-IV) (+ IN-SITU)
IN-SITU – N.Tekov, T. Hrádok, Vráble, T. Mlyňany, Mochovce – on-site
Sediment – Tlmače (Hron), Nový Tekov (elektráreň), Kalná n/Hronom (Hron), Čifáre (rybník)
Milk – Kalná (T. Hrádok)

Figure 48 - Map of the sampling/measuring points of soil, in situ gamma spectroscopy, sediments and milk

Figure 49 - Map of the sampling/measuring points of water (surface, drinking, and underground)

Figure 50 - Map of the SDS (Stable Dosimetry Station) location



○ **TDS** - Mochovce (3x), Levice, Tlmače, Z. Moravce, Vráble, RÚ RaO

● **TDS** – Nemčiňany, V. Vozokany, M. Vozokany, Č. Hrádok, Nevidzany, Tajná, Čifáre, Tehla, V. Ďur, Rohožnica, Kalná, H. Seč, N. Tekov, V. Kozmálovce, M. Kozmálovce, Kozárovce,

Figure 51 - Map of the TDS (Teledosimetry System) location

Around Mochovce NPP 15 SDS are located and a station is present in the locality of RR RAW (Republic Radioactive Waste Repository in Mochovce – Managed by JAVYS). The stations take off aerosol particles permanently by their absorption in the filter. Moreover, they contain a polyethylene tank for fallout collection (wet and dry together) and there are located cartridges equipped with TLD (Thermoluminescent Dosimeters) at arms installed at the stations. The environmental radiation monitoring covers an area of about 15 km from the power plant.

Dose rates of gamma radiation in the air in SDS locations are measured by HARSHAW 4500 equipment and TLD cards consisting of: 2x TLD 100 (LiF: Mg, Ti) characterized by low fading and being suitable to a long-term monitoring as for example emergency dosimeters up to 10 Gy, and 2x TLD 200 (CaF2:Dy) characterized by high fading, higher sensitivity and being suitable to a monitoring with duration of about 1 month.

The reports on monitoring of radioactivity in the SE-EMO environment contain results from both types of dosimeters. The values stated are in units of ambient dose equivalent rate H*(10). Nine other TL dosimeters are located in the Mochovce NPP area purposed on measuring the operation and emergency radiation situation.

There are 24 monitoring stations of TDS located in the vicinity of Mochovce NPP which monitor a dose rate of gamma radiation, volume activity of aerosols and radioactive iodine.

Dose rates of gamma radiation in the air are measured with RSS high pressure ionization chamber manufactured by Reuter Stokes Company. Dose rates are presented without deduction of a cosmic radiation contribution and the air pressure value corresponds with the data from the Mochovce Weather Station.

The values stated in the reports on monitoring of radioactivity in the SE-EMO environment are in units of ambient dose equivalent rate H*(10). The gamma dose rates in the air are listed without subtracting the contribution of cosmic radiation. However, the cosmic radiation contribution was measured at the Veľké Kozmálovce dam, positioning the chamber at the centre of the lake in manner to avoid the ground contribute.

Field gamma spectrometry, using a portable Germanium detector connected with a multichannel analyzer, give, from 2007 dimensional unit in Bq/kg. This unit was specified as Bq/m^2 in the previous years. Regarding the fact that the laboratory deal with specific activities, the surface activities were converted onto the specific ones. It has taken into account the average nominal weight of soil from the location specified.

Aerosols are taken off from all 15 SDS allocated around Mochovce NPP (RR RAW SDS is not equipped with the off-taking device). Aerosols are taken off via flushing equipment VOPV 200-05 installed in SDS with the temperature of inner space controlled. The overflow of flushing equipment is set on 70 m^3/hour with an exception for SDS SE-Mochovce with the overflow set on 100 m^3/hour. The filter exposition time is as of 1 week.

Fall outs are taken off from 16 stable dosimetry station locations allocated around SE EMO. They are absorbed by 10 dm^3 PE tank at the water surface through a stack hole with the diameter of 196 mm (206 mm for Vráble). Samples are taken off quarterly.

Water samples are taken off by the off-take tank. In regard of underground waters and radiation monitoring bore holes, it is used a pneumatic sampler. Water from bore holes (underground waters) of the RR RAW area is taken off by employees of JAVYS a.s. through the transportation tanks prepared by SE laboratory.

The Environmental Radiation Monitoring Laboratory (ERML) determines volume activity of individual radionuclides by gamma-spectrometry in surface and drinking waters, ERML determines also ^{3}H and ^{90}Sr activity as well as total alpha activity and total beta activity. For determining total alpha activity and total beta activity, ERML takes off samples with the volume of 1 dm^3 at two locations (upstream and downstream the outlet hole). The weekly sample off-takes from the given location are mixed into one sample that ERML evaluates once in a quarter. Surface and drinking water samples are to be taken off quarterly.

Off-takes of milk samples are provided by cooperative farm Kalná nad Hronom /Tekovský Hrádok farm/. SE laboratory prepared weekly mixed sample from daily samples off-take for gamma-spectrometry analysis. For ^{90}Sr analysis, SE laboratory prepares monthly mixed sample from weekly milk samples off-take. Liquid milk samples have been processed before performing measurements in lyophilisator.

Snow is taken off into the off-take tank with the size of 1 m^2, which is placed on the roof of the SE Laboratory in Levice. After the snow had melted at the room temperature it is treated in the same way as in waters processing and measuring for individual analyses.

Average and instantaneous dose rates in the RR RAW show usually lower values than those from other locations. According to the Radiation monitoring plan for the environment of NPP Mochovce, ERML monitors examination levels for dose rates measured by TLD and ionization chamber.

ERML takes off sedimentary deposits from the river Hron quarterly from three locations situated in Tlmače (upstream the dam V. Kozmálovce), the discharge tube downstream the dams N. Tekov and at Kalná nad Hronom.

17.1.1 Summary of radioactivity levels

Tables 105 and 106 provide a summary of radioactivity levels in the existing environment respectively in 2005 and 2006, and 2007 and 2008 in Regional, Local and Site Study Area. A more comprehensive list of measured parameters is reported in Annex 4.2.

In the table, when a measure is anticipated by the symbol "<" it means that, for that sample and in the current measurement condition (as type of instrumentation, adopted geometry, background counts etc.), the exposed value represent the Minimum Detectable Activity (MDA).

Table 105 - Summary of radioactivity levels in existing environment (2005-2006)

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2005		2006	
Radioactivity in soil (gamma spectrometry)				
^{137}Cs	Kalná n/Hronom	4.76-4.96 Bq/kg	Kalná n/Hronom	4.62-5.38 Bq/kg
	Nový Tekov	10.0-10.7 Bq/kg	Nový Tekov	10.3-13.0 Bq/kg
	Malé Kozmálovce	8.62-9.65 Bq/kg	Malé Kozmálovce	10.5-13.8 Bq/kg
	Veľký Ďur	9.72-11.6 Bq/kg	Veľký Ďur	10.7-12.7 Bq/kg
	Nemčiňany	14.5-15.0 Bq/kg		
	Č. Hrádok	53.6-56.5 Bq/kg		
^{40}K	Kalná n/Hronom	506-552 Bq/kg	Kalná n/Hronom	561-563 Bq/kg
	Nový Tekov	585-627 Bq/kg	Nový Tekov	626-633 Bq/kg
	Malé Kozmálovce	587-608 Bq/kg	Malé Kozmálovce	638-640 Bq/kg
	Veľký Ďur	561-596 Bq/kg	Veľký Ďur	596-608 Bq/kg
	Nemčiňany	572-583 Bq/kg		
	Č. Hrádok	559-585 Bq/kg		
U-rad	Kalná n/Hronom	28.8-29.6 Bq/kg	Kalná n/Hronom	31.6-37.1 Bq/kg
	Nový Tekov	33.1-34.5 Bq/kg	Nový Tekov	36.1-39.0 Bq/kg
	Malé Kozmálovce	30.4-34.2 Bq/kg	Malé Kozmálovce	35.8-39.0 Bq/kg
	Veľký Ďur	35.4-37.5 Bq/kg	Veľký Ďur	40.0-40.2 Bq/kg
	Nemčiňany	25.8-27.1 Bq/kg		
	Č. Hrádok	35.4-35.5 Bq/kg		
Th-rad	Kalná n/Hronom	33.8-35.7 Bq/kg	Kalná n/Hronom	39.5-42.7 Bq/kg
	Nový Tekov	34.3-39.0 Bq/kg	Nový Tekov	42.6-43.3 Bq/kg
	Malé Kozmálovce	34.7-40.9 Bq/kg	Malé Kozmálovce	43.8-45.0 Bq/kg
	Veľký Ďur	37.3-42.0 Bq/kg	Veľký Ďur	41.2-43.3 Bq/kg
	Nemčiňany	32.1-36.0 Bq/kg		
	Č. Hrádok	36.7-39.1 Bq/kg		
Radioactivity in soil (radiochemistry) regional area				
^{90}Sr	Kalná n/Hronom	1.7 Bq/kg	Kalná n/Hronom	2.0 Bq/kg
	Veľký Ďur	2.7 Bq/kg	Veľký Ďúr	2.3 Bq/kg
	Malé Kozmálovce	3 Bq/kg	Malé Kozmálovce	2.9 Bq/kg
	Nový Tekov	3.9 Bq/kg	Nový Tekov	2.6 Bq/kg
	Červený Hrádok	1.6 Bq/kg		
	Nemčiňany	2.8 Bq/kg		

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2005		2006	
	Radioactivity in soil (radiochemistry) – Protection area			
^{90}Sr	Tekovský Hrádok	3.7 Bq/kg	Tekovský Hrádok	3.5 Bq/kg
	Nový Tekov	3.2 Bq/kg	Nový Tekov	2.3 Bq/kg
	Tesárske Mlyňany arboretum	4.3 Bq/kg	Tesárske Mlyňany arboretum	3.0 Bq/kg
	Vráble	2 Bq/kg	Vráble	1.3 Bq/kg
	Mochovce NPP	3.9 Bq/kg	Mochovce NPP	2.0 Bq/kg
	Aerosol			
Total beta activity	SDS ERML	75-1,092 μBq/m^3	SDS ERML	156-1,049 μBq/m^3
	SDS Levice	76-1,076 μBq/m^3	SDS Levice	117-1,157 μBq/m^3
	SDS Kalná n/Hronom	119-964 μBq/m^3	SDS Kalná n/Hronom	123-1,019 μBq/m^3
	SDS Mochovce	116-934 μBq/m^3	SDS Mochovce	103-982 μBq/m^3
	SDS Čifáre	136-1,085 μBq/m^3	SDS Čifáre	127-1,013 μBq/m^3
	SDS Veľký Ďur	65-374 μBq/m^3	SDS Veľký Ďur	86-1,062 μBq/m^3
	SDS Vráble	125-1,044 μBq/m^3	SDS Vráble	77-917μBq/m^3
	SDS Tajná	121-1,001 μBq/m^3	SDS Tajná	973 μBq/m^3
	SDS Červený Hrádok	126-1,362 μBq/m^3	SDS Červený Hrádok	157-1,197 μBq/m^3
	SDS Nemčiňany	65-709 μBq/m^3	SDS Nemčiňany	79-1,115 μBq/m^3
	SDS Malé Kozmálovce	150-936 μBq/m^3	SDS Malé Kozmálovce	134-976 μBq/m^3
	SDS Nový Tekov	121-1,019 μBq/m^3	SDS Nový Tekov	114-918 μBq/m^3
	SDS Kozárovce	64-1,300 μBq/m^3	SDS Kozárovce	101-1,125 μBq/m^3
	SDS Zlaté Moravce	127-1,040 μBq/m^3	SDS Zlaté Moravce	171-1,018 μBq/m^3
	SDS Rybník	94-1,047 μBq/m^3	SDS Rybník	126-1,079 μBq/m^3
	Fall out activity			
^{137}Cs	LRKO	<1.46 Bq/m^2	LRKO	<1.62 Bq/m^2
	SDS Levice	<1.43 Bq/m^2	SDS Levice	<1.28 Bq/m^2
	Kalná n/Hronom	<1.30 Bq/m^2	Kalná n/Hronom	<1.35 Bq/m^2
	Mochovce	<1.39 Bq/m^2	Mochovce	<1.24 Bq/m^2
	Čifáre	<1.27 Bq/m^2	Čifáre	<1.42 Bq/m^2
	Veľký Ďur	<1.28 Bq/m^2	Veľký Ďur	<1.35 Bq/m^2

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2005		2006	
	Vráble	0.756 Bq/m^2	Vráble	0.710 Bq/m^2
	Tajná	<1.39 Bq/m^2	Tajná	<1.19 Bq/m^2
	Červený Hrádok	<1.41 Bq/m^2	Červený Hrádok	<1.60 Bq/m^2
	Nemčiňany	<1.36 Bq/m^2	Nemčiňany	<1.04 Bq/m^2
	Malé Kozmálovce	<1.12 Bq/m^2	Malé Kozmálovce	1.43 Bq/m^2
	Nový Tekov	<1.35 Bq/m^2	Nový Tekov	<1.25 Bq/m^2
	Kozárovce	<1.34 Bq/m^2	Kozárovce	<1.42 Bq/m^2
	Zlaté Moravce	<1.37 Bq/m^2	Zlaté Moravce	<1.06 Bq/m^2
	Rybník	<1.27 Bq/m^2	Rybník	0.504 Bq/m^2
^{40}K	LRKO	<17.1 Bq/m^2	LRKO	14.5 Bq/m^2
	SDS Levice	<15.3 Bq/m^2	SDS Levice	13.3 Bq/m^2
	Kalná n/Hronom	26.4 Bq/m^2	Kalná n/Hronom	83.7 Bq/m^2
	Mochovce	14.8 Bq/m^2	Mochovce	12.3 Bq/m^2
	Čifáre	10.4 Bq/m^2	Čifáre	23.4 Bq/m^2
	Veľký Ďur	11.3 Bq/m^2	Veľký Ďur	9.87 Bq/m^2
	Vráble	98.0 Bq/m^2	Vráble	7.93 Bq/m^2
	Tajná	15.1 Bq/m^2	Tajná	17.3 Bq/m^2
	Červený Hrádok	9.20 Bq/m^2	Červený Hrádok	12.4 Bq/m^2
	Nemčiňany	10.6 Bq/m^2	Nemčiňany	12.5 Bq/m^2
	Malé Kozmálovce	33.6 Bq/m^2	Malé Kozmálovce	50.2 Bq/m^2
	Nový Tekov	13.0 Bq/m^2	Nový Tekov	15.4 Bq/m^2
	Kozárovce	10.2 Bq/m^2	Kozárovce	34.2 Bq/m^2
	Zlaté Moravce	<14.9 Bq/m^2	Zlaté Moravce	11.0 Bq/m^2
	Rybník	11.1 Bq/m^2	Rybník	21.1 Bq/m^2
U-rad	LRKO	<3.45 Bq/m^2	LRKO	<3.96 Bq/m^2
	SDS Levice	<3.69 Bq/m^2	SDS Levice	<3.04 Bq/m^2
	Kalná n/Hronom	<3.24 Bq/m^2	Kalná n/Hronom	3.69 Bq/m^2
	Mochovce	<3.35 Bq/m^2	Mochovce	<3.10 Bq/m^2
	Čifáre	<2.80 Bq/m^2	Čifáre	5.75 Bq/m^2
	Veľký Ďur	4.13 Bq/m^2	Veľký Ďur	7.98 Bq/m^2
	Vráble	<2.97 Bq/m^2	Vráble	4.71 Bq/m^2
	Tajná	3.86 Bq/m^2	Tajná	<3.06 Bq/m^2
	Červený Hrádok	3.02 Bq/m^2	Červený Hrádok	7.36 Bq/m^2
	Nemčiňany	3.77 Bq/m^2	Nemčiňany	<2.52 Bq/m^2
	Malé Kozmálovce	3.36 Bq/m^2	Malé Kozmálovce	6.02 Bq/m^2
	Nový Tekov	5.97 Bq/m^2	Nový Tekov	5.58 Bq/m^2

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2005		2006	
	Kozárovce	3.46 Bq/m^2	Kozárovce	4.72 Bq/m^2
	Zlaté Moravce	6.08 Bq/m^2	Zlaté Moravce	2.61 Bq/m^2
	Rybník	4.12 Bq/m^2	Rybník	3.97 Bq/m^2
Th-rad	LRKO	<5.29 Bq/m^2	LRKO	<5.71 Bq/m^2
	SDS Levice	<5.13 Bq/m^2	SDS Levice	<4.26 Bq/m^2
	Kalná n/Hronom	<4.50 Bq/m^2	Kalná n/Hronom	<5.00 Bq/m^2
	Mochovce	<5.04 Bq/m^2	Mochovce	<4.46 Bq/m^2
	Čifáre	<4.74 Bq/m^2	Čifáre	<5.10 Bq/m^2
	Veľký Ďur	<4.64 Bq/m^2	Veľký Ďur	<4.50 Bq/m^2
	Vráble	<4.63 Bq/m^2	Vráble	<4.93 Bq/m^2
	Tajná	<4.79 Bq/m^2	Tajná	<4.17 Bq/m^2
	Červený Hrádok	<4.71 Bq/m^2	Červený Hrádok	<5.57 Bq/m^2
	Nemčiňany	<4.68 Bq/m^2	Nemčiňany	<3.69 Bq/m^2
	Malé Kozmálovce	<3.94 Bq/m^2	Malé Kozmálovce	<5.25 Bq/m^2
	Nový Tekov	<4.84 Bq/m^2	Nový Tekov	<4.25 Bq/m^2
	Kozárovce	<4.63 Bq/m^2	Kozárovce	<5.35 Bq/m^2
	Zlaté Moravce	<4.94 Bq/m^2	Zlaté Moravce	<3.82 Bq/m^2
	Rybník	<4.53 Bq/m^2	Rybník	<4.99 Bq/m^2
Volume activity in surface water				
^{137}Cs	Levice (Podlužianka)	<7.17 mBq/dm^3	Kalná n/Hronom (Hron)	<5.75 mBq/dm^3
	V. Kozmálovce (ČS-Perec)	<6.21 mBq/dm^3	Mochovce (Telinský potok)	<5.43 mBq/dm^3
	Kalná n/Hronom (Hron)	<5.53 mBq/dm^3	Tlmače (Hron)	<6.06 mBq/dm^3
	Mochovce (Telinský potok)	<6.26 mBq/dm^3	V. Kozmálovce (Hron-Hať)	<6.15 mBq/dm^3
	Nemčiňany (rybník)	<7.17 mBq/dm^3	V. Kozmálovce (Hron-pod výpustným otvorom)	<5.77 mBq/dm^3
	Tlmače (Hron)	<6.21 mBq/dm^3		
	V. Kozmálovce (Hron-Hať)	<6.21 mBq/dm^3		
	V. Kozmálovce (Hron-pod výpustným otvorom)	<5.49 mBq/dm^3		
^{40}K	Levice	158 mBq/dm^3	Kalná n/Hronom	143 mBq/dm^3

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2005		2006	
	(Podlužianka)		(Hron)	
	V. Kozmálovce (ČS-Perec)	151 mBq/dm^3	Mochovce (Telinský potok)	383 mBq/dm^3
	Kalná n/Hronom (Hron)	162 mBq/dm^3	Tlmače (Hron)	149 mBq/dm^3
	Mochovce (Telinský potok)	410 mBq/dm^3	V. Kozmálovce (Hron-Hať)	149 mBq/dm^3
	Nemčiňany (rybník)	158 mBq/dm^3	V. Kozmálovce (Hron-pod výpustným otvorom)	240 mBq/dm^3
	Tlmače (Hron)	151 mBq/dm^3		
	V. Kozmálovce (Hron-Hať)	151 mBq/dm^3		
	V. Kozmálovce (Hron-pod výpustným otvorom)	185 mBq/dm^3		
U-rad	Levice (Podlužianka)	19.9 mBq/dm^3	Kalná n/Hronom (Hron)	30.6 mBq/dm^3
	V. Kozmálovce (ČS-Perec)	<15.0 mBq/dm^3	Mochovce (Telinský potok)	13.8 mBq/dm^3
	Kalná n/Hronom (Hron)	<12.6 mBq/dm^3	Tlmače (Hron)	22.6 mBq/dm^3
	Mochovce (Telinský potok)	<15.9 mBq/dm^3	V. Kozmálovce (Hron-Hať)	17.1 mBq/dm^3
	Nemčiňany (rybník)	19.9 mBq/dm^3	V. Kozmálovce (Hron-pod výpustným otvorom)	30.4 mBq/dm^3
	Tlmače (Hron)	<15.0 mBq/dm^3		
	V. Kozmálovce (Hron-Hať)	<15.0 mBq/dm^3		
	V. Kozmálovce (Hron-pod výpustným otvorom)	<12.4 mBq/dm^3		
Th-rad	Levice (Podlužianka)	<25.1 mBq/dm^3	Kalná n/Hronom (Hron)	<18.9 mBq/dm^3
	V. Kozmálovce (ČS-Perec)	<21.0 mBq/dm^3	Mochovce (Telinský potok)	<20.1 mBq/dm^3
	Kalná n/Hronom (Hron)	<19.9 mBq/dm^3	Tlmače (Hron)	<20.7 mBq/dm^3

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2005		2006	
	Mochovce (Telinský potok)	<21.8 mBq/dm^3	V. Kozmálovce (Hron-Hať)	<22.5 mBq/dm^3
	Nemčiňany (rybník)	<25.1 mBq/dm^3	V. Kozmálovce (Hron-pod výpustným otvorom)	<20.3 mBq/dm^3
	Tlmače (Hron)	<21.0 mBq/dm^3		
	V. Kozmálovce (Hron-Hať)	<21.0 mBq/dm^3		
	V. Kozmálovce (Hron-pod výpustným otvorom)	<19.7 mBq/dm^3		
^3H	Levice (Podlužianka)	1.0-2.9 Bq/dm^3	Kalná n/Hronom (Hron)	1.0-5.7 Bq/dm^3
	V. Kozmálovce (ČS-Perec)	1.0-2.7 Bq/dm^3	Mochovce (Telinský potok)	1.0-3.1 Bq/dm^3
	Kalná n/Hronom (Hron)	1.0-3.6 Bq/dm^3	Tlmače (Hron)	1.0-4.3 Bq/dm^3
	Mochovce (Telinský potok)	1.0-1.1 Bq/dm^3	V. Kozmálovce (Hron-Hať)	1.0-2.0 Bq/dm^3
	Nemčiňany (rybník)	1.0-2.0 Bq/dm^3	V. Kozmálovce (Hron-pod výpustným otvorom)	1.0-1.5 Bq/dm^3
	Tlmače (Hron)	1.0-5.0 Bq/dm^3	Čifáre (rybník)	1.0-1.3 Bq/dm^3
	V. Kozmálovce (Hron-Hať)	1.0-2.0 Bq/dm^3		
	V. Kozmálovce (Hron-pod výpustným otvorom)	1.0 Bq/dm^3		

Table 106 - Summary of radioactivity levels in existing environment (2007-2008)

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2007		2008	
Radioactivity in soil (gamma spectrometry)				
^{137}Cs	Kalná n/Hronom	4.56-5.23 Bq/kg	Kalná n/Hronom	5.23-5.39 Bq/kg
	Nový Tekov	9.85-10.90 Bq/kg	Nový Tekov	5.92-12.10 Bq/kg
	Malé Kozmálovce	9.13-12.50 Bq/kg	Malé Kozmálovce	13.3-17.3 Bq/kg
	Veľký Ďur	10.4-14.2 Bq/kg	Veľký Ďur	10.1-11.0 Bq/kg
^{40}K	Kalná n/Hronom	555-567 Bq/kg	Kalná n/Hronom	538-558 Bq/kg
	Nový Tekov	616-631 Bq/kg	Nový Tekov	595-641 Bq/kg
	Malé Kozmálovce	632-651 Bq/kg	Malé Kozmálovce	624-629 Bq/kg
	Veľký Ďur	595-597 Bq/kg	Veľký Ďur	585-604 Bq/kg
U-rad	Kalná n/Hronom	33.3-35.6 Bq/kg	Kalná n/Hronom	33.4-34.9 Bq/kg
	Nový Tekov	37.3-39.4 Bq/kg	Nový Tekov	37.5-39.7 Bq/kg
	Malé Kozmálovce	36.7-38.5 Bq/kg	Malé Kozmálovce	36.2-38.7 Bq/kg
	Veľký Ďur	38.1-40.1 Bq/kg	Veľký Ďur	39.0-39.3 Bq/kg
Th-rad	Kalná n/Hronom	41.7-41.9 Bq/kg	Kalná n/Hronom	40.9-42.4 Bq/kg
	Nový Tekov	43.1-43.5 Bq/kg	Nový Tekov	41.3-44.9 Bq/kg
	Malé Kozmálovce	42.5-44.1 Bq/kg	Malé Kozmálovce	42.7-43.8 Bq/kg
	Veľký Ďur	42.5-43.0 Bq/kg	Veľký Ďur	41.9-44.3 Bq/kg
Radioactivity in soil (radiochemistry) regional area				
^{90}Sr	Kalná n/Hronom	2.0 Bq/kg	Kalná n/Hronom	1.1 Bq/kg
	Veľký Ďur	2.3 Bq/kg	Veľký Ďur	2.3 Bq/kg
	Malé Kozmálovce	2.0 Bq/kg	Malé Kozmálovce	1.8 Bq/kg
	Nový Tekov	2.8 Bq/kg	Nový Tekov	2.0 Bq/kg
Radioactivity in soil (radiochemistry) – Protection area				
^{90}Sr	Tekovský Hrádok	2.9 Bq/kg	Tekovský Hrádok	2.4 Bq/kg
	Nový Tekov	3.0 Bq/kg	Nový Tekov	
	Tesárske Mlyňany arborétum	3.2 Bq/kg	Tesárske Mlyňany arborétum	3.3 Bq/kg
	Vráble	1.6 Bq/kg	Vráble	1.8 Bq/kg
	Mochovce NPP	1.4 Bq/kg	Mochovce NPP	0.8 Bq/kg
Aerosol				
Celková	SDS LRKO	55-514 $\mu Bq/m^3$	SDS LRKO	120-733 $\mu Bq/m^3$

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2007		2008	
	SDS Levice	99-514 μBq/m³	SDS Levice	102-478 μBq/m³
	SDS Kalná n/Hronom	68-437 μBq/m³	SDS Kalná n/Hronom	76-586 μBq/m³
	SDS Mochovce	22-515 μBq/m³	SDS Mochovce	109-574 μBq/m³
	SDS Čifáre	31-434 μBq/m³	SDS Čifáre	74-522 μBq/m³
	SDS Veľký Ďur	67-495 μBq/m³	SDS Veľký Ďur	78-454 μBq/m³
	SDS Vráble	43-495 μBq/m³	SDS Vráble	64-444 μBq/m³
	SDS Tajná	62-526 μBq/m³	SDS Tajná	65-443 μBq/m³
	SDS Červený Hrádok	39-469 μBq/m³	SDS Červený Hrádok	98-515 μBq/m³
	SDS Nemčiňany	49-591 μBq/m³	SDS Nemčiňany	109-506 μBq/m³
	SDS Malé Kozmálovce	34-500 μBq/m³	SDS Malé Kozmálovce	67-422 μBq/m³
	SDS Nový Tekov	42-471 μBq/m³	SDS Nový Tekov	80-467 μBq/m³
	SDS Kozárovce	43-606 μBq/m³	SDS Kozárovce	81-557 μBq/m³
	SDS Zlaté Moravce	51-412 μBq/m³	SDS Zlaté Moravce	77-521 μBq/m³
	SDS Rybník	48-537 μBq/m³	SDS Rybník	47-472 μBq/m³
Fall out activity				
^{137}Cs	LRKO	<1.66 Bq/m²	LRKO	<1.58 Bq/m²
	SDS Levice	<1.27 Bq/m²	SDS Levice	<1.25 Bq/m²
	Kalná n/Hronom	<1.44 Bq/m²	Kalná n/Hronom	<1.44 Bq/m²
	Mochovce	<1.38 Bq/m²	Mochovce	<1.28 Bq/m²
	Čifáre	<1.43 Bq/m²	Čifáre	<1.31 Bq/m²
	Veľký Ďur	<1.32 Bq/m²	Veľký Ďur	<1.20 Bq/m²
	Vráble	0,939 Bq/m²	Vráble	<1.34 Bq/m²
	Tajná	<1.12 Bq/m²	Tajná	<1.32 Bq/m²
	Červený Hrádok	<1.44 Bq/m²	Červený Hrádok	<1.34 Bq/m²
	Nemčiňany	<1.32 Bq/m²	Nemčiňany	<1.21 Bq/m²
	Malé Kozmálovce	1.25 Bq/m²	Malé Kozmálovce	<1.24 Bq/m²
	Nový Tekov	<1.29 Bq/m²	Nový Tekov	<1.19 Bq/m²
	Kozárovce	<1.35 Bq/m²	Kozárovce	<1.19 Bq/m²
	Zlaté Moravce	<1.45 Bq/m²	Zlaté Moravce	<1.21 Bq/m²
	Rybník	<1.46 Bq/m²	Rybník	<1.26 Bq/m²
^{40}K	LRKO	13.3 Bq/m²	LRKO	13.5 Bq/m²
	SDS Levice	13.5 Bq/m²	SDS Levice	14.4 Bq/m²
	Kalná n/Hronom	13.9 Bq/m²	Kalná n/Hronom	33.4 Bq/m²
	Mochovce	13.4 Bq/m²	Mochovce	21.3 Bq/m²

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2007		2008	
	Čifáre	15.3 Bq/m^2	Čifáre	20.1 Bq/m^2
	Veľký Ďur	7.14 Bq/m^2	Veľký Ďur	14.7 Bq/m^2
	Vráble	15.9 Bq/m^2	Vráble	18.2 Bq/m^2
	Tajná	16.7 Bq/m^2	Tajná	112 Bq/m^2
	Červený Hrádok	15.1 Bq/m^2	Červený Hrádok	19.1 Bq/m^2
	Nemčiňany	15.9 Bq/m^2	Nemčiňany	12.5 Bq/m^2
	Malé Kozmálovce	32.6 Bq/m^2	Malé Kozmálovce	12.8 Bq/m^2
	Nový Tekov	16.0 Bq/m^2	Nový Tekov	29.0 Bq/m^2
	Kozárovce	20.3 Bq/m^2	Kozárovce	45.4 Bq/m^2
	Zlaté Moravce	12.5 Bq/m^2	Zlaté Moravce	9.93 Bq/m^2
	Rybník	21.4 Bq/m^2	Rybník	12.9 Bq/m^2
U-rad	LRKO	10.5 Bq/m^2	LRKO	<3.75 Bq/m^2
	SDS Levice	3.32 Bq/m^2	SDS Levice	<3.33 Bq/m^2
	Kalná n/Hronom	4.24 Bq/m^2	Kalná n/Hronom	<3.44 Bq/m^2
	Mochovce	<3.27 Bq/m^2	Mochovce	<3.46 Bq/m^2
	Čifáre	7.77 Bq/m^2	Čifáre	<3.49 Bq/m^2
	Veľký Ďur	<3.27 Bq/m^2	Veľký Ďur	<3.11 Bq/m^2
	Vráble	2.36 Bq/m^2	Vráble	<3.39 Bq/m^2
	Tajná	<2.83 Bq/m^2	Tajná	<3.66 Bq/m^2
	Červený Hrádok	3.89 Bq/m^2	Červený Hrádok	<3.31 Bq/m^2
	Nemčiňany	4.76 Bq/m^2	Nemčiňany	4.37 Bq/m^2
	Malé Kozmálovce	<3.73 Bq/m^2	Malé Kozmálovce	<3.05 Bq/m^2
	Nový Tekov	<3.16 Bq/m^2	Nový Tekov	<3.27 Bq/m^2
	Kozárovce	4.59 Bq/m^2	Kozárovce	<3.25 Bq/m^2
	Zlaté Moravce	3.57 Bq/m^2	Zlaté Moravce	<3.11 Bq/m^2
	Rybník	4.51 Bq/m^2	Rybník	<3.26 Bq/m^2
Th-rad	LRKO	<5.26 Bq/m^2	LRKO	<5.29 Bq/m^2
	SDS Levice	<4.15 Bq/m^2	SDS Levice	<4.56 Bq/m^2
	Kalná n/Hronom	<5.14 Bq/m^2	Kalná n/Hronom	<4.90 Bq/m^2
	Mochovce	<4.70 Bq/m^2	Mochovce	<4.43 Bq/m^2
	Čifáre	<5.13 Bq/m^2	Čifáre	<4.75 Bq/m^2
	Veľký Ďur	<4.65 Bq/m^2	Veľký Ďur	<4.11 Bq/m^2
	Vráble	<5.14 Bq/m^2	Vráble	<4.44 Bq/m^2
	Tajná	<4.14 Bq/m^2	Tajná	<4.71 Bq/m^2
	Červený Hrádok	<5.29 Bq/m^2	Červený Hrádok	<4.61 Bq/m^2
	Nemčiňany	<4.11 Bq/m^2	Nemčiňany	<4.12 Bq/m^2

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2007		2008	
	Malé Kozmálovce	<5.12 Bq/m^2	Malé Kozmálovce	<4.30 Bq/m^2
	Nový Tekov	<4.42 Bq/m^2	Nový Tekov	<4.24 Bq/m^2
	Kozárovce	<5.04 Bq/m^2	Kozárovce	<4.24 Bq/m^2
	Zlaté Moravce	<4.95 Bq/m^2	Zlaté Moravce	<4.44 Bq/m^2
	Rybník	<5.01 Bq/m^2	Rybník	<4.10 Bq/m^2
Volume activity in surface water				
^{137}Cs	Kalná n/Hronom (Hron)	3.48 mBq/dm^3	Kalná n/Hronom (Hron)	<6.16 mBq/dm^3
	Mochovce (Telinský potok)	4.36 mBq/dm^3	Mochovce (Telinský potok)	3.03 mBq/dm^3
	Tlmače (Hron)	2.82 mBq/dm^3	Tlmače (Hron)	<6.15 mBq/dm^3
	V. Kozmálovce (Hron-Hať)	2.67 mBq/dm^3	V. Kozmálovce (Hron-Hať)	3.84 mBq/dm^3
	V. Kozmálovce (Hron - pod výpustným otvorom)	5.52 mBq/dm^3	V. Kozmálovce (Hron - pod výpustným otvorom)	<6.15 mBq/dm^3
^{40}K	Kalná n/Hronom (Hron)	179 mBq/dm^3	Kalná n/Hronom (Hron)	137 mBq/dm^3
	Mochovce (Telinský potok)	453 mBq/dm^3	Mochovce (Telinský potok)	390 mBq/dm^3
	Tlmače (Hron)	122 mBq/dm^3	Tlmače (Hron)	131 mBq/dm^3
	V. Kozmálovce (Hron-Hať)	125 mBq/dm^3	V. Kozmálovce (Hron-Hať)	133 mBq/dm^3
	V. Kozmálovce (Hron - pod výpustným otvorom)	339 mBq/dm^3	V. Kozmálovce (Hron - pod výpustným otvorom)	310 mBq/dm^3
U-rad	Kalná n/Hronom (Hron)	25.5 mBq/dm^3	Kalná n/Hronom (Hron)	20.8 mBq/dm^3
	Mochovce (Telinský potok)	25.8 mBq/dm^3	Mochovce (Telinský potok)	<15.8 mBq/dm^3
	Tlmače (Hron)	23.0 mBq/dm^3	Tlmače (Hron)	<18.9 mBq/dm^3
	V. Kozmálovce (Hron-Hať)	20.6 mBq/dm^3	V. Kozmálovce (Hron-Hať)	30.6 mBq/dm^3
	V. Kozmálovce (Hron - pod výpustným otvorom)	21.0 mBq/dm^3	V. Kozmálovce (Hron - pod výpustným otvorom)	30.1 mBq/dm^3
Th-rad	Kalná n/Hronom (Hron)	<18.7 mBq/dm^3	Kalná n/Hronom (Hron)	<22.1 mBq/dm^3

Source	Radioactivity in environmental samples in Regional, Local and Site study area			
	2007		2008	
	Mochovce (Telinský potok)	12.8 mBq/dm^3	Mochovce (Telinský potok)	<21.1 mBq/dm^3
	Tlmače (Hron)	<20.2 mBq/dm^3	Tlmače (Hron)	<22.6 mBq/dm^3
	V. Kozmálovce (Hron-Hať)	<22.5 mBq/dm^3	V. Kozmálovce (Hron-Hať)	<23.0 mBq/dm^3
	V. Kozmálovce (Hron - pod výpustným otvorom)	<20.1 mBq/dm^3	V. Kozmálovce (Hron - pod výpustným otvorom)	<22.0 mBq/dm^3
^3H	Kalná n/Hronom (Hron)	1.1-6.3 Bq/dm^3	Kalná n/Hronom (Hron)	1.6-8.1 Bq/dm^3
	Mochovce (Telinský potok)	1.0-4.7 Bq/dm^3	Mochovce (Telinský potok)	1.1-6.0 Bq/dm^3
	Tlmače (Hron)	1.0-5.5 Bq/dm^3	Tlmače (Hron)	1.1-4.9 Bq/dm^3
	V. Kozmálovce (Hron-Hať)	1.0-4.9 Bq/dm^3	V. Kozmálovce (Hron-Hať)	1.0-4.7 Bq/dm^3
	V. Kozmálovce (Hron - pod výpustným otvorom)	1.0-3.0 Bq/dm^3	V. Kozmálovce (Hron - pod výpustným otvorom)	1.0-3.0 Bq/dm^3
	Čifáre (rybník)	1.0-2.4 Bq/dm^3	Čifáre (rybník)	1.0-3.0 Bq/dm^3

18.0 ASSESSMENT OF ANTICIPATED AREA DEVELOPMENT IF THE PROPOSED ACTIVITY WAS NOT UNDERTAKEN

The site location for the construction of the four units at Mochovce was determined based on a land use decision and the subsequent construction permit.

Mochovce NPP was designed and its construction has been launched and realized as a four-unit NPP with common technological components.

The area is not expected to develop in a way other than how it will be with Units 3 and 4, due to the presence of Units 1 and 2 that prevent the area from developing in any other way.

19.0 COMPLIANCE BETWEEN PROPOSED ACTIVITY AND PHYSICAL-PLANNING DOCUMENTATION IN FORCE

The history of construction of the nuclear power plant follows the regional planning process which provides a methodical and completely functional solution for the given location and defines the organization principles and material and time coordination of the construction of the installation in Mochovce. Regional planning process included not only maintenance of long-term harmony between natural and cultural values of this region, but it also focused on care for and protection of human health and of the main environmental components – soil, water and air.

The site location for the construction of the four units at Mochovce was determined based on a land use decision and the subsequent construction permit.

Mochovce NPP was designed and its construction has been launched and realized as a four-unit NPP with common technological components.

The proposed activity will take place in an area whose functional utilization was approved for these activities in 2004 in the valid town and country plan of the territorial unit of the region of Nitra – amendments and supplements. The site of Mochovce is classified, from an urbanization point of view (residential structure), as an “area for industry, civil engineering and warehousing activity” (map and legend included in Annex 2.2).

A further related land use planning document is the town and country plan of the village of Kalná nad Hronom.

Further details regarding planning documentation are reported in the chapter “Programmatic Framework” of the Present Report.

III EVALUATION OF ANTICIPATED ENVIRONMENTAL IMPACTS OF PROPOSED ACTIVITY, INCLUDING HEALTH

Likely impacts of Proposed Activity have been evaluated following the methodology described in Section C, Part VII of the present report. In particular, for each considered Environmental Component, likely effects on valued ecosystem components (VECs) have been identified and assessed.

In the following chapters, results of assessment process are reported.

1.0 IMPACTS ON POPULATION

Likely impacts on population are described in terms of human health and member of the public, which are the VECs identified for Atmospheric Environment and Hydrology and Groundwater.

Likely impacts on population are also described as it concerns the Socio Economic Conditions.

Therefore, the results of the assessment process for impacts on population can be found in paragraphs concerning Impacts on Air (Section C, part III, chapter 4.0), Impacts on water conditions (Section C, part III, chapter 5.0) and Other Impacts (Section C, part III, chapter 15.0).

In the following paragraphs a description of radiation and radioactivity sources in the environment, remarks to the doses evaluation methodology, and an analysis of the likely impact on health population in selected districts of Slovak Republic are reported.

1.1 Sources of radioactivity

The radiation and radioactivity environment includes natural (cosmic radiation, solar radiation, external terrestrial sources) and anthropogenic sources (in this case the operation of the Mochovce NPP).

Regardless of where people live and work, they are exposed to natural sources of radiation. The magnitude of radiations dose from natural sources varies greatly, both spatial and temporally, and is mainly attributable to:

- ionizing radiation from cosmic rays;
- naturally occurring radionuclides in air and water; and
- gamma radiation from radioactive material in the soil, rocks and building materials.

Mochovce NPP emits into the atmosphere through the monitored chimney that serves both the ventilation system (see Section 5.6.2 “Ventilation system and treatment of the gaseous and airborne wastes“) of units 1 and 2 (the second chimney will serve units 3 and 4), the radioactive gas deriving from gas cleaning system following the degassing of the primary circuit and the off gas deriving from the liquid radioactive waste treatment facility (LRAWTF). In fact this facility does not have a direct air emission but its ventilation system is connected to the main ventilation system of Units 1 and 2. The pathway from the LRAWTF to the ventilation system of the NPP is also monitored independently.

The liquid radioactive discharges derive from waste water cleaning system and LRAWTF: all the liquid waste are subjected to radiological and chemical controls and only when their quality conforms to prescribed limit values, they are released into the environment.

Table 107 presents the evaluation criteria used to assess the likely effects on the Radiation and Radioactivity Environment.

Table 107 - Criteria used in evaluation of likely effects on radiation and radioactivity

Radiation and Radioactivity Subcomponent	Evaluation Criteria
Radiation Dose to Members of the Public	▪ ICRP guidelines ▪ Regulatory limits on annual dose ▪ Ordinance of the Government No. 345/2006 Coll.
Radioactivity in the Atmosphere	▪ ICRP guidelines ▪ Ordinance of the Government No. 345/2006 Coll.
Radioactivity in Surface Water	▪ ICRP guidelines ▪ Ordinance of the Government No. 345/2006 Coll. ▪ Ordinance of the Government No. 296/2005 Coll.
Radioactivity in Groundwater	▪ ICRP guidelines ▪ Ordinance of the Government No 296/2005 Coll. on Surface water, groundwater and wastewater ▪ Ordinance of the Government No. 345/2006 Coll.
Radioactivity in the Terrestrial Environment	▪ ICRP guidelines ▪ Ordinance of the Government No. 345/2006 Coll.

1.2 Total annual limits for discharges from EMO12 and MO34

Gaseous radioactive substances are released into the atmosphere through the venting stacks while the liquid radioactive substances are released from the waste water treatment facilities.

Discharges of radionuclides into the environment are assessed according to the following requirements:

- limits for radioactive discharges; and
- limits for the population doses.

Limits for radioactive emissions into atmosphere and hydrosphere will be authorized by the Public Health Authority before starting operation of MO34 based on the criterion that the radiation limit of 250 μSv/year (to the critical group of inhabitants(5)) shall not be exceeded (Ordinance of the Government No. 345/2006 Coll.).

Currently, the annual limits reported in Tables 108 and 109 for different types of radionuclides are set for EMO12:

Table 108 - Discharges from ventilation chimney

ISOTOPES	ANNUAL LIMIT [Bq]
Radioactive noble gases	4.1×10^{15}
Iodine^{131} (in gas and aerosol form)	6.7×10^{10}
Long-lived aerosols (half-life>8 days)	1.7×10^{11}

Table 109 - Discharges from water treatment facilities

ISOTOPES	ANNUAL LIMIT [Bq]
Tritium	1.2×10^{13}
Other radionuclides	1.1×10^{9}

During the operation of Units 1 and 2 (from the very beginning) the emission values have always attained only from a tenth to a thousandth percents of the yearly limits for the gaseous discharges and maximum tens of percent for liquid discharges, and it can be supposed that the emissions from Units 3 and 4 will follow this trend.

Yearly limits, reference investigation levels and intervention levels for radioactive airborne release under normal condition for EMO12 are presented in

(5) Critical group is defined as the group of people (living in the sorroundings of the NPP) who is thought to have the greatest exposure to radiation from authorised discharged.

the Design Framework, chapter 2.9.1 “Permit to release gaseous radioactive substances into the environment”.

With regard to limits for the population doses, the environmental annual reports prepared by Slovenské Elektrárne for Mochovce NPP show that, during the last eleven years of operation, the maximum values of the annual effective doses are negligible compared with the annual limits (much less than 1% of allowed values).

1.3 Plant operating conditions for VVERs

Plant states considered in the design basis are treated differently depending on their probabilities of occurrence and their consequences. The following four groups are usually distinguished to be used in the design analyses.

It has to be noted that the frequencies reported in this sections are the frequencies of occurrences of failures which perturb the normal state of the plant (the so-called initiating events, or IEs), bringing the plant to an abnormal/accidental state in which the transients generated by the IE challenge the integrity of the physical barriers which prevent the release of radioactive material into the environment. The challenge can be of different severity but, in any case, unless unlikely, unfavourable combinations of subsequent failures occur in the plant, the plant safety systems are able to bring the unit to a safe state. For this reason, the frequencies associated with the Design Basis Conditions are much higher than the frequencies of occurrence of scenarios actually leading to core damage (severe accidents) and hence to significant radioactive releases (see box “Safety Assessment related to accidental conditions”).

- **Normal operational states**

They include all occurrences that are expected frequently or regularly in the course of normal operation of the plant. All operations or occurrences specific to normal conditions of the plant are considered: power operation or manoeuvring of the plant, maintenance, testing and refuelling. The occurrences included in this group do not violate so-called "Operational Limits and Conditions" established for the plant. The most typical items of this group are for example:

  - transition from cold shutdown to hot shutdown state;
  - planned shutdown of the plant;
  - tightening of bolts and studs.

Frequencies of occurrence for plant states of this group are usually greater than 1 per reactor/year.

- **Anticipated operational occurrences**

Plant states classified into this group include all operational processes deviating from normal operation, which are expected to occur once or several times during the operating life of the plant. Generally, the occurrences of this group do not cause any significant damage to items important to safety nor lead to accident conditions. The most important plant conditions included in this group, with allowable number of occurrences assumed in the design, are for example:

- loss of off-site power;
- rupture of steam generator tube;
- loss of primary circuit make-up;
- spurious opening of SG feedwater isolating valve;
- spurious reactor scram;
- small LOCA compensated by normal make-up.

Frequencies of occurrence for plant states belonging to this group are usually in the range of 10^{-2} per reactor/year; however, some plant states of this group are estimated to be less frequent (range of 10^{-2} – 10^{-4}). Conditions classified as belonging to this group are usually included in the list of the design basis accidents.

- **Accident conditions**

Accident conditions are defined as deviations from operational states which are not expected to occur, but are postulated because their consequences would include the potential for the release of a significant amount of radioactive-material. Design basis accidents (DBAs) are the most drastic accident conditions that the plant must be designed to cope with. For these conditions the releases of radioactive materials are kept within acceptable limits, owing to the appropriate design of the plant. Plant conditions included in this group are defined by specifying the initiating event and by describing the appropriate availability of plant systems. Single failure criterion and other general design principles are applied in this definition. Postulated events that initiate the most significant accidents classified as design basis accidents are for example:

- spectrum of large/small break LOCAs caused by postulated ruptures of primary circuit piping;
- spectrum of various steam lines ruptures inside and outside the containment (including rupture of single SG tube);
- spurious opening of pressurizer safety valve or safety relief valve;

Frequencies of postulated initiating events (PIEs) included in this group are usually in the range of 10^{-2} – 10^{-6} events per reactor/year. Evolution of an accident sequence classified as DBA may lead to plant states in which the availability of plant systems is reduced below the design basis conditions. These accident states exceeding design basis are called Beyond Design Basis Accidents (BDBAs). It should be pointed out that in view of appropriate design provisions and existing design margins, not all BDBA conditions will necessarily lead to excess radioactivity releases.

- **Severe accidents beyond design basis**

Accidents in which the releases of radioactive materials exceed acceptable design limits, including those causing significant core degradation, are called severe accidents. In current safety philosophy these accidents are considered in the design in a limited way. According to this approach, accident management measures are established, aiming at the reduction of likelihood of severe accidents or at the mitigation of consequences of these events. Some representative severe accident sequences are selected and analyzed in this context in the project.

1.4 Remarks to the doses evaluation methodology

The main safety objective of a nuclear power plant is to ensure that its operation does not cause radiation hazards to population in the vicinity nor could otherwise harm the environment. The radiation exposure arising from the operation of a nuclear power plant shall be kept as low as reasonably achievable (ALARA principle).

The amount of radioactivity emitted during normal operation of nuclear power plants is very small as compared to radiation background which exists naturally in the environment. For these reasons, the doses conferred to population cannot be directly measured but only assessed on the basis of the possible pathways of exposure for the public.

Radiation doses deriving from both internal and external irradiation as a consequence of atmospheric and aquatic discharges of radioactive materials. The following Figure 52 shows the exposure pathways that are to be considered, primarily in air, drinking water, agricultural products and natural foodstuff.

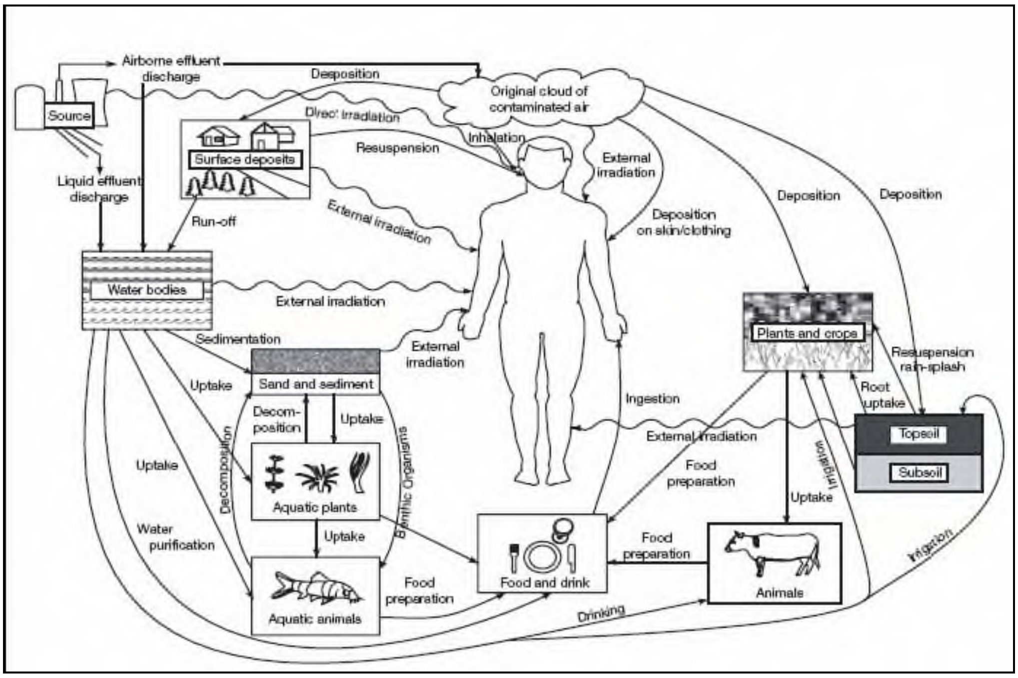


Figure 52 - The possible pathways of exposure for the public as a result of discharges of radioactive material to the environment

The methods for assessing radiation doses to the population around a nuclear power plant shall be reliable and conservative; therefore the models, calculation methods and computer programmes used for these purposes, shall be sufficiently qualified. Typically, the assessment involves a combination of measurement on environmental indicators (water, sediments, air, etc.) and modelled data. Often, the calculated radioactivity level into the environment is below the analytical limits of detection.

In the following, radiological impacts in normal operational states and in anticipated operational occurrences (in practice deriving from the usually low radioactive discharges during normal operational states and, for anticipated operational occurrences, conservatively assumed as 100% of the permitted limit values) on surrounding population (in terms of doses) will be estimated for the simultaneous operation of the four units. The assessment of radiological impact (Annex 4.1) was done by means of the deterministic code RDEMO©.

Doses to population due to accidental conditions (DBA) will be taken conservatively from POSAR of EMO12, where the last assessments of radiological impact were done by means of code RTARC©. The doses indicated in the following are obviously referred to an accident occurring to only one unit, in the direction of blowing wind.

Realistically, for the dose commitment, while for normal operating conditions operation of four units is considered, in accident condition only one unit is considered in failure.

For a better comprehension of the results shown in the following, two things have to be pointed out:

- the highest radiological consequences are associated to incidental scenarios whose expected frequency of occurrence is generally extremely low. In fact, the plant has been designed and will be built in such a way that the events with the highest radiological consequences (i.e., severe accident scenarios) are extremely unlikely, as they are estimated to occur less than once every $1×10^6$ years.

- The doses in case of accident shown in this chapter, although already considerably low, refer to EMO12 POSAR and hence have to be regarded as an upper bound for the estimation of the real doses associated with MO34 accidental events. In fact, the performed revision of the MO34 Basic Design has led to the identification of several safety improvements (which have not been implemented yet in EMO12) and to a reduced leak-rate from containment, which will contribute to further reduce the radiological consequences of MO34 accidental conditions. Due to these reasons, new lower dose targets will be considered for radiological impact during DBA conditions of MO34 with respect to the values previously considered for EMO12.

1.5 Radiation doses to members of the public

As anticipated at the beginning of Section C, part III, chapter 1.0, in the following it will be estimated the radiological impact on surrounding population (in terms of doses) in normal operational states and in anticipated operational occurrences taking into account the simultaneous operation of the four units. In the simulation, discharge values and meteorological data from 2006, 2007 and 2008 have been used.

The assessment of the radiological impact was done by the deterministic code RDEMO©.

To estimate the emissions of radionuclides into the atmosphere and hydrosphere in the full configuration (EMO12 and MO34), as well as the radiological situation in the environment around the power plant and the expected effects on inhabitants, an evaluation based on observations at the two reference units (EMO12) was used.

The assessment is reported in the "Assessment of the Radiological Impact of the Radioactive Discharges from Operation of 4 Reactors NPP Mochovce – 1st revision" (SE Report B0120/Spec/2007/6-1; Annex 4.1).

Simulation was performed, much conservatively, for an area with a 60 km radius around Mochovce NPP, in the Slovak Republic territory, in which there are approximately 1.2 million inhabitants.

1.5.1 Radiation doses deriving from normal operation

The analysis of doses to the surrounding population was made on the basis of the radioactive discharges into the atmosphere and hydrosphere during 2006, 2007 and 2008 from operation of EMO12. These discharge data are of the same order of magnitude of data from the last operational years with regard to discharged activity and radio nuclide composition.

RAS discharges from operation of units 3 and 4 are assumed to be on the same level. Balance data of discharged activity for individual radio nuclides were extrapolated by doubling the value of current discharges from operation of NPP Mochovce units 1 and 2 (due to increased amount of reactors from two to four) and then used in the calculation. For example, the list of radio nuclides and their activities given in Table 110, has been obtained doubling the RAS discharges of EMO12 in 2008.

Table 110 - Radionuclides and their activities used for calculation of radiological impact during normal operation for 2008 year

Radionuclides	Atmosphere	Hydrosphere
	[Bq]	
^{3}H	1.168E+12	1.571E+13
^{14}C CO_2	3.786E+10	0.000E+00
^{14}C C_nH_m	6.576E+11	0.000E+00
^{41}Ar	1.736E+12	0.000E+00
^{85}Kr	7.747E+11	0.000E+00
^{85m}Kr	1.812E+10	0.000E+00
^{87}Kr	5.750E+10	0.000E+00
^{88}Kr	5.585E+10	0.000E+00
^{131m}Xe	1.564E+11	0.000E+00
^{133}Xe	5.133E+10	0.000E+00
^{133m}Xe	3.099E+10	0.000E+00
^{135}Xe	1.533E+11	0.000E+00
^{131}I aerosol	7.170E+04	8.927E+05
^{131}I gaseous	2.963E+05	0.000E+00
^{133}I	2.191E+06	0.000E+00
^{46}Sc	5.250E+04	0.000E+00
^{51}Cr	1.472E+06	3.711E+06
^{54}Mn	1.333E+06	1.245E+06
^{59}Fe	2.649E+05	6.822E+05
^{57}Co	3.094E+04	3.163E+05
^{58}Co	1.634E+06	1.161E+06
^{60}Co	2.553E+06	1.639E+06
^{65}Zn	1.272E+05	6.617E+05
^{75}Se	6.689E+04	0.000E+00
^{95}Zr	3.681E+05	6.276E+05
^{95}Nb	3.415E+05	4.512E+05
^{103}Ru	6.014E+04	3.917E+05
^{106}Rh	1.443E+05	9.842E+05
^{110m}Ag	7.118E+06	5.382E+06
^{122}Sb	2.643E+05	0.000E+00
^{124}Sb	3.560E+05	6.522E+05

Radionuclides	Atmosphere	Hydrosphere
	[Bq]	
^{134}Cs	4.726E+04	2.064E+06
^{137}Cs	1.039E+05	3.642E+06
^{141}Ce	6.279E+04	7.248E+05
^{144}Ce	2.334E+05	2.477E+06
^{181}Hf	1.403E+05	0.000E+00
^{89}Sr	1.896E+03	6.087E+03
^{90}Sr	1.240E+04	1.722E+04
^{238}Pu	8.062E+02	2.306E+03
$^{239+240}Pu$	2.620E+03	2.528E+04
^{241}Am	1.453E+02	1.480E+03

Evaluation of radiological impact of RAS discharges during normal operation of four reactors installed in NPP Mochovce is based on assumption that limits for RAS discharges from operation of four reactors will be twice as high as limits for RAS discharges from the two already operating units 1 and 2 of NPP Mochovce. All other input data for the code RDEMO© are identical for two and four reactors.

Calculations by code RDEMO© show that regions with the highest annual IED (Individual Effective Dose), and 50 (70)-year commitments CED (Collective Effective Dose), are located in ESE direction and NW from the NPP area along the flow direction of the river Hron and in direction of predominating winds.

Moreover results show that annual IED and CED commitments are highest in sectors along the river Hron (significant impact of liquid radioactive discharges). Critical zone with permanent residence with the highest annual IED is in ESE direction in 3-5 km distance – zone No. 64 where it is located the village of Nový Tekov.

The maximum annual effective dose for inhabitants calculated by the model during normal operation of 4 reactors is 0.215 μSv/year for 2006. The result of this calculation is 0.259 μSv/year for 2007 and 0.295 μSv/year for 2008.

The CED commitment (for 50/70 years) for the whole region (1,200,000 inhabitants) is 10.7 man×mSv for 2006, 16.7 man×mSv for 2007 and 18.7 man×mSv for 2008.

1.5.2 Radiation doses deriving from anticipated operational occurrences

Annual balance limit values for RAS discharges for four reactors installed in the nuclear power plant Mochovce were assumed as double values compared with currently valid limit values for operation of NPP Mochovce units 1 and 2. The list of radionuclides and their assumed activities at 100% level of limits for 4 reactors is given in Table 111.

Table 111 - Radionuclides and their activities used for calculation of radiological impact at reached 100% limit values for discharges

Radionuclides	Atmosphere	Hydrosphere
	[Bq]	
^{3}H	5.810E+11	2.400E+13
^{14}C CO_2	2.364E+10	0.000E+00
^{14}C CnHm	4.516E+11	0.000E+00
^{41}Ar	3.254E+12	0.000E+00
^{51}Cr	3.057E+10	3.707E+08
^{54}Mn	2.754E+10	7.416E+07
^{59}Fe	6.019E+09	7.047E+07
^{57}Co	5.867E+08	2.970E+07
^{58}Co	3.533E+10	5.388E+07
^{60}Co	3.449E+10	8.256E+07
^{65}Zn	2.705E+09	7.168E+07
^{75}Se	2.130E+09	0.000E+00
^{85m}Kr	1.891E+14	0.000E+00
^{85}Kr	3.326E+14	0.000E+00
^{87}Kr	6.699E+14	0.000E+00
^{88}Kr	6.271E+14	0.000E+00
^{89}Sr	2.665E+07	4.273E+05
^{90}Sr	1.080E+08	1.283E+06
^{95}Zr	8.196E+09	6.626E+07
^{95}Nb	6.687E+09	4.459E+07
^{103}Ru	1.692E+09	4.320E+07
^{106}Rh	3.199E+09	1.045E+08
^{110m}Ag	1.620E+11	3.865E+08
^{124}Sb	7.549E+09	5.412E+07

Radionuclides	Atmosphere	Hydrosphere
	[Bq]	
^{131}I gas	1.264E+11	0.000E+00
^{131}I aerosol	7.579E+09	9.028E+07
^{131m}Xe	3.176E+15	0.000E+00
^{133m}Xe	5.962E+14	0.000E+00
^{133}Xe	9.597E+14	0.000E+00
^{135}Xe	1.646E+15	0.000E+00
^{134}Cs	1.022E+09	8.283E+07
^{137}Cs	2.325E+09	2.795E+08
^{140}Ba	6.042E+08	0.000E+00
^{141}Ce	1.255E+09	6.845E+07
^{144}Ce	4.482E+09	2.250E+08
^{181}Hf	1.414E+09	0.000E+00
^{238}Pu	6.147E+06	1.041E+05
^{239}Pu	4.629E+06	8.545E+04
^{240}Pu	4.629E+06	8.545E+04
^{241}Am	6.966E+07	1.925E+05

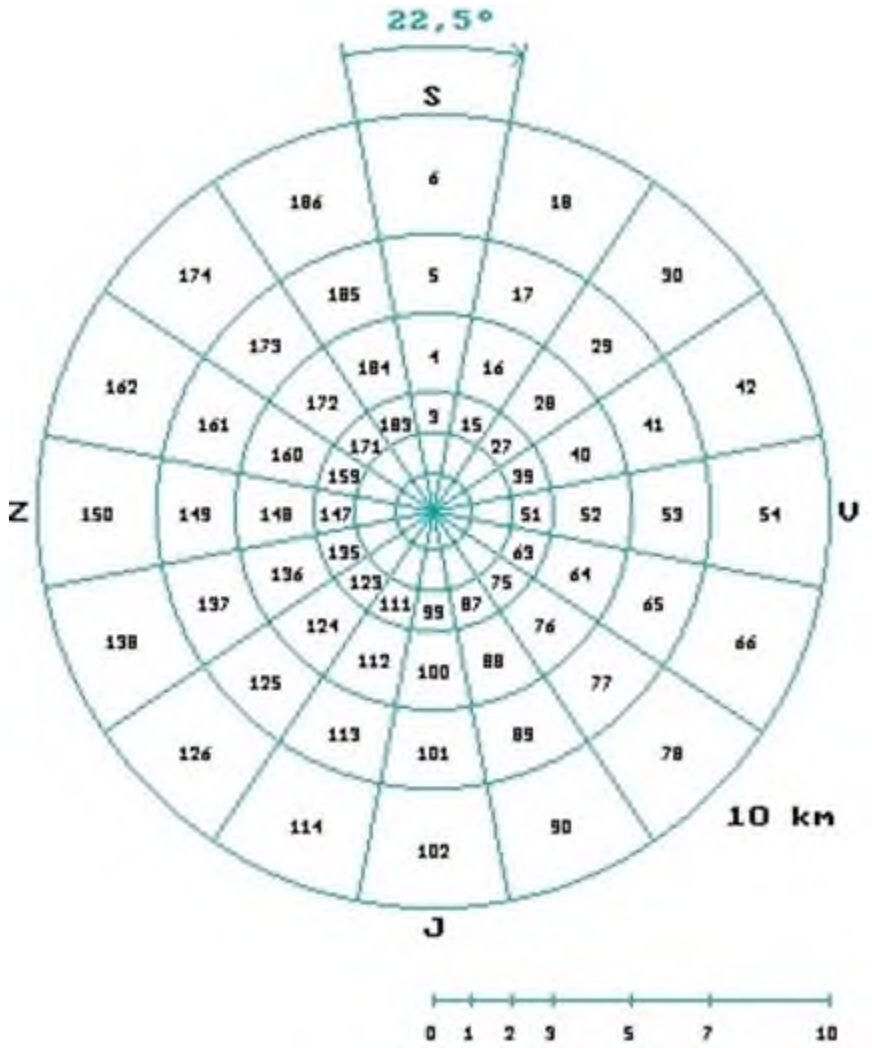
Calculations performed by the code RDEMO© show that regions with the highest values of individual effective doses (IED) and 50(70)-year commitments of CED are found in SE and NW direction from the NPP area in direction of predominating winds and of the river Hron.

Zone with calculated maximal IED in the whole region is a permanently uninhabitated zone located in WNW direction at 0 – 1 km distance.

Permanently habitated (critical) zone with the highest value of annual IED is in ESE direction at 3 – 5 km distance – zone No. 64 with the village Nový Tekov.

Results show that annual IED is predominantly contributed to by atmosphere (93.0%) rather than hydrosphere (7.0%). The highest annual IED reaches 4.47 µSv for year. As for normal operation, the calculated value is negligible compared with legislative requirements (Ordinance of the Government of SR No. 345/2006 Coll.) for maximum annual effective dose to inhabitants from critical group (250 µSv/year).

The CED commitment (for 50/70 years) for the whole region (1,200,000 inhabitants) is 465.3 man×mSv.



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1.5.3 Conclusions

In conclusion, the calculated results show that the radiological impact of radioactive discharges during normal operation and under anticipated operational occurrences of 4 reactors is negligible, much below the siting design limit for nuclear installations (Table 112).

It is expected that, when the new units will be in operation, the annual discharges of MO34 will be comparable with EMO12 discharges. The same is valid for the inhabitant doses (there is linear dependency between released activity and inhabitant doses).

It is clear that in 2006, 95% (98% for years 2007 and 2008) of the (negligible) dose from the NPP releases will be due to Tritium discharge into the river Hron. For this reason, the model RDEMO© conservatively overestimates real dose situation because it predicts that all water which was drunk by inhabitants during the year is taken from river Hron.

It can be useful to remark that the Tritium calculated dose itself is much less than normal variations of the natural background. For example, the calculated Tritium dose is lower than the variations (decrease) of natural dose rate from terrestrial natural sources (at 1 m above ground) after 10 mm of rain. In other words, these variations have an effect on individual dose greater than Tritium contribution dose (NUREG Report 1501/August 1994 on parts regarding the variability of background radioactivity).

Conservative estimation of the transboundary impact due to released Tritium (for four units operation) trough the river Hron, can be performed. This can be estimated taking into account an additional dilution in river Danube at the confluence of river Hron with Danube River. Average flow rate of Danube in Bratislava is 2000 m^3/s. For the evaluation, it has been assumed the same flow rate in Štúrovo, while the average Hron flow rate (during Tritium release) in year 2008 was 28 m^3/s. So the additional dilution factor for Tritium concentration in Danube is 0,014. The corresponding very conservatively calculated doses for inhabitants of a critical group living in Hungary, close to the confluence of rivers Hron and Danube, from Tritium releases into river Hron in 2006 was 3.0 nanoSv, in 2007 was 3.6 nanoSv and in 2008 it was 4.0 nanoSv.

Dose to an individual from the critical group obtained from discharges of other radionuclides are order of magnitude lower in comparison to Tritium dose. A similar conclusion can be assumed about the transboundary radiological impact of radionuclides other than Tritium, discharged into river Hron. In fact, these radionuclides are predominantly attached to sediment particles and as there are no dams (obstacle for sediments downstream) constructed on river Danube, no catchment of these sediments is assumed. Similarly, dose from these sediments is orders of magnitude lower for the inhabitants of a critical group living in Hungary, close to the confluence of rivers Hron and Danube.

Transboundary impact from airborne releases in Hungary (the same place as in previous paragraph) has been calculated by the code RDEMO as 2,9E-10 Sv/y, which gives really a negligible contribution to dose rate during everyday's life (compared to natural background, etc.).

Thus, assuming the most conservative results of calculation (year 2008), the total dose rate for an inhabitant in Hungary living at the confluence of rivers

Hron and Danube is calculated as 4.3 nanoSv/y, These values, not measureable by instruments, are, in comparison with dose limits or doses from natural background, very low, and practically equal to zero from a radiation protection point of view.

As far as concerns the transboundary impact of discharges in Austria, there is no impact to inhabitants from NPP EMO water discharges into river Hron. Concerning the impact from airborne discharges in Austria, the dose evaluation at a distance between the source of release and the country border (100 km), is at the limit of validity of any radiological assessment models. In fact, the evaluated dose is in the order of tens of pico Sv due to the modest releases and to the huge dilution of pollutants (at that distance), From the results of RDEMO, an approximation of calculated individual dose from NPP EMO discharges gives dose about 1.E-11 Sv/y for an inhabitant living at the Austrian border close to Bratislava. Again, the value is practically equal to zero from a radiation protection point of view.

Anyway, on the basis of the constant SE care about the environment, Mochovce NPP could focus its environmental sampling programme on levels of Tritium in the groundwater and in river Hron. The much conservatively model for Tritium dose calculation should be refined too. Then, there would be the need to perform a dedicated assessment to the dose calculation model in order to gain a more precise confirmation that the increased contribution due to Tritium discharge in surface water does not contribute significantly to the increase of annual radiation dose for the critical group of exposed population.

Moreover, due to the use of new Gadolinium fuel, Tritium production in reactors should be decreased by about 27% in comparison with the current situation. Consequently, this will also result in a decrease of Tritium doses to critical group.

No long term build up of radioactivity in environment is likely because of the small amount of radioactivity routinely released by the power plant. Further, the extensive environmental radiation monitoring program (section C, Part IV) would provide early detection of any unexpected build up. Early detection would allow mitigation measures to be put in place.

It may be noted that the scientific literature on ecological risk from long-term exposure to low-level ionizing radiation suggests that no observable effects have been found, even in the most sensitive species of organisms, at dose rates less than 1 mGy per day. By limiting the exposure of humans to a maximum dose of 0.250 mSv per year (with actual doses incurred being substantially smaller), it is therefore clear that adequate protection will be ensured for local flora and fauna.

Table 112 - Predicted doses to members of the public during operations compared with natural background and regulatory limit

Natural background (UNSCEAR, 2000)	Regulatory Limit (*)	Max annual effective dose for inhabitants				
		Normal operation State			Anticipated operational occurrences	
μSv/year	μSv/year	Year	μSv/year	Regulatory limit (%)	μSv/year	Regulatory limit (%)
2400	250	2006	0.215	0.09	4.47	1.79
		2007	0.259	0.10		
		2008	0,295	0.12		

(*) Slovakian Ordinance of the Government No 345/2006

1.5.4 Radiological consequences during design basis accident conditions

Common design and realization of safety measures for NPP EMO12 gave assumptions to elaborate safety analysis for both units and for that reason preoperational safety analyses report (POSAR) was written for NPP EMO12. The chapter "safety analyses" in POSAR include radiological consequences which have been actualized by each change of fuel type. POSAR actualization and radiological consequences during design basis accident conditions is chronology described below.

Preliminary safety analyses report for NPP EMO34 is elaborated in accordance with law No. 541/2004, regulation No. 50/2006 and safety guideline No. BNS I.11.1/2008.

The results of the analyses for DBA are assessed in terms of the fulfilment of safety functions which are derived from the three safety objectives (Safe shutdown and long-term sub-criticality, Residual heat removal, Limitation of radioactive leakages and graded according to the expected frequencies of occurrence of the postulated event sequences. The initial and boundary conditions for the analyses and the grading of the derived safety functions are determined by the risk involved, i.e. the greater the probability of occurrence of an event, the tighter the acceptance criteria; therefore the allowable consequences are more restrictive for the sequences calculated as less frequent. Fulfilment of the safety objectives is assured by the integrity of unharmed barriers to protect the public against the consequences of radioactive substances release.

These barriers are as follows:

1) the chemical and physical structure of nuclear fuel,

2) the fuel cladding,

3) the reactor coolant pressure boundary,

4) the reactor hermetic zone building (hermetic zone).

The mathematical models used in the consequence assessment bear some resemblance to those used to assess the impact of normal operations, since they reflect the same atmospheric phenomena and environmental processes leading to radiological exposure. The main difference is that, for an accidental release, the accident event itself and the resulting dispersion processes are simulated through time, whereas in normal operations environmental concentrations are assumed to achieve steady-state conditions.

Compliance with the dose targets has to be verified at 2 kilometres from the NPP, since an evaluation of dose commitment (within one year) at shorter distances from the plant is not significant. In fact, an "exclusion area" around the Mochovce Nuclear Power Plant (in an area of radius ranging from 2 to 3 kilometres) has been established in 1979 by a Decision of the Regional Health Office No. H-IV-2370/79, in which no permanent residence is allowed.

Following limits had been approved by the District Health State Authority in Levice (representative of the National Health State Authority of the Slovak Republic):

Mandatory limits	***Effective dose [mSv])***	***Dose to thyroid [mSv]***
	≤50	≤500

Based on the conservative approach these dose limits to the public had been verified at the distance of 2 kilometres from the NPP and they have been used as reference for the evaluations of 1st, 2nd, 3rd stages of EMO 12.

New limits for radiological consequence, shown in the following table, have been defined based on Governmental Decree 345/2006 and on the subsequent standpoint OOZPŽ/8155/2006 issued in 2007 by UVZ for EMO12.

Mandatory limits	***Effective dose [mSv])***	***Dose to thyroid [mSv]***
	≤50	≤250

Calculated dose shall be below the limits for postulated accidents. These acceptance criteria have been used as reference for the evaluations of the 4th stage concerning the adoption of Gd fuel of IInd generation (Power Uprate 1471 MWt) and they have to be verified around the Mochovce NPP within a radius ranging from 2 to 3 kilometers ("exclusion area").

For ease of comprehension of the contents, in the following not only the 4th stage evaluations - but also the 1st, 2nd and 3rd stages calculations for EMO12 and MO34 PRESAR evaluations - have been compared with the new dose limits., This approach is further justified given that, as it could be noticed in the following, all calculated doses are well below the postulated limits.

EMO12 radiological consequences during design basis accident conditions

For instance, the worst design basis accident that has been considered for the Mochovce nuclear power plant is an instantaneous full size "guillotine" rupture of the cold leg of one of the primary coolant loop, located between the main coolant pump and the reactor vessel nozzle. The analysis of the accident radiological consequences is based on the pessimistic assumption that all fuel rods in the reactor core fail, leading to 100% release of volatile radionuclides from fuel pin gaps into the primary coolant during the release phase of the accident.

Dispersion of the released plume is evaluated using a Gaussian plume model as the code RTARC©.

For EMO12, that have to be regarded as un upper bound for the estimation of the real doses associated with MO34 accidental events, were performed safety analyses (also in terms of radiological consequences) elaborated in compliance with US NRC RG 1.70 and UJD SR guideline BNS 1.4.1/1995 in following four subsequent steps:

- **1st Stage**

Safety analyses and IInd related radiological consequences were elaborated in 1997 by the consortium EUCOM and reported in POSAR for standard fuel and within their framework, the impact on environment was assessed for selected analysis.

- **2nd Stage**

The safety analyses for the profiled fuel were elaborated in 1999-2000 by OKB Gidropress.

- **3rd Stage**

Radiological consequences, calculated by RTARC© program for Gd fuel of IInd generation were elaborated in 2006 by VÚJE, a.s. and reported in POSAR for Gd fuel of IInd generation.

- **4th Stage**

The elaboration of Radiological consequences for Gd fuel of IInd generation (Power Uprate 1471 MWt) has been performed by VÚJE, a.s. in 2007.

1st Stage

Safety analyses and related radiological consequences were elaborated in 1997 by consortium EUCOM and reported in POSAR for standard fuel and within their framework, the impact on environment was analysed for selected analysis. This includes following analyses:

- Spectrum of large break LOCAs caused by postulated ruptures of primary circuit piping. This consists in a double-ended guillotine Loss-Of-Coolant Accident (LOCA 2 x 500 mm), with the pipe break location in the non-isolable part of the cold leg of one of the main circulation loops, i.e., between the main isolating valve and the reactor-pressure-vessel nozzle (maximum DBA);
- Spectrum of various steam lines ruptures inside and outside the containment (including rupture of SG tubes).
- Spurious opening of pressurizer safety valve or safety relief valve.

In case of large LOCA, it was conservatively assumed that:

- damage of 100% of fuel assemblies and leakage of 100% of activity present in the gap between pellets and cladding to coolant;
- the accident will happen at the end of equilibrium cycle during which the reactor worked at normal operation at maximal power output;
- total volume of primary coolant is released into containment.

Table 113 shows the comparison of maximal calculated doses for LOCAs, on the border of protection zone, with acceptance criteria.

Table 113 - Spectrum of postulated piping break within the reactor coolant pressure boundary – Comparison of calculated doses and acceptance criteria.

EMO12	*Effective dose [mSv]*	*Dose to thyroid [mSv]*
Large break LOCAs	11	29
Mandatory limits	≤50	≤250

In addition, scenarios of containment bypass (e.g., steam generator tube rupture with open Safety Valves on the main steam line or of another line from the reactor coolant pressure boundary to outside of containment) have been taken into account. The doses evaluated in these cases are shown in the following tables, showing that the design acceptance criteria are complied with also in these cases.

As far as concerns spectrum of various steam lines ruptures, two events were considered:

- untightness of primary collector equal to collector lid rip off with untightness size of 13.569 cm^2;
- breaking of one steam generator tube with bilateral leakage.

Table 114 shows the comparison of maximal calculated doses, on the border of protection zone, with acceptance criteria.

Table 114 - Spectrum of various lines ruptures crossing the hermetic area and Lid rip off - Comparison of calculated doses and acceptance criteria.

EMO12	*Effective dose [mSv]*	*Dose to thyroid [mSv]*
Lid rip off (calculated doses)	6	32
SGTR 1 tube	1	5
SGTR 1 tube with SV in open position	8	46
Mandatory limits	≤50	≤250

With regard to spurious opening of one pressurizer safety valve or safety relief valve, this scenario does not lead to Loss of Coolant Accident and hence there is no dose commitment for the population.

For the inadvertent opening of one check valve or isolation valve separating the reactor coolant boundary and low-pressure part of the system, the systems to be considered are the JNG system (low pressure emergency core cooling system), the JNB system (core cooling after earthquake) and the JEF system (Pressurizer relief tank). Indeed, all the other systems connected to the reactor coolant boundary are “high pressure” systems which mean that they can normally operate at the RCS pressure.

2nd Stage

The safety analyses for the profiled fuel were elaborated in 1999-2000 by OKB Gidropress and, due to the largely conservative hypothesis of 1st Stage, radiological consequences calculated by EUCOM (1997) for standard fuel are deemed to be valid for the profiled fuel too.

3rd Stage

Radiological consequences, calculated by RTARC© program for decrease of coolant amount in primary circuit, for Gd fuel of 2nd generation (power output 100%) were elaborated in 2006 by VÚJE, a.s. and reported in POSAR for Gd fuel of 2nd generation.

Analyses refer to scenarios similar to those considered in 1st Stage:

- Spectrum of large break LOCAs caused by postulated ruptures of primary circuit piping.
- Spectrum of various lines ruptures crossing the hermetic zone.
- Rupture of single SG tube or Lid rip off.
- Spurious opening of pressurizer safety valve or safety relief valve.

Table 115 shows the comparison of maximal calculated doses for LOCAs, on the border of protection zone, with acceptance criteria.

Table 115 - Spectrum of postulated piping break - Comparison of calculated doses and acceptance criteria.

EMO12	*Effective dose [mSv]*	*Dose to thyroid [mSv]*
Large break LOCAs	3.04	2.77
Mandatory limits	≤50	≤250

As far as concerns spectrum of various steam lines ruptures, two events were considered:

- untightness of primary collector equal to collector lid rip off with untightness size of 13.569 cm^2;
- Rupture of steam line crossing the hermetic area.

Table 116 shows the comparison of maximal calculated doses, on the border of protection zone, with acceptance criteria.

Table 116 - Spectrum of various lines ruptures crossing the hermetic area and Lid rip off - Comparison of calculated doses and acceptance criteria.

EMO12	*Effective dose [mSv]*	*Dose to thyroid [mSv]*
Lid rip off	0.67	3.07
Rupture of the line crossing the hermetic area	1.88	9,57
Mandatory limits	≤50	≤250

With regard to spurious opening of one pressurizer safety valve or safety relief valve, this scenario does not lead to loss of coolant accident and hence there is no dose commitment for the population.

4th Stage

The elaboration of radiological consequences for Gd fuel of II generation (Power Uprate) has been performed by VÚJE, a.s. in 2007.

In the project of power upgrading of units EMO12 from power 1375 MWt to 1471 MWt were calculated the new safety analyses for increased reactor power within the requirements BNS I.11.1/2006 The analyses include the radiological consequences described below.

Calculation analyses of initialize event are realized by thermal-hydraulic code RELAP5/MOD3.2.2. T-H analyses of hermetic zone are realized by calculated code MELCOR and thermal-hydraulic analyses of fuel rods are realized by code TRANSURANUS.

From the viewpoint of the core cooling conditions the governing accidents with loss of primary coolant and radiological consequences is considered the worst case “Instantaneous guillotine double-ended break of MCP “cold” leg at the reactor inlet”. Location of leak is conservatively assumed directly near the reactor vessel because in this case the largest uncovering of the reactor core occurs.

Analyses refer to scenarios similar to those considered in the 1st Stage:

- Spectrum of large break LOCAs caused by postulated ruptures of primary circuit piping.
- Spectrum of various steam lines ruptures inside and outside the containment (including rupture of single SG tube).
- Spurious opening of pressurizer safety valve or safety relief valve.

Table 117 shows the comparison of maximal calculated doses of postulated ruptures of primary circuit piping, on the border of protection zone, with acceptance criteria.

Table 117 - Spectrum of postulated piping break - Comparison of calculated doses and acceptance criteria.

EMO12	*Effective dose [mSv]*		*Dose to thyroid [mSv]*	
	2 km	***3 km***	***2 km***	***3 km***
Large break LOCAs	3.92	3.46	2.49	2.19
Mandatory limits	≤50		≤250	

Accidents with primary-to-secondary leaks are characterized by violation of the primary circuit boundaries and escape of activity outside the hermetic zone.

The analysis considers following versions with occurrence of primary-to-secondary leak:

- lift-off of steam generator collector cover with occurrence of primary leak with superposition of loss of station service power;
- break of steam generator tube with occurrence of primary-to-secondary leak without loss of power.

For calculation of radiological consequences was taken into account the worst case in operation at power the loss-of-sealing of steam generator "cold" collector cover occurs with formation of primary leak (equivalent area of 13.569 cm^2). This initial event represents the maximum diameter of leaks from primary to secondary side of SG. During this process will not be disturb acceptance criteria.

Table 118 shows the comparison of maximal calculated doses, on the border of protection zone, with acceptance criteria.

Table 118 - Leaks from primary to the secondary side of the steam generator - Comparison of calculated doses and acceptance criteria

EMO12	*Effective dose [mSv]*		*Dose to thyroid [mSv]*	
	2 km	*3 km*	*2 km*	*3 km*
Leaks from primary to secondary side of SG	1.19	1.01	3.30	2.80
Mandatory limits	≤50		≤250	

For the inadvertent opening of one check valve or isolation valve separating the reactor coolant boundary and low-pressure part of the system, the systems to be considered are the JNG system (low pressure emergency core cooling system), the JNB system (core cooling after earthquake) and the JEF system (Pressurizer relief tank). Indeed, all the other systems connected to the reactor coolant boundary are "high pressure" systems which mean that they can normally operate at the RCS pressure.

With regard to spurious opening of one pressurizer safety valve or safety relief valve, this scenario does not lead to loss of coolant accident and hence there is no dose commitment for the population.

MO34 radiological consequences during design basis accident conditions

Dispersion of the released plume is evaluated using a Gaussian plume model, through the code RTARC©. In the elaboration of the MO34 Preliminary Safety Analysis Report, radiological consequences were calculated in 2008 by VÚJE for the typical following DBA scenarios (analogous to EMO 12 evaluations):

- double-ended guillotine Loss-Of-Coolant Accident (LOCA 2 x 500 mm), with the pipe break location in the non-isolable part of the cold leg of one of the main circulation loops, i.e., between the main isolating valve and the reactor-pressure-vessel nozzle (maximum DBA);

- rupture of a steam-generator cold collector primary lid (equivalent area of rupture = 13.569 cm^2), with a coolant leakage into secondary circuit (bounding scenario for primary-to-secondary leakage scenarios).

In all the scenarios, highly-conservative assumptions have been adopted:

a) for thermal-hydraulic analyses of the accident (performed with the codes RELAP5 and MELCOR), including:

  - selection of the most adverse position of pipe rupture;
  - adoption of the single-failure criterion for the system with the worst consequences on the evolution of the accident;
  - no credit to hermetic zone spray to wash-down fission products;
  - use of a hermetic zone leak-rate about three times larger than the value measured for EMO12 and expected for MO34;
  - assumption of direct releases from the hermetic zone to the environment without consideration of retention of radioactive material in structures surrounding the hermetic zone.
  - for the second scenario, 100% of the primary coolant released to environment before the leak is isolated.

b) for radiological analyses calculating the off-site consequences of the accident (performed with the RTARC© code), including:

  - highest admissible specific radioactivity of primary coolant;
  - radioactive inventory of fuel gap at the end of fuel cycle;
  - worst meteorological conditions;
  - no sheltering taken into account in dose calculations.

The fuel radioactive source term has been taken from the analyses performed for EMO12, i.e., Gd fuel of II generation (specific data will be used for the analyses to be included in the Final Safety Analysis Report).

On the basis of the assumptions discussed above, it can be clearly expected that the radiological consequences presented hereinafter are significantly higher than the actual consequences of a DBA.

Table 119 shows the comparison of maximal calculated doses for LOCAs, on the border of protection zone (2 kilometers), with acceptance criteria.

Table 119 - Spectrum of postulated piping break – Comparison of calculated doses and acceptance criteria

MO34	*Effective dose [mSv]*		*Dose to thyroid [mSv]*	
	2 km	*3 km*	*2 km*	*3 km*
Large break LOCAs	0.39	0.25	0.46	0.29
Mandatory limits	≤50		≤250	

The significant reduction of the radiological consequences of a LOCA, with respect to the analyses performed for EMO12, is based on a more realistic estimate of the fuel damage occurring during a LOCA accident. These analyses are described above. In fact, instead of assuming a damage of 100% of fuel assemblies and release of 100% of fuel gap inventory (as done in previous analyses) of more precise evaluation of the extent of the fuel damage has been possible by using the code TRANSURANUS. The TRANSURANUS code (developed at the EC Joint Research Center, Institute for Transuranium Elements, Karlsruhe, Germany) has been successfully employed in several international programs (e.g., EU PHARE, EXTRA) involving also other countries of Eastern Europe (e.g. Czech Republic, Hungary).

Through statistical thermo-mechanical calculations, by using the TRANSURANUS code, it is possible to achieve a conservative but more realistic estimation of the number of fuel elements for which failure cladding can be expected, thus, reducing the excessive margin of conservativeness adopted previously for the radioactive source term.

Table 120 shows the comparison of maximal calculated doses for the second DBA Scenario, on the border of protection zone, with acceptance criteria.

Table 120 - Leaks from primary to the secondary side of the steam generator – Comparison of calculated doses and acceptance criteria

MO34	*Effective dose [mSv]*		*Dose to thyroid [mSv]*	
	2 km	*3 km*	*2 km*	*3 km*
Leaks from primary to secondary side of SG	2.92	2.10	18.5	13.3
Mandatory limits	≤50		≤250	

Conclusions

Considered accidents have been chosen as the most representative scenarios and performed calculations have been carried out with very conservative assumptions.

All the analyses confirm that, even with these conservative assumptions, a large margin exists with respect to the dose targets; indeed, the calculated values are more than one order or magnitude lower than the dose target.

The differences between the analyses performed for MO34 and those performed in the past for EMO12 have to be ascribed to minor differences in the definition of the scenarios to be analyzed and in the assumptions adopted in the analyses.

1.6 Assessment of impacts on human health

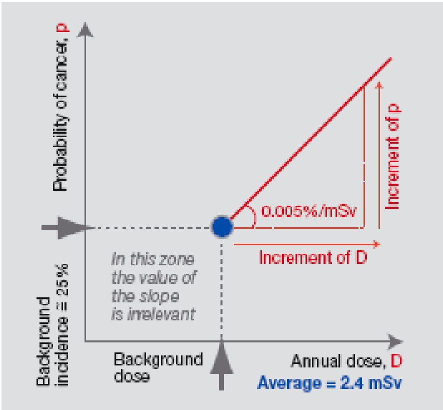
Given that NPPs radioactive effluents determine only a slight increase of the effective dose rate compared to the natural background (estimated to be around 2.4 mSv/y – UNSCEAR, 2004), these can be considered as a negligible source of doses to population.

Regarding Mochovce NPP, the maximal annual effective dose for the “critical group” of inhabitants calculated by the model RDEMO® considering normal operation of 4 reactors has been estimated to be 0.215 μSv/y for 2006, 0.259 μSv/y for 2007 and 0.295 μSv/y for 2008, several order of magnitude lower than the limit imposed by Slovakian law (0.25 mSv/y) and consequently greatly below the effective dose due to natural background.

The observational evidences for radiation-induced cancer in humans derive largely from the great exposures of the population to high effective doses such as the Chernobyl accident, Hiroshima and Nagasaky or the victims of Mayak accident.

In the absence of directly applicable observational evidence, the rate of cancer induction at low doses can be estimated by extrapolation from observations at high doses. A particularly simple extrapolation estimate is provided by the widely-adopted *linearity hypothesis*, according to which the increased risk is proportional to the committed dose.

This hypothesis has been adopted by the major advisory bodies in their recent publications. There are some differences in the details of the proposed models and several of these groups (ICRP6, NCRP7 and UNSCEAR8) have included an effectiveness factor (DDREF – Dose and Dose-Rate Effectiveness Factor) of about 2 in the low doses region, which halves the risk per unit dose compared to the risk given by a linear extrapolation from the high dose region.



Probability of cancer as function of committed annual dose

[6] ICRP – International Commission on Radiological Protection

[7] NCRP – National Council on Radiation Protection

[8] UNSCEAR – United Nations Scientific Committee on the Effects of Atomic Radiation

As shown in the figure above, an estimate worldwide in character for the risk of eventual fatal cancer at low doses and low dose rates is 0.05/Sv.

This risk factor can be applied to an "average person" but in its most precise form it applies to an “average population”. Applying the risk of eventual fatal cancer the effective dose of 0.215 μSv/y to the “critical group” of population around Mochovce NPP results in a risk of fatal cancer equal to 1.075 10^{-08}, i.e. around 1 event each 100 million of inhabitants.

This risk can be compared with the ratio of world annual number of deaths due to cancer (estimated to be 7.9 million in 2007[9]) to the world population of (around 6.68 billion people), i.e. around 1 event each 1000 inhabitants. It implies that is impossible to distinguish the number of deaths due to natural causes from the ones due to a presence of a NPP.

Despite being widely accepted as a guideline in setting standards for public health protection, the conservative hypothesis of linearity has not already been firmly recognized by the scientific community.

Many evidences that at low doses the effects are much lower than implied by linearity have raised some doubts on the validity of the above mentioned hyphotesis. This view is reflected in a position statement issued in early 1996 by the *Health Physics Society,* a leading US professional organization. According to this position statement, for doses below 100 mSv "risks of health effects are either too small to be observed or are non-existent."

Anyway, in order to confirm the uselessness of a specific epidemiologic study for the effects on population due to the negligible doses from the Mochovce (or others) NPP, the inhabitants of the district of Levice (with a population of 120021 inhabitants) were selected for the investigated set, meanwhile inhabitants of the districts of Dunajská Streda (about 69 km far from Mochovce NPP, with a population of 114.217 inhabitants in 2004) and Senica (about 93 km far from Mochovce NPP, with a population of 60.891 inhabitants in 2001) were selected as control sets.

The position of the three districts is shown on the following map.

[9] Source: http://www.who.int website

Position of Senica, Dunajská Streda and Levice.

Senica and Dunajská Streda were selected as control sets due to their similar characteristics to Levice district:

- high proportion of rural inhabitants living and working in the same district,
- high proportion of locally produced food (vegetables, fruit, meat from domestic animals etc.),
- slow development of industry producing pollution,
- absence of radioactive underlying rock.

At this stage it is necessary to remark that for the development of oncologic illnesses contributes not only radiation but also other exogenous and endogenous factors. These exogenous factors include heterogeneous chemical substances. Endogenous factors include hereditary illness.

1.6.1 Evaluation

The data in the graphs reported in Figures 54 to 59 were grouped into two periods. The first period is between 1968 and 1995, i.e. prior to the operation of the first two blocks of the NPP. The second period is between 1996 and 2004 and includes the starting of the operation of the NPP (1998-1999).

In the graphs, it can be observed an increase in the registered number of illness even in periods when no new possible sources of environmental radioactivity occurred. This is likely due to an overall worsening of the environment and to an increase in the average age of the inhabitants (in higher age categories there is a higher frequency of oncologic illnesses).

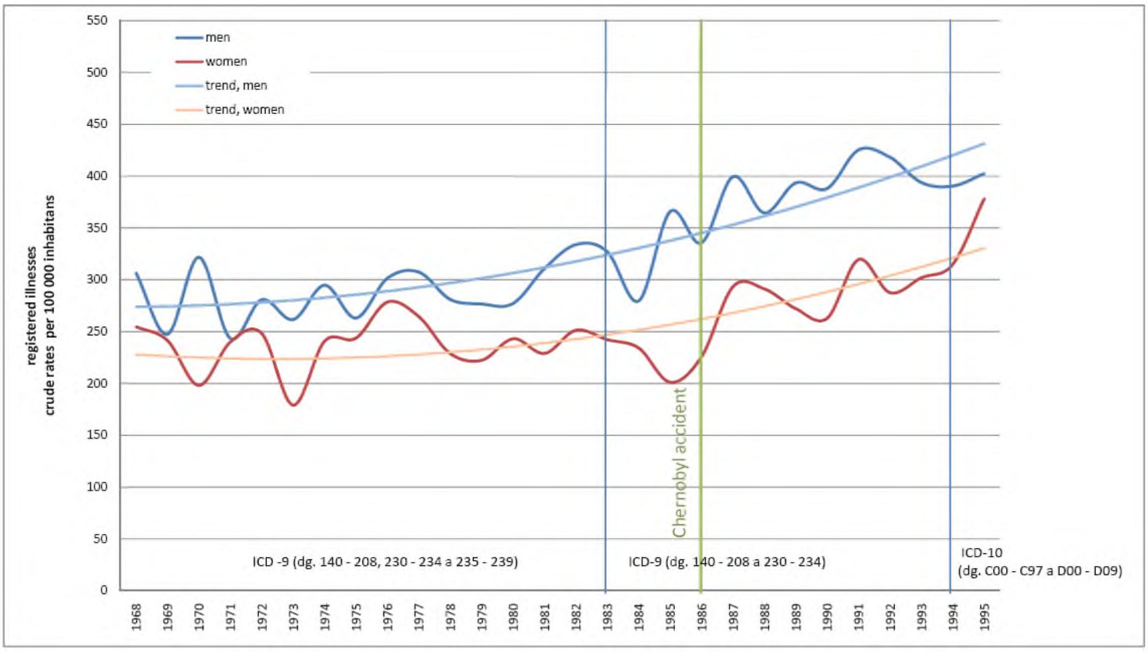


Figure 53 - Incidents of fatal tumors in the district of Dunajská Streda 1968 - 1995

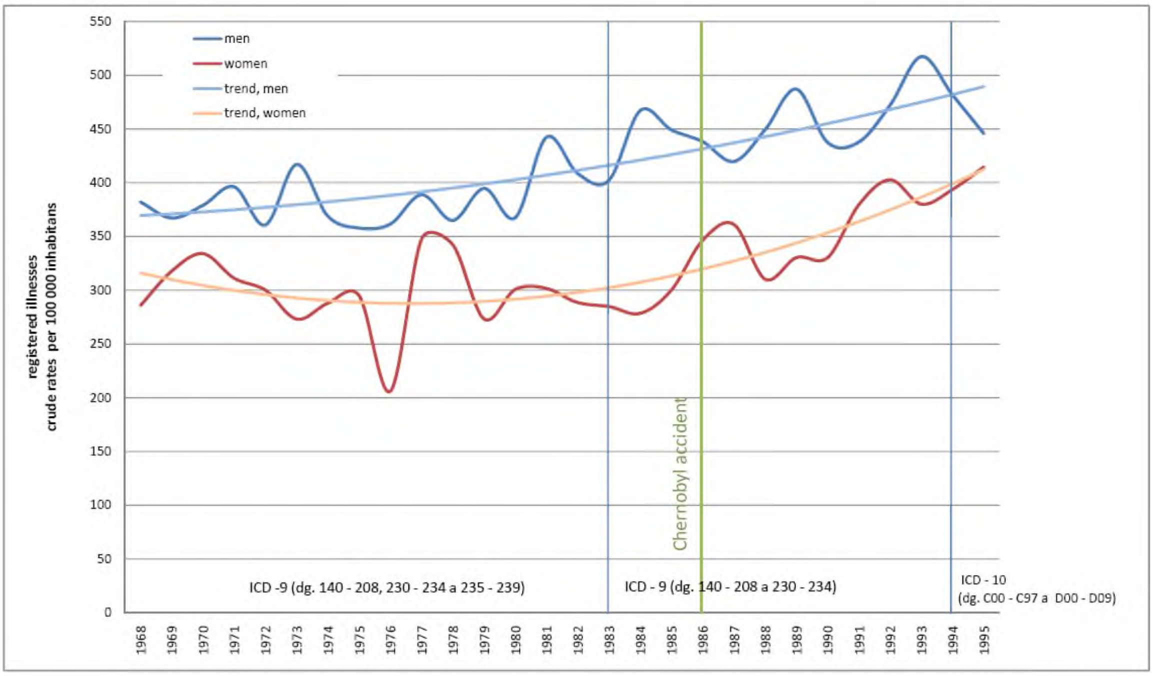


Figure 54 - Incidents of fatal tumors in the district of Levice 1968 - 1995

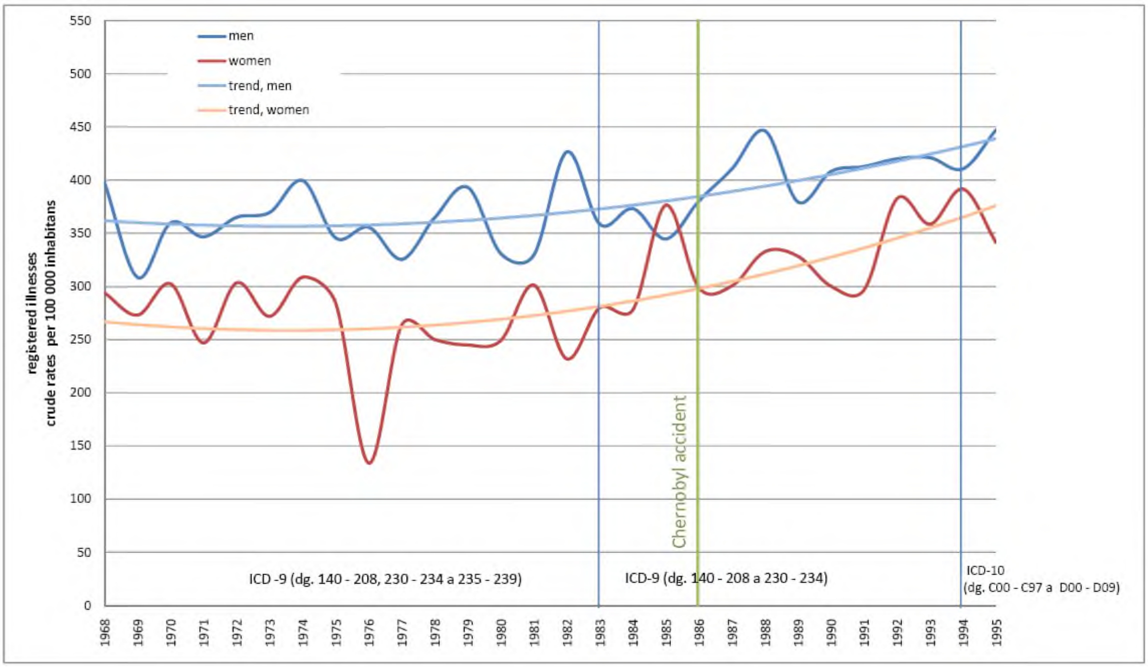


Figure 55 - Incidents of fatal tumors in the district of Senica 1968 - 1995

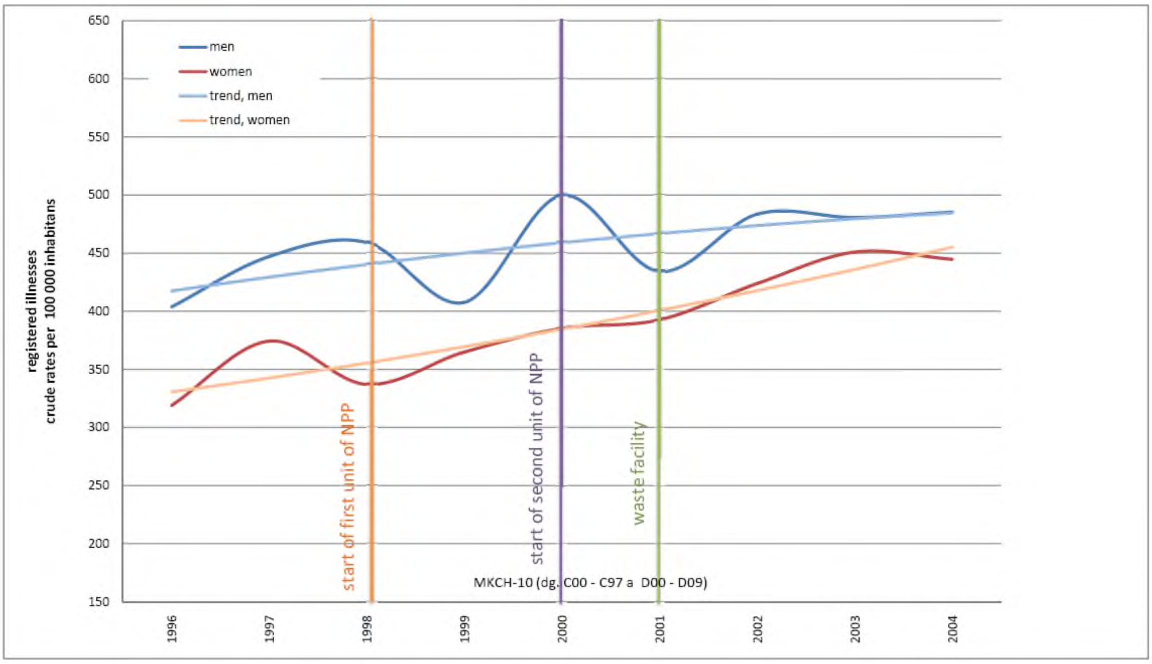


Figure 56 - Incidents of fatal tumors in the district of Dunajská Streda 1996 - 2004

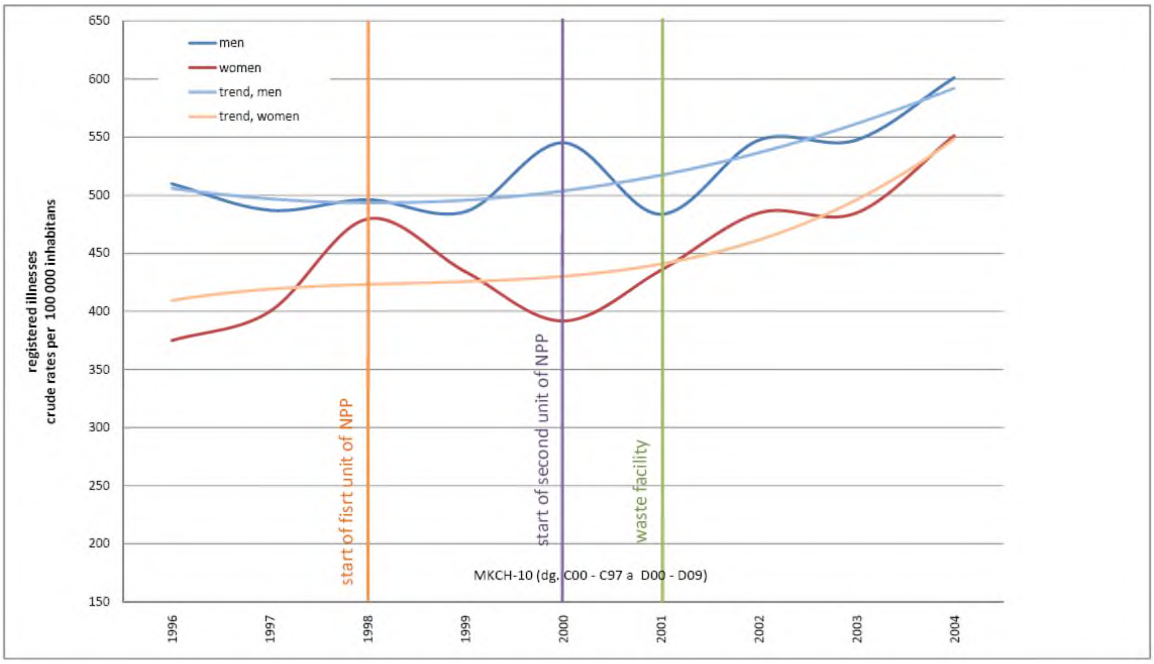


Figure 57 - Incidents of fatal tumors in the district of Levice 1996 - 2004

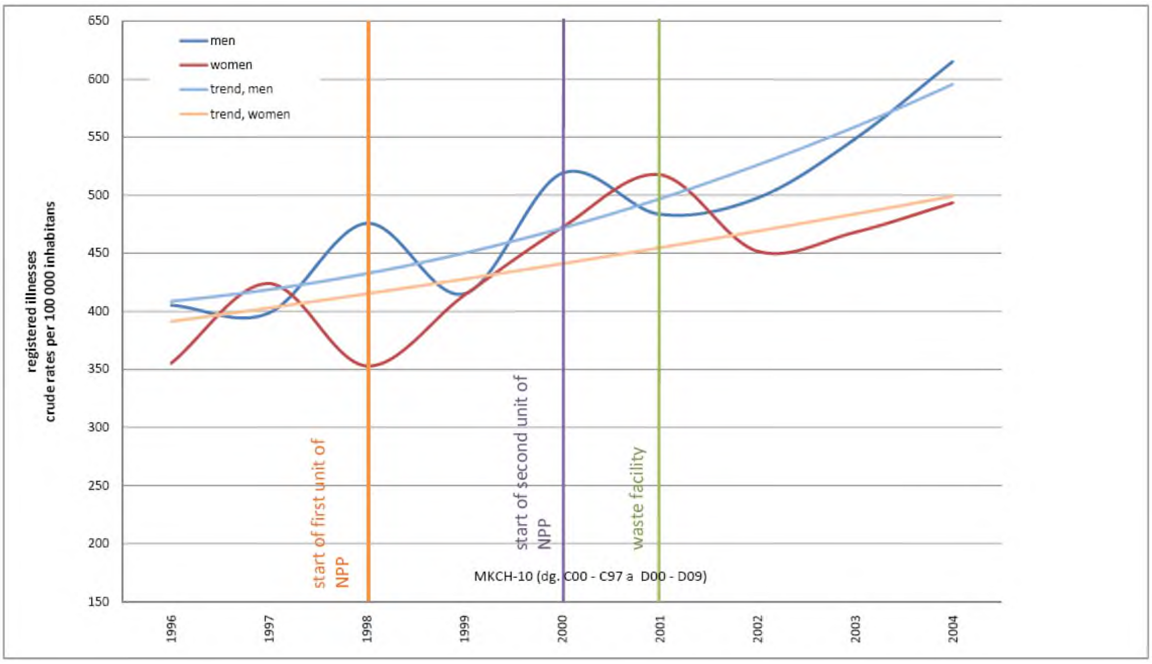


Figure 58 - Incidents of fatal tumors in the district of Senica 1996 - 2004

From the graphs it is possible to observe a difference between the registered numbers of illness between genders. This is likely due to the highly effective immune system of women. The human immune system is, infact, responsible for the destruction of abnormal.

All the graphs present an increase of the trend due to the fact that the life condition is evolved, the average age of the people is increased but with the level of wellness also the illnesses linked to this way of life are also increased such as the lung cancers connected with the smoke or the liver cancers connected with the alcohol use.

From the graph of the first period, the curve increases after the Chernobyl incident when there was a large increase in radioactivity in the environment in the monitored areas.

Form the observation of the graphsof the two periods, it can be highlighted that the trend of registered number of illness is comparable for the two periods in all the considered districts.

In particular, when comparing the curves referring to the second observed period for the district of Levice with the ones of the other districts, it is possible to notice that their trend is comparable. It is, therefore, reasonable consider that the operation of the NPP has no impact on the inhabitants of the monitored district.

The percentage increase in the number of new oncologic illnesses per year was calculated.The values reported in Table 128 were found for the each considered district.

Table 121 - Average annual increase in incidents

District	1968 – 1995		1996 - 2004	
	men	Women	men	women
Dunajská Streda	2.1	1.7	1.8	4.2
Levice	1.2	1.8	1.9	3.6
Senica	0.8	1.7	5.1	3.5

For the reasons explained in the Introduction and for the aforementioned statistical consideration on human health, it is clear that the operation of Mochovce NPP does not present a negative impact on the health of the closer inhabitants of the monitored district of Levice.

2.0 IMPACTS ON ROCK ENVIRONMENT, MINERAL RAW MATERIALS, GEODYNAMIC PHENOMENA AND GEOMORPHOLOGIC CONDITIONS

No interactions between the Project and Geology were identified during the operations phase and consequently no likely effect occurs.

3.0 IMPACTS ON CLIMATIC CONDITIONS

Likely impacts on climate condition are described in terms of local atmosphere, which is one of the VECs identified for Atmospheric Environment.

Therefore, the results of the assessment process for impacts on climate condition can be found in paragraphs concerning Impacts on Air (Section C, part III, chapter 4.0).

4.0 IMPACTS ON AIR

Project-environment interactions with Atmospheric Environment were identified for project activities during operation phase both for non radiological and radiological parameters.

The interaction of Units 3 and 4 with atmospheric environment are due to release of combustion products (NO_x, SO_x and CO), water vapour emissions from cooling towers and from the radioactive gas deriving from gas cleaning system and the off gas deriving from the liquid radioactive waste treatment facility (LRAWTF).

4.1 Non radiological parameters

The effects of interactions on VECs (local atmosphere and human health) occur in the Local Study area.

Table 122 presents the evaluation criteria used to assess the likely effects on the Atmospheric Environment.

Table 122 - Criteria used in evaluation of likely effects on Atmospheric Environment

Atmospheric Environment Subcomponent	Evaluation Criteria
Air Quality	• Act No. 478/2002 Coll. on the Protection of Air from Pollutants (Air Act) as amended by Act No. 203/2007 Coll., • Ministry of the Environment Decrees No. 705/2002 Coll. and 706/2002 Coll.

4.1.1 Release of combustion products

The Power Plant is not a significant emitter to conventional air pollutants including NO_x, SO_x, CO_2 and particulate. The larger source of such emissions during operations is the stand-by diesel generators (see Section B, Part II, chapter 1). The effect of atmospheric emissions from these sources is assessed below. Vehicle emissions were not considered during the operation phase since they are expected to be similar to existing conditions because of a similar sized workforce.

The World Health Organization air quality guidelines for NO_2 and SO_2 are 200 μg/m^3 and 303 μg/m^3, respectively for 1-hour mean values. There is no World Health Organization guideline for CO. Accordingly we used the stringent air quality guidelines for CO adopted by the Ontario Ministry of Environment, Canada, i.e. 5,000 μg/m^3.

The impacts of the emissions from emergency diesel powered generators were assessed using the SCREEN3 model. The SCREEN3 model is developed by the U.S. EPA to provide a simple method to calculate pollutant concentration estimates. This model provides a full range of meteorological conditions including all stability classes and wind speeds to find maximum impacts.

It was assumed that the 13 generators have:

- Model years between 2000 and 2005;
- Comply with the U.S. EPA Tier 1 technology equipments;
- Power ratings of 4000 hp; and
- Tested for 20 hours per year.

It was assumed that only one generated will be operational at a time within a 200×200 m area, with the effective source height of 2.0 m.

The maximum 1-hour, ground-level concentrations from the operation of emergency generator are presented in Table 123.

Table 123 - Ground-level concentration from the operational emergency generator

Downwind Distance [m]	Predicted Ambient Concentration [µg/m^3]		
	NO_X	CO	SO_2
500	1,770	224	20
1,000	963	122	11
1,500	667	84	7
2,000	496	63	6
2,500	392	50	4
3,000	319	40	4
3,500	268	34	3
4,000	229	29	3
4,500	199	25	2
5,000	175	22	2
WHO criterion [µg/Nm^3]	200	5000	303

The effect of the modelled concentration is predicted to be minor for several reasons. First, the existing air quality is good and not apparently impacted by the current testing of six generators from the operating units 1 and 2. Second, while the one hour criterion might be exceeded, this condition could only occur for a maximum of 260 hours per year at approximately 3% of the time. Thirdly the modelling assumption included worst case climatic conditions that would overestimate the effects.

4.1.2 Water vapour emissions

As far as concerns water vapour releases through the cooling towers, during full operation of EMO12 are emitted approximately 3,740 MW of heat energy into the atmosphere in the form of waste heat. The emission of heat and water could lead to local and regional climatic changes. Taking into consideration the relatively low energy output of Mochovce NPP this impact should have only a local significance.

The following effects are displayed:

- increased average air humidity on the ground layer;
- increased average air temperature on the ground layer;
- increased occurrence of ground mist;
- increased volume of rainfall;
- increased formation of frost ;
- decreased period of sunshine;
- creation of water vapour plumes from the cooling towers.

The size of the impact of all four units was elaborated through mathematical modelling by the Slovak Hydrometeorological Institute in Bratislava (Ref. safety report) who came up with the following conclusions:

- average annual increase in the number of hours with the occurrence of mist to a distance of 25 km is 17 hours with a maximum of 66.4 hours in the surroundings of the cooling towers;
- average annual increase in the number of hours with the occurrence of frost to a distance of 25 km is 14.9 hours with a maximum of 58.4 hours in the surroundings of the cooling towers;
- average increase in air temperature in the ground layer of the atmosphere to a distance of 25 km is 0.072 °C, maximum increase is 0.272 °C in the surroundings of the cooling towers;
- increased rainfall intensity is a maximum of 0.0023 mm/hour, total maximum annual rainfall increased by a maximum of 20.2 mm, average to a distance of 2.1 km is 2.1 mm;
- average number of hours with the occurrence of frost to a distance of 2.1 km is 85.5 hours, maximum time is 459 hours for ground to a distance of 0.9 km; and
- average annual reduced period of sunshine is 20.6 hours to a distance of 20 km, maximum is 67.6 hours around the cooling towers.

The intensity of the impact depends on the output of the power plant and the time of year. The greatest intensity is in summer months. The total volume of emissions in 2006 was 15,498,960.00 m^3, and for 2005 was 14,695,839.60 m^3, which corresponds to emissions of 0.49 m^3/s and 0.47 m^3/s, respectively.

These predicted effects of the water vapour releases are considered minor for two reasons. First, the effects are local and largely contained to the Protection zone. Second the magnitude of the effect is well within the normal variation in local meteorological conditions. For example, the change in rainfall is approximately 3% of the yearly average rainfall. In summary the effects of cooling tower emissions on the local microclimate are trivial or barely noticeable.

4.2 Radiological parameters

Human health (including members of the public and workers) has been selected as the VEC for radiological parameters of Atmospheric Environment.

The effects of interactions on VECs occur in the Local Study area (see Table 135, Section C, part VII, paragraph 1.3)

The criteria and the measurement basis for determining the significance of the likely effects are described in Table 139.

Regarding radioactive aerosol, considering that Units 3 and 4 will have approximately the same level of emission of EMO12 and also on the basis of air monitoring program measures (see Section C, part IV, chapter 10.2), the anticipated impacts can be considered negligible.

The extent of the effects of these interactions on VECs is detected through the radio-ecological detailed monitoring plan.

Doses to workers, which are due to Operation of nuclear systems, Radioactive waste management and Spent fuel management, are assessed in the chapter Occupational Health and Safety and workers' Radioprotection (see Design Framework, paragraph 2.9 of Part II EIA Structure).

Considering that exposure for workers of MO34 will be similar to exposure measured for workers of EMO12, the figures of occupational exposure reported in the Design Framework, paragraph 2.9 of Part II EIA Structure show that the expiated collective dose and the maximal individual dose for workers contractors is low compared with WANO Performance Indicator.

The extent of the effects of these interactions on VECs is detected through the radio-ecological detailed monitoring plan and through the organizational and operational measures for prevention, elimination, minimization and compensation of environmental and health impacts as described in Section C, Part IV.

4.3 Likely environmental effects

For non radiological parameters, based on the above assessment of airborne emission, there are no adverse effects of the project on Atmospheric Environment during operation phase (Table 124).

For radiological parameters, a minor adverse effect is identified for human health workers.

Table 124 - Atmospheric Environment - Significance of likely adverse effects

Likely Adverse Effect							
Valued ecosystem component	**Adverse effect**	**Magnitude** (of effect)	**Geographic Extent** (of effect)	**Timing and Duration** (of effect)	**Frequency** (of conditions causing effect)	**Degree of Reversibility** (of effect)	**Significance of adverse effect**
			Non radiological parameters				
Local atmosphere / *Human health*	Effects on air quality due to predicted ambient concentration of conventional emission	*low*	*moderate*	*moderate*	*moderate*	*low*	*no adverse effect*
			Radiological parameters				
Human health workers	*Doses to workers* On average, workers doses are much below the regulatory limits of 20 mSv/year and 100 mSv over a five year period (see section C, Part **III**, chapter 1.0).	*moderate*	*low*	*moderate*	*high*	*moderate*	*minor adverse effect*

5.0 IMPACTS ON WATER CONDITIONS

Project-environment interactions with hydrology and groundwater were identified for project activities during operation phase both for non radiological and radiological parameters.

Likely effects of normal operation on hydrology and groundwater are related to:

- heat release;
- quality of surface water and groundwater;
- aquatic biota conditions; and
- radioactive emissions

5.1 Non radiological parameters

The effects of interactions on VECs (human health and member of the public, Hron River and other water sources quality and aquatic species) occur both in the Local and Regional Study area (see Table 135, Section C, VII paragraph 1.3).

Table 125 presents the evaluation criteria used to assess the likely effects on the hydrology and groundwater.

Table 125 - Criteria used in evaluation of likely effects on Hydrology and Groundwater

Hydrology and groundwater	Evaluation Criteria
Water temperature and quality	• Slovak Decree No 296/2005 • Percent change.
Aquatic biota conditions	• Professional judgement

5.1.1 Heat release

Small amounts of heat can be released into river Hron through cooling tower blow down.

Measurements taken between 1970 and 1982 indicate a maximum river water temperature at Tlmace, upstream of the dam at Veľké Kozmálovce, of 24 °C (VÚVH and SMHÚ, Water Quality of Rivers in Slovakia 1977–1982, Bratislava, 1983).

According to the Slovak Decree No.296/2005, which limits the permissible temperature of non-trout rivers to 26 °C and the maximum river temperature rise to 5 °C, the liquid effluent released to the river is regularly monitored in order to comply with the regulatory limit.

5.1.2 Change to the quality of surface water

Similarly to the heat release, the quality of the liquid effluent is regularly monitored in order to comply with the regulatory limit of the Slovak Decree No.296/2005.

5.1.3 Aquatic biota conditions

In order to determine whether from the operation of EMO12 and MO34 an effect on the aquatic biota is likely, the concentrations of the key chemicals of concerns have been estimated for the downstream environment for river Hron and compared with reference values suggested by the Canadian Water Quality Guidelines for the Protection of Aquatic Life Canadian Guidelines have been chosen on the basis of Golder Associates experience in conducting Environmental Impact Assessment on this issue.

In particular, due to their environmental concern, the following key parameters have been considered:

- hydrazine;
- residual chlorine;
- N-NO_3^-;
- N-NH_4^+.

For the estimation of concentrations of the chemicals in the downstream environment for river Hron due to the operation of MO34, the following data have been utilised:

- chemical background water quality of the river Hron upstream of the discharge;
- maximum, minimum, and average flow of river Hron below the reservoir;
- chemical concentrations in the current effluent and the total effluent with the four units (EMO12 and MO34);
- current discharge flow rate and total effluent with the four units (EMO12 and MO34);
- water quality guidelines for the protection of aquatic life.

In Table 126 the chemical concentrations of considered parameters measured in river Hron water sample collected upstream of the discharge point and in EMO12 discharge water samples are reported.

Table 126 - Measured concentration of chemicals of concerns in river Hron and discharge water samples.

Parameter	Units	River Hron Water	Discharged Water
N-NH_4^+	mg/l	0.109	0.46
N-NO_3^-	mg/l	1.38	7.63
residual Chlorine	mg/l	<0.05	<0.05
hydrazine	mg/l	<0.2	<0.2

The indicated values show that hydrazine and residual chlorine do not present a substantial increment in the measured concentrations in the upstream samples and in the discharged samples. Considering that from operation of MO34 the discharged concentrations of the parameters of interest will be approximately the same of the ones coming from the operation of EMO12, hydrazine and residual chlorine have not been considered for the estimation of likely effects on the aquatic biota.

For the estimation of concentrations of the above mentioned chemicals, the dilution factors of discharged water have been calculated, considering that the discharge low rate of 4 units will be approximately double compared to the discharge due to the operation of two units.

In order to calculate the dilution factor for discharge water, the average, maximum and minimum flow of river Hron below the reservoir, reported in Table 127, have been considered and referred to the effective discharged flow rate for 2 units and estimated discharge flow rate for 4 units (Table 128).

The river Hron flow rates have been chosen in order to take into consideration the most conservative hypotheses.

Table 127 - River Hron flow rates

Profile	Long-term average flow rate [m^3/s]	1-yearly max flow rate [m^3/s]	100-yearly min flow rate [m^3/s]
V. Kozmálovce-Hron	47.16	320	7.78

Table 128 - Effective discharged flow rate for 2 units and estimated discharge flow rate for 4 units

	Discharged flow rate [m^3/s]
Effective value for EMO12 in 2005	0.16
Estimated EMO12+MO34	0.32

The dilution factor for two and for units in case of average, minimum and maximum flow rate of river Hron are reported in Table 129.

Table 129 - Dilution factors

	Dilution factor (/)	
	EMO12	**EMO12+MO34**
Long-term average flow rate	294.75	147.38
1-yearly maximum flow rate	2,000.00	1,000.00
100-yearly minimum flow rate	48.63	24.31

On the basis of the calculated dilution factor, it has been possible to estimate the concentrations of the considered chemicals in the downstream environment of river Hron.

The estimated values are reported in Table 130, and compared with reference values suggested by the Canadian Water Quality Guidelines for the Protection of Aquatic Life.

Table 130 - Estimated values of the considered chemicals in the downstream environment and reference values

Parameter	Units	EMO12	EMO12 + MO34	Reference values
		long-term average flow rate		
$N\text{-}NH_4^+$	∝g/l	1.56	3.12	-
$N\text{-}NO_3^-$	∝g/l	25.89	51.77	13,000
		1-yearly maximum flow rate		
$N\text{-}NH_4^+$	∝g/l	0.23	0.46	-
$N\text{-}NO_3^-$	∝g/l	3.82	7.63	13,000
		100-yearly minimum flow rate		
$N\text{-}NH_4^+$	∝g/l	9.46	18.92	-
$N\text{-}NO_3^-$	∝g/l	156.92	313.83	13,000

Therefore, the estimated values for the considered chemicals of concerns result lower than the reference values suggested by Canadian Water Quality Guidelines for the Protection of Aquatic.

5.2 Radiological parameters

Project-environment interactions with Radioactivity in surface water and in the aquatic environment, included groundwater, were identified for projects activities during operation phase.

The extent of the effects of radioactivity in surface water and in the aquatic environment, included groundwater is detected through the radio-ecological detailed monitoring plan.

The effects of interactions with VECs (Human health and member of the public) occur in the Regional Study area (see Table 135, Section C, VII paragraph 1.3).

The criteria and the measurement basis for determining the significance of the likely effects are described in Table 139.

The extent of the effects of these interactions on VECs is detected through the radio-ecological detailed monitoring plan.

As rightly estimated in section C, part III, paragraph 1.5.3, it is expected that when the new units will be in operation, the annual discharges of MO34 will be comparable with EMO12 discharge.

It is clear that 95% of the (negligible) dose from releases from the NPP will be due to tritium discharge to river Hron.

It can be useful to remark that the tritium calculated dose itself is much less than normal variations of the natural background. For example, the calculated tritium dose is lower than the variations (decrease) of natural dose rate (at 1 m above ground) after 10 mm of rain. In other words, these variations have an effect on individual dose greater than tritium contribution dose (NUREG Report 1501/August 1994 on parts regarding the variability of background radioactivity).

Anyway, on the basis of the constant SE care about the environment, Mochovce NPP could focus its environmental sampling programme on levels of tritium in the groundwater and in river Hron. Since the model RDEMO© conservatively overestimates real dose situation, the much conservatively model for tritium dose calculation should be refined too.

Moreover, due to the use of new gadolinium fuel, tritium production in reactors should be decreased by about 27% in comparison with the current situation. This will also result in decrease of tritium doses to critical group.

5.3 Likely Environmental Effects

For non radiological parameters, no long-term build up of pollutants in the environment is likely because of the limited amount of water based releases. Monitoring programs are identified in Chapter 8 “Plan for follow-up and monitoring program” which are directed towards verifying this conclusion.

For radiological parameters, a minor adverse effect has been identified for *Human health and member of the public.* .

The significance of the likely effects is evaluated in Table 131.

Table 131 - Hydrology and groundwater- Significance of likely adverse effects

		Likely Adverse Effect					
Valued ecosystem component	**Adverse effect**	**Magnitude** (of effect)	**Geographic Extent** (of effect)	**Timing and Duration** (of effect)	**Frequency** (of conditions causing effect)	**Degree of Reversibility** (of effect)	**Significance of adverse effect**
		Non radiological parameters					
Hydrology, Hydrogeology and Aquatic biota	*Chemical and physical effect*	*low*	*moderate*	*moderate*	*high*	*low*	*no adverse effect*
		Radiological parameters					
Human health and member of the public	*Doses to member of the public* maximum annual effective dose for inhabitants calculated by model for normal operation of 4 reactors (0.215 μSv/year) is negligible compared with maximum annual effective dose to inhabitants from critical group (250 μSv/year).	*low*	*low*	*moderate*	*high*	*moderate*	*minor adverse effect*

6.0 IMPACTS ON SOIL

Commencing operation of MO34 and the proper operation thereof will not encroach upon further agricultural or forestry land nor will it have an impact on the extent of the utilized land. The rainwater drainage system has been developed in the framework of the construction activities and it is combined with EMO12 as well.

This is why impact on the stability and erosion of the soil is unlikely.

No long-term build up of pollutants in the soil is likely because of the absence of measurable effects on the terrestrial environment. Monitoring programs are identified in Chapter 8 "*Plan for follow-up and monitoring program*" which are directed towards verifying this conclusion.

7.0 IMPACTS ON FAUNA, FLORA AND THEIR BIOTOPES

The likely effects on vegetation, flora and fauna, natural reserves and protected areas (including habitat and biota) as a result of radioactive emissions and airborne effluents releases are assessed in Section C, part III, chapters 4.0 and 5.0.

It is not expected that operation of MO34 could considerably influence (by synergic or cumulated effect from the existing nuclear sources - 4 units of the NPP) the gene pool and biodiversity (population, flora, fauna or vegetation).

Only the likely effects of conventional releases are evaluated in this section.

No long-term build up of pollutants in the environment is likely because of the absence of measurable effects on the terrestrial environment. Monitoring programs are identified in Chapter 8 "*Plan for follow-up and monitoring program*" which are directed towards verifying this conclusion.

8.0 IMPACTS ON LANDSCAPE

In consideration that civil parts of NPP are completed up to 70%, the commission and operation of units 3 and 4 of Mochovce NPP have no likely effects on the landscape.

Should the proposed activity not be carried out (zero variant) the impacts on the landscape would remain the same. The structure and the utilization of the landscape as well as the relation of the representation of the particular natural elements in the affected area would not change due to the proposed activity, and neither would the relation between the natural and anthropogenic elements of the natural environment.

As far as the impact on the landscape scenery is concerned, it is reasonable to state that the ongoing construction of the internal technology of MO34 and its subsequent operation will not change any aspect of the local landscape.

9.0 IMPACTS ON PROTECTED AREAS AND THEIR PROTECTION ZONES

No interactions between the Project and protected areas were identified during the operations phase and consequently no likely effect occurs.

The operation of the MO34 will be realized in a closed area of SE EMO which is located approximately in the center of the three-kilometer protection zone of the nuclear power plant (area of the facility). In this area there are no protection zones and they cannot be declared due to the existing nuclear facility. A conservative estimation of the effect of the facility on the boundary of this area is under natural background levels and it will not have any negative consequences on protected areas and their protection zones (see Annex 2, maps 8 and 9).

10.0 IMPACTS ON DEVELOPMENT OF ENVIRONMENTAL SYSTEMS

The likely effects deriving from the commission and operation of Units 3 and 4 of Mochovce NPP are reasonably comparable with likely impact coming from operation of Units 1 and 2.The results of the environment impact assessment have highlighted that the significance of the identified likely adverse effects is minor.

Therefore the area is not expected to develop in a way other than how it will be with Units 3 and 4, due to the minor likely adverse effects identified and to the presence of Units 1 and 2.

11.0 IMPACTS ON URBAN COMPLEX AND LAND USE

No interactions between the Project and land use were identified during the operations phase and consequently no likely effects occur.

The urban complex is made by the existing arrangement of the area characterized by building structures, civil and technical equipment, communications and technical infrastructure, which constitute, together with the functional utilization of the area, an indivisible unit managed by its population. The area is characterized as being a mixture of historical buildings with the modern complex and distribution systems, the economic and territorial effect of which exceed the boundaries of the area.

This report describes the impacts of the proposed variants (zero and proposed activity) of the operations on the urban complex and the land use.

If the proposed activity is not realized (zero variant), the impacts on the urban complex and the land use would remain unchanged.

12.0 IMPACTS ON CULTURAL AND HISTORICAL LANDMARKS

No interactions between the Project and cultural and historical heritage were identified during the operations phase and consequently no likely effects occur on the cultural and historical folk traditions.

13.0 IMPACTS ON ARCHEOLOGICAL LOCALITIES

No interactions between the Project and archeological localities were identified during the operations phase and consequently no likely effects occur.

14.0 IMPACTS ON PALEONTOLOGICAL LOCALITIES AND IMPORTANT GEOLOGICAL LOCALITIES

No interactions between the Project and paleontological localities and important geological localities were identified during the operations phase and consequently no likely effects occur.

15.0 IMPACTS ON CULTURAL VALUES OF AN INTANGIBLE NATURE

No interactions between the Project and cultural values of an intangible nature were identified during the operations phase and consequently no likely effects occur.

16.0 OTHER IMPACTS

The present study has established that effects to economic conditions are likely as a result of the project. The effects and their significance are summarized below:

- creation of new employment opportunities and maintenance of existing jobs within the study areas, resulting in improved employment stability;
- increase of the population associated with, or directly dependent on, MO34 related employment.

It is determined that the above represents a positive effect. Increased employment associated with MO34 will serve to maintain income levels, which are a major determinant of an individual's or family's quality of life. Mochovce NPP will remain one of the single largest employers in the region. These effects will contribute to economic activity growth trough process expenditure and pay rolls.

- Creation of new business activity and increased number of industrial, commercial and institutional business/operations associated with, or directly dependent on, Mochovce NPP related expenditures.

It is determined that the above represents a positive effect. Increased business activity associated with MO34 will contribute to growth and development in the local and regional economic base.

- Increased community stability trough existent of a long term power plant with employment opportunities.

It is determined that the above represents a positive effect. Increased population associated with MO34 will contribute to the maintenance of the social structure and stability of communities across the region.

17.0 SPATIAL SYNTHESIS OF THE IMPACTS OF THE ACTIVITY IN THE AREA

Spatial synthesis of the impacts is described within the assessment process of each environmental component.

Supposed anthropogenic impact, its relation to the ecological stability of the area

The proposed activity (operation of the nuclear power plant) will be performed in the area of SE-EMO. The anthropogenic impact of the area will be increased only very slightly by the effect of the operations of the NPP, predominantly by the small increase of the frequency of transport connected with the operation of the plant.

Spatial extent of the supposed overloading of site

The vulnerability of water (section C, part II, chapter 6), soil (chapter C, II.2.4), air (chapter C, II.5), fauna and flora (chapter C, II.7), the quality of life (chapter II.11) and ecological profitability (chapter II.10), will not be influenced by the proposed activity more than the permitted extent. That is why it is reasonably not to expect further impacts on the vulnerable elements of the environment in the overloaded localities of the area.

18.0 COMPLEX ASSESSMENT OF ANTICIPATED IMPACTS IN TERMS OF THEIR RELEVANCE AND THEIR COMPARISON WITH LEGAL REGULATIONS IN FORCE

As reported in the Design Framework and in Section B, Part II Output data, and as assesses for each considered environmental component, the commission and operation of MO34 will be in compliance with legal regulation in force.

Following the Impact assessment procedure, the likely environmental effects associated with the project have been identified and the mitigation measures that have been identified to eliminate, reduce or control any adverse effects; and the likely residual effects that remain after mitigation are here described.

The assessment has been conducted in accordance with the four-step process described in Section C, Part VII.

Project/environment interactions that remain following Steps 1 and 2 of the assessment methodology are evaluated and the associated effect(s) described.

Consistent with accepted practice, quantitative as well as qualitative methods, including professional expertise and judgement, are used to predict and describe the likely effects. Specific assessment criteria are applied to assess the importance of each effect in each environmental component.

Each interaction is considered individually and associated effects described. Based on the identified criteria, a determination is made as to whether an effect is likely, and if so, the nature of the effect is described. If effects are unlikely or negligible, no further assessment is conducted.

Otherwise, the effects are advanced for further consideration of mitigation and residual effects.

The criteria applied for the individual environmental components and the assessment of likely effects is presented individually for each environmental component within Section C, Part III.

The assessment of likely environmental involved the evaluation of inter-connections among the components and consequently effects resulted from.

The inter-dependencies among the components are recognized by means of the linkages from the physical and socio-economic components through to the biological components (and VECs) and ultimately to human health (Figure 59).

Likely effects have been identified for the following environmental components:

- Atmosphere environment;
- Hydrology and groundwater.

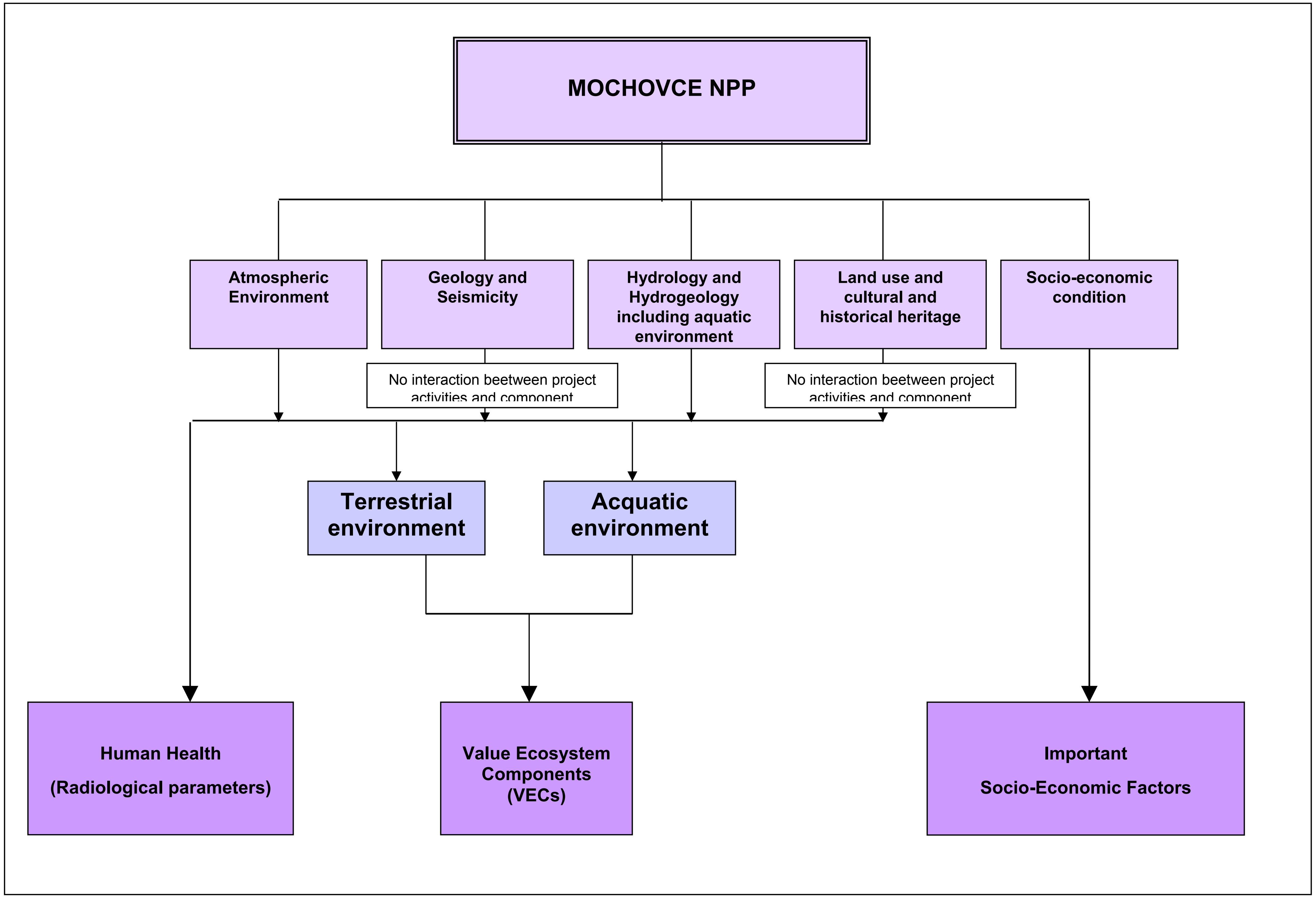


Figure 59 - Inter-relationship of project and environmental components

Determination of the significance of the residual effects of the project is the fourth step in the assessment of effects process.

Residual environmental effects are those that remain after the preceding assessment process, including the application of mitigation to eliminate, reduce or control the adverse effects of the project where appropriate. It was determined through the assessment of effects of the project that some residual effects are likely. These residual effects are summarized in Table 132.

The significance of each residual effect was established within a framework of criteria and effect levels. To ensure a consistent and reproducible evaluation, the common criteria are used for all residual effects within all environmental components (Table 132).

The definition of the level of effect within each criterion varies by environmental component to recognize that the units and range of measurement are distinct for each component.

Environmental effects associated with the project have been described and their significance evaluated in the preceding sections. The evaluation was conducted individually for each residual effect within each environmental component.

A summary of the residual environmental effects and their significance is presented in Table 132.

No likely adverse effects were identified in either the completion or operations phase for Atmospheric Environment and Hydrology, Hydrogeology and Aquatic Environment.

A minor adverse effect was identified in the operations phase for the radiation exposure to workers and members of the public. The predicted doses are well below regulatory limits. For example the predicted dose to members of the public as a result of the project is less than 0.1% of Slovak and international standards (a summary of these results is provided in Tables 105 and 106).

Table 132 - Summary of adverse and beneficial effects

Likely adverse/beneficial environmental effect	*Identified mitigation*	*Residual adverse /beneficial effect*
Atmospheric Environment		
Non radiological parameters		
None	No mitigation measure required	None
Radiological parameters		
Increase in the average individual radiation doses to workers and to members of the public as a result of the Completion of MO34	Policies and operational procedures. Adoption of burnable gadolinium fuel elements	Radiation doses to worker and member of the public are low or not detectable
Geology and Seismicity		
None	No mitigation measure required	None
Hydrology and Groundwater including Aquatic Environment		
Non radiological parameters		
None	No mitigation measure required	
Radiological parameters		
Increase in the average individual radiation doses to workers and to members of the public as a result of the Completion of MO34	Policies and operational procedures. Adoption of burnable gadolinium fuel elements	Radiation doses to worker and member of the public are low or not detectable
Increase of background tritium concentration in surface water and groundwater	Adoption of burnable gadolinium fuel elements. Development of an *radioecological analysis*	Radiation doses to worker and member of the public are low or not detectable, therefore the expected doses to aquatic biota will be as well low or not detectable
Terrestrial Environment		
None	No mitigation measure required	None
Land Use and Cultural and Historical Heritage		
None	No mitigation measure required	None
Socio-economic Condition		
Increase economic activity trough process expenditures and pay-roll		Beneficial effect:
Increase community stability trough existent of a long term power plant with employment opportunities		Beneficial effect:

18.1 Conclusions

Mochovce is an operating NPP with two units in operation since 1999 and two units in a partially completed state. The project involves the commission and operation of units 3 and 4 and the operations of all 4 units to generate electricity for distribution to the Slovak Republic grid.

This Report provides the results of an assessment of the likely effects on the environment due to the commission and operation of units 3 and 4 and the continued operations of all 4 units for approximately 40 years.

It is noted that Mochovce is an existing facility on a well established site with an existing Protection Zone (approximately 3 km). As a result of more than 6 years of operations, extensive measures have been incorporated to ensure that the effects of the project are monitored and mitigated using practical technology. In carrying out the environmental assessment existing safety and environmental protection systems and programs were taken into account along with planned enhancement and environmental programs.

The assessment of the environmental effects of the project and their significance is described in section C, Part III.

For non radiological parameters, no residual adverse effects were identified in the operations phase for Atmospheric Environment, Geology and Seismicity, Hydrology, Hydrogeology and Aquatic Environment.

For radiological parameters, a minor adverse effect was identified in the operations phase for the radiation exposure to workers and members of the public. The predicted doses are well below regulatory limits. For example the predicted dose to members of the public as a result of the project is less than 0.1% of Slovak and international standards (a summary of these results is provided in Table 133).

The EIA also considered the effects of accidental conditions that might be expected and found that existing and planned safety measures are sufficient to mitigate any adverse effect.

Taking into account the findings of the present EIA Study, including the identified mitigation measures, it is a SE conclusion that the project is not likely to have any significant adverse effect on the environment. Indeed, the project will result in a number of positive effects through reducing greenhouse gases emissions (if compared to conventional power plant) and providing economic benefits to the immediate and surrounding communities.

Table 133 - Summary of residual adverse/beneficial effects of the Project and their significance

Residual adverse effect	Significance
Atmospheric Environment	
Non radiological parameters	
Change in local climate due to predict increased of the amount of heat discharged to atmosphere	No adverse effect
Radiological parameters	
Increase in the average individual radiation doses to workers and to members of the public as a result of the Completion of MO34	Minor adverse effect (not significant)
Hydrology and Groundwater including Aquatic Environment	
Non radiological parameters	
Chemical and physical effect	No adverse effect
Radiological parameters	
Increase in the average individual radiation doses to workers and to members of the public as a result of the Completion of MO34 Increase of background tritium concentration in surface water and groundwater	Minor adverse effect (not significant)
Socio-economic Condition	
Beneficial effect: increase economic activity trough process expenditures and pay-roll Beneficial effect: increase community stability trough existent of a long term power plant with employment opportunities	Beneficial effect

19.0 OPERATIONAL RISKS AND THEIR POTENTIAL IMPACT ON THE AREA

Operational risks are assessed in the Design Framework and section C, Part IV of present report.

IV PROPOSED MEASURES FOR PREVENTION, ELIMINATION, MINIMIZATION AND COMPENSATION OF ENVIRONMENTAL AND HEALTH IMPACTS

1.0 PHYSICAL-PLANNING MEASURES

The radiation dose targets for an individual of the population due to radioactive releases from the NPP during normal/abnormal operation for siting of the nuclear facility, shall not exceed the maximum dose allowed by Slovakian regulatory body (Ordinance of the Government No 345/2006), which is 0.25 mSv/year.

The exclusion area (Protection Zone) for Mochovce NPP was determined by Decree of Region Health Officer No. H-IV-2370/79 from 15.10.1979; it is a zone in which permanent residence is prohibited. The average distance of exclusion area boundary to Mochovce NPP is about 3 km (Figure 60).

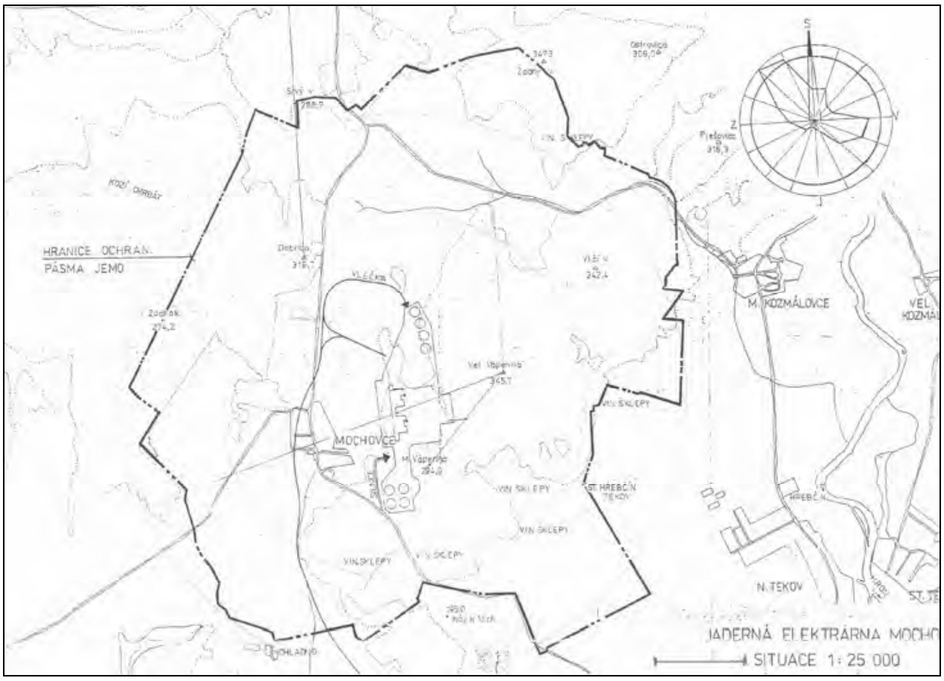


Figure 60 - Exclusion Area Border (Protection Zone) of Mochovce NPP

This radiation dose target is stated in compliance with Ordinance of the Slovak Government No 345/2006 on Basic Requirements for Radiation Protection of Public and Workers against Ionization Radiation and on the decision of the Slovak regulatory body valid for Mochovce NPP site. The use of dose constraint (250 µSv/year) is fully according with ICRP recommendations and the objectives of European Community Directive 96/29.

2.0 TECHNICAL MEASURES

The most significant technical measures applied for the reduction of impacts on the envionment and health are described in the Design Framwork (Section II, Chapter 2).

3.0 TECHNOLOGICAL MEASURES

The most significant technological measures applied for the reduction of impacts on the envionment and health are described in the Design Framwork (Section II, Chapter 2).

4.0 ORGANIZATIONAL AND OPERATIONAL MEASURES

4.1 Measures during normal operation

An external laboratory of radiation control was built in Levice (ELoRC Levice) in connection with the adopted radiation protection measures of the Mochovce NPP to monitor the radioactivity of the environment in the surroundings of the Mochovce NPP. It began its activities in 1986, about the time of the Chernobyl accident, with the aim of obtaining to data prior to the NPP being put into operation. During the first year of its activity, the laboratory focused its attention on monitoring foodstuff for the National Veterinary Institute within the radiation monitoring following the accident of the Chernobyl NPP.

At the same time, ELoRC Levice focused on performing activities of pre-operation monitoring of radioactivity in connection with construction and finishing of EMO12. Currently, ELoRC Levice performs monitoring of radioactivity of elements of the environment in connection with the operation of EMO12, FSKRAO and RÚRAO in Mochovce for the purpose of monitoring the influence of the operation of EMO12 on the surroundings. Because of the approved monitoring programme for the surroundings of the Mochovce NPP and the implementation of the programme, it may be stated that ELoRC Levice performs monitoring of the surroundings for all four units – EMO12 and MO34 under construction - within the fulfilment of the monitoring programme.

In addition, each year a Report on Controlling Radioactivity in the Surroundings of SE-EMO is issued. It presents results of the monitoring of the impact of the NPP operation on particular elements of the environment. The report is prepared by the department of ELoRC and TDS. The report contains also the programme of monitoring in the surroundings of NPP for particular year, and all the results of monitoring (of direct measurement of radiation characteristics in the field, and the results obtained based on samples taken in the environment and their laboratory evaluation in ELoRC Levice).

Samples of air, soil, water and food chain (feedstuff, milk, agricultural products etc.) from the territory within 20 km from the plant are regularly measured and evaluated by the Laboratory of Radiation Control of the Surroundings in Levice (ELoRC). All potentially radioactive influences of emissions and other exhaust released into air and hydrosphere (surface water, drinking water, current sediments on the bottoms of reservoirs etc.) on the surroundings of the plant are monitored.

In line with the monitoring plan for radiation control of the Mochovce NPP surroundings, EMO/2NA-052.01-02, the Mochovce NPP controls the radiological influences on the environment and population. Monitoring is focused on documenting that radiological influences, i.e. exposure of population and concentration of isotopes from emission, are lower than limits set in Appendix No 3 of the Slovak Republic Government Decree No 345/2006 Coll. on main safety requirements of health protection and public protection from ionizing radiation (and limits set by the Nuclear Regulatory Authority of the Slovak Republic), and that these impacts are as low as reasonably achievable – ALARA.

The present monitoring reults of operation in surrounding of EMO12 allow the assessment of likely environmental impacts and constitute a basis for the assessment of future likely impacts of MO34 when it will be operating.

In the surroundings of the Mochovce NPP, 15 stable dosimetry stations (SDS) are located; one station is on the grounds of the National Disposal Site of Radioactive Waste (RR RAW) in Mochovce that is operated by the Nuclear and Decommissioning Company, a.s. (JAVYS). The stations continually take aerosol particles by means of the absorption on filters. In addition, they contain polyethylene tank to collect the fall (both, dry and wet together) and also cartridges equipped with thermoluminiscent dosimeters (TLD) on protuberant arms. Environmental radiation monitoring covers the territory within approximately 15 km from the plant.

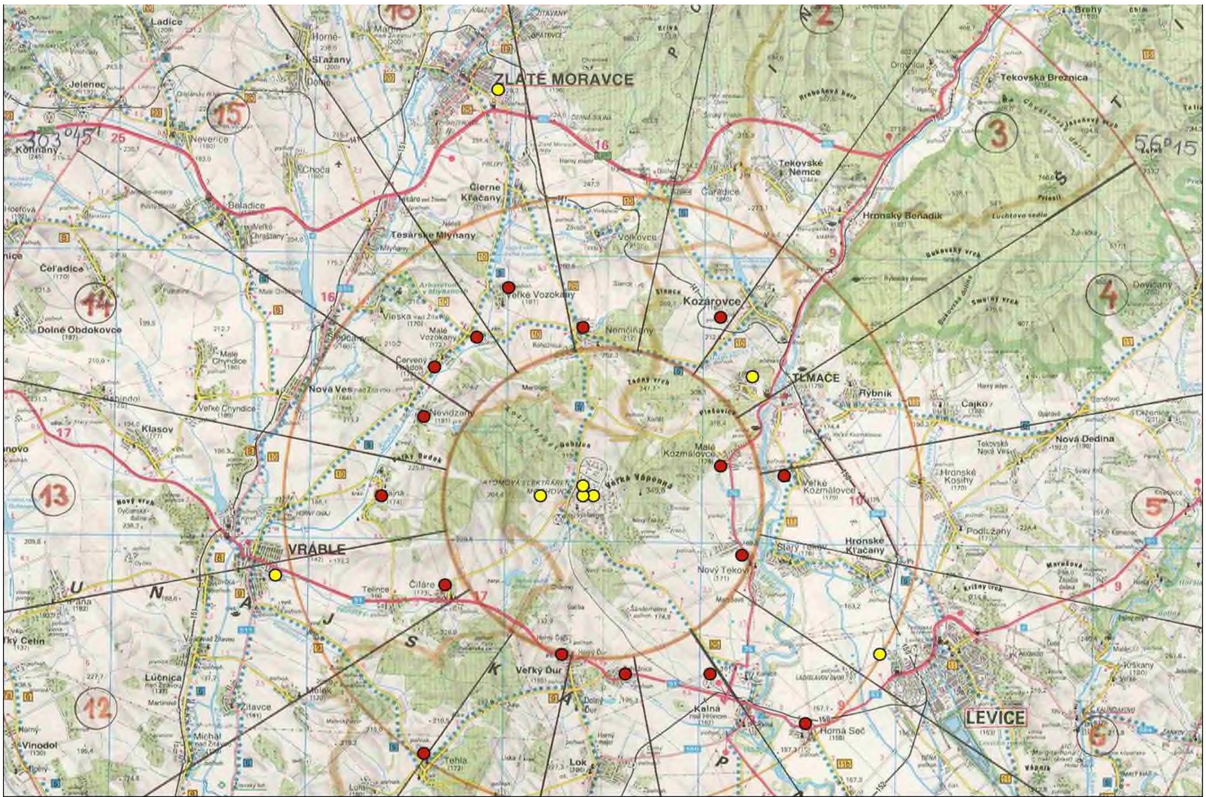
In the surroundings of the Mochovce NPP, 24 monitoring stations of teledosimetry system (TDS) are located. They monitor the input of the gamma radiation, volume activity of aerosols and radioactive iodine (TDS – Figure 61).

The range of monitoring of the surroundings of the site since operations begin has only been slightly modified. The monitoring of several isotopes was expanded to include more commodities. Each year the monitoring is slightly modified based on the actual situation. All changes are described in annual reports.

Monitoring is controlled by the regulation “Programme of radiation monitoring in the vicinity of Mochovce NPP (QA-07-01)” that describes the radiation monitoring around NPP Mochovce in radius of 20 km from the plant.

Figure 61 - TDS station

Figure 62 shows placement of measurement stations TDS stations. They are placed in two circuits. The 1st circuit of the NPP is made up of 16 monitoring stations of type 1 and 3 stations of type 3. The measuring station of the system on the 1st circuit is made up of a freestanding building. The 2nd circuit approximately 3-15 km from the NPP is made up of 21 control measuring points on which there are 16 monitoring stations of type 2 and 5 of type 3. Each measurement station is made up of a freestanding building.



TDS - Mochovce (3x), Levice, Tlmače, Z. Moravce, Vráble, RÚ RaO

TDS – Nemčiňany, V. Vozokany, M. Vozokany, Č. Hrádok, Nevidzany, Tajná, Čifáre, Tehla, V. Ďur, Rohožnica, Kalná, H. Seč, N. Tekov, V. Kozmálovce, M. Kozmálovce, Kozárovce,

Figure 62 - Placement of stations TDS in the surroundings of the Mochovce NPP

The purpose of the first circuit is to provide data on the size of any possible release and the data is used for decision making for the first prognosis of the impact of a nuclear accident on the NPP and its surroundings, or it can help in determining whether there has been a release of radionuclides to the air and to provide information on it. The aim of the second TDS circuit is to provide information on the actual radiation situation in selected settlements close to the NPP with larger populations.

The main components of the TDS stations are:

- TDS type 1- gamma radiation dose rate monitor;

- TDS type 2 - gamma radiation dose rate monitor, sampler for captured aerosol and iodine activity;
- TDS type 3 - gamma radiation dose rate monitor, aerosol and iodine monitor.

The monitored radiological values are:

- dose rate of gamma radiation;
- volume activity of aerosol;
- volume activity of radioactive iodine.

Other monitored values and signals are:

- air inflow for measuring the bulk activity in aerosol;
- temperature;
- charge of the accumulators;
- state of the electrical safety signalization;
- presence of power.

A more detailed description of particular measurements and an analysis of obtained results are given in Section C, Part IV of this report.

4.2 Measures in case of accidents – Emergency Plan

The design, project execution and operation of nuclear power plants ensure that the likelihood of an accident resulting in significant radiation exposures to workers and members of the public is very small. Nevertheless, it is still necessary to prepare suitable emergency procedures, means and equipment – an integral part of emergency response for all levels of accidents. The existence of a proper emergency plan is a standard practice – it is a prerequisite for licensing process resulting in granting a licence for operation of the nuclear installation.

The legal requirements on emergency preparedness come from Act No.541/2004 Coll. on Peaceful Utilization of Nuclear Energy, Act No. 355/2007 Coll., Act No. 444/2006 Coll. on Civil Protection of Population and Ministerial Order No. 345/2006 Coll.

The UJD Decree No. 55/2006 on Details in Emergency Planning in Case of Accident describes the main principles and details for emergency planning and preparedness of operators, as well as of state and municipal authorities located outside the plant (off-site authorities).

In accordance with the above acts, the operating organization, regulatory bodies and public authorities shall cooperate to prepare emergency plans.

The major tasks of emergency planning and preparedness are as follow:

- to decrease the risk of accident or emergency, or to reduce their consequences;
- to prevent serious direct health damage (death, etc.); and
- to decrease the probability of possible later health damage (e.g. cancer) as far as it is reasonably achievable.

Emergency preparedness is a complex of activities aimed at fulfilling all measures necessary to protect employees and other persons, if risk of accident or release of radioactive materials is possible. It includes establishment of emergency plans, training system, correct procedures and exercises for individuals, authorities and organizations to perform activities which have to be fulfilled according to On-site Emergency Plan (OEP) and Off-site Emergency plans – Plans for Population Protection in the threatened area. Accordingly, preparation and precise activities of EMO personnel shall be ensured if it comes to significant emissions of radioactive materials into the working environment and surroundings and it is necessary to take measures to protect human health in the area of the nuclear facility, as well as health of inhabitants in the surroundings of the nuclear facility.

Plant Manager is responsible for maintaining emergency preparedness in accordance with the requirements stated in legislation.

4.2.1 Off-Site Emergency Plan

The National Emergency Plan in case of Nuclear or Radiation Accident describes activities, links of individual units of national emergency response organization. It provides a balance of forces, sources and means necessary for an effective response.

It specifies the links to IAEA and cooperation with neighbouring countries in accordance with bilateral and international agreements.

The "Plan of Population Protection in case of Radiation Accident in Nuclear Power Facilities" (JEZ) is the document based on which the off-site emergency response is managed. The plans were prepared by Emergency Control Departments of County Councils in Nitra and Banská Bystrica in accordance with the Act No. 541/2004 Coll. on Peaceful Utilization of Nuclear Energy, UJD Decree No. 55/2006 on Details in Emergency Planning in Case of Accident, Act No. 444/2006 Coll. on Civil Protection of Population and Ministerial Order No. 345/2006 Coll.

It defines the organizations involved in regional emergency preparedness and defines duties of the individual subjects.

The Government of the Slovak Republic is responsible for the national emergency planning and preparedness. The relevant ministries are responsible for coordination of preparedness and potential activation of the Integrated Emergency System of the Slovak Republic.

Off-site Emergency Response Organization is provided at two levels:

- National level - the Safety Committee of SR and the Central Emergency Headquarters of SR are the control and coordination bodies for events during which population and environment are in a danger. They provide uniform preparedness and efficient realization of measures for protection as well as actions during a radiation event considering both the public and economy in the territory of the Slovak Republic. The Safety Committee is established by the Government of the Slovak Republic.

- Regional level - emergency commissions are established at district and municipal councils. They are coordinated by the emergency commissions of county councils in Nitra and Banská Bystrica. The commissions are responsible for "planning measures according to the relevant region". Plans of Public Protection are approved by the Ministry of the Interior of the Slovak Republic and assessed by the Nuclear Regulatory Authority (UJD).

The National Emergency Response Organization is shown in Figure 63.

4.2.2 On-site Emergency Plan

The basic documentation is “On-site Emergency Plan” putting emphasis on emergency events related to radiological hazard to the personnel within the territory of nuclear facility and is linked to the Plans of Public Protection in the surroundings of nuclear facility. The On-site Emergency Plan shall include measures in case of emergency events involving combination of non-nuclear and nuclear hazards in accordance with UJD Decree No. 55/2006 usiing also the IAEA documents TEC-DOC 955 and the updated document IAEA TEC-DOC 953. The On-site Emergency Plan came into force after being approved by the Nuclear Regulatory Authority of the Slovak Republic (UJD) and positively appraised by the Ministry of Foreign Affairs of the Slovak Republic.

The On-site Emergency Plan was coordinated with the Off -site Emergency Plans – i.e. with the Plans of Public Protection.

The detailed description of plan chapters is given in the section Emergency Plan Implementing Procedures.

They relate mainly to classification of emergency state, evaluation of technology, prognoses, development of events and implementation of protective measures.

SE-MO34 prepared for the construction period, in accordance with the Act No.541/2004 Coll. on Peaceful Utilization of Nuclear Energy and UJD Decree No. 55/2006 Coll., the Preliminary On-site Emergency Plan approved by UJD Decision No. 272/2007 of 14.08.2007. The Preliminary On-site Emergency Plan follows the EMO On-site Emergency Plan approved for the Units 1&2 that are in operation. The SE-MO34 plant created an emergency team of the plant managing and coordinating activities which follow from the Preliminary On-site Emergency Plan in the territory of SE-MO34 plant in accordance with the instructions of ERO SE EMO (On-site Emergency Response Organization). In accordance with the Integrated Safety Plan the main contractors of construction and assembly works prepared their own emergency plans a created own emergency teams in connection to the Preliminary On-site Emergency Plan for MO34 and the SE-MO34 emergency team.

*On-site Emergency Response Organization (**ERO**)* is establishment and arrangement of departments and personnel in licence holder´s organizational structure in such mutual links with the appropriate state and municipal authorities that ensure performance of actions necessary to prevent accidents in nuclear facilities or to mitigate and remove the consequences. The basic diagram of the Emergency Response Organization is shown in Figure 64. Links between ERO and the National Emergency Response Organization are shown in Figure 63.

The Emergency Response Organization includes:

a) classification of operational states of nuclear facility, in case of an accident determination of severity and anticipated course,

b) announcing the accidents according to severity ,

c) notification of personnel in the territory of nuclear facility and in the threatened area, way of warning population and giving information about the accident,

d) licence holder´s emergency response organizational structure,

e) technical, communication and material means designed to suppress any accident or mitigate the consequences including their back-up systems,

f) alert system,

g) monitoring of the territory and surroundings of the nuclear facility,

h) protection of employees and other persons legally moving on the territory of nuclear facility,

i) trainings on On-site Emergency Plan and practising the plan,

j) links to Plan of Public Protection) in the threatened area,

k) criteria for cancellation of emergency states and principles of nuclear facility restoration,

l) giving information to public,

m) list of bodies, legal entities and physical entities involved in the actions of the emergency plans,

n) fire protection documentation,

o) plan of medical measures.

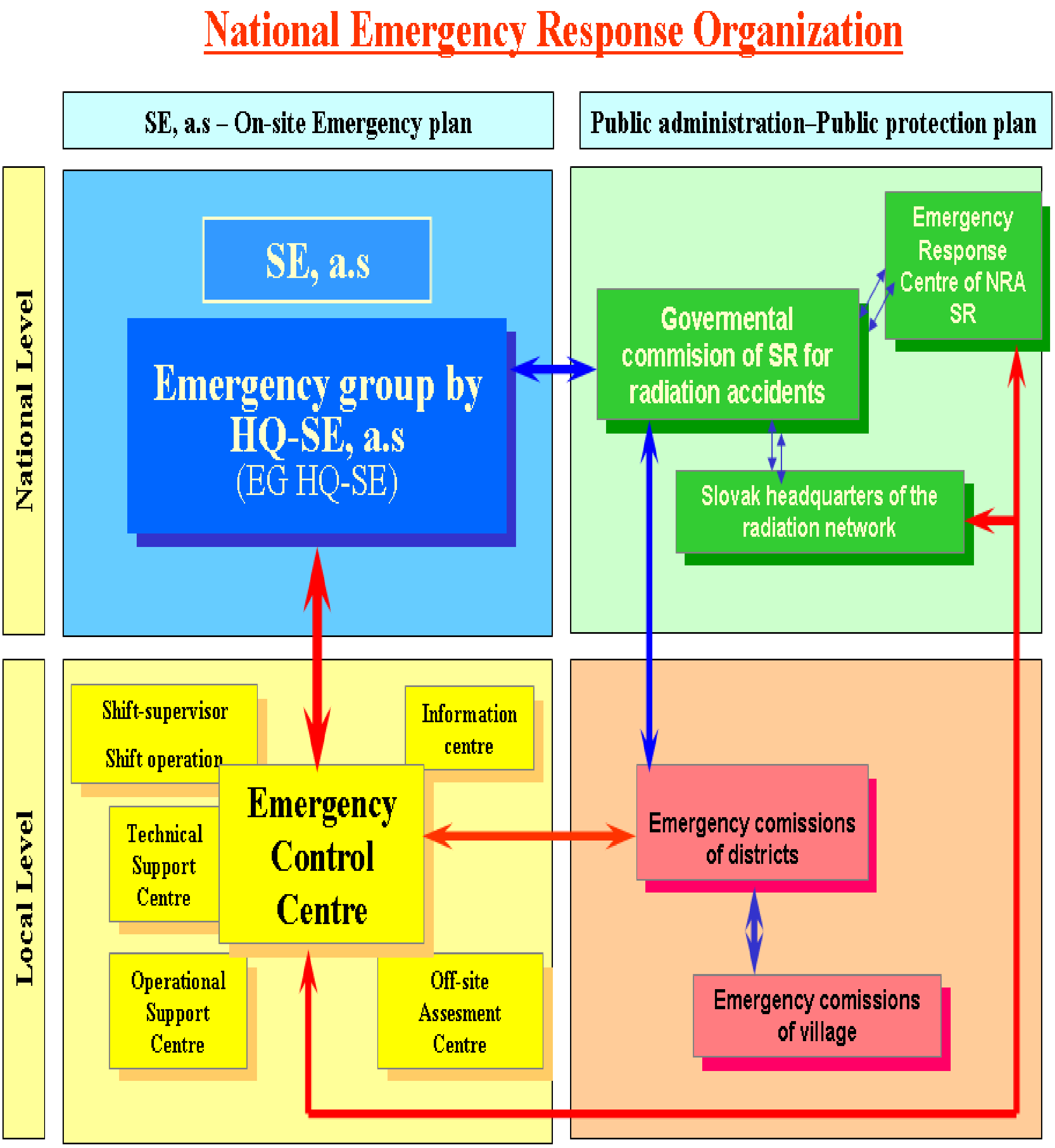


Figure 63 - National Emergency Response Organization

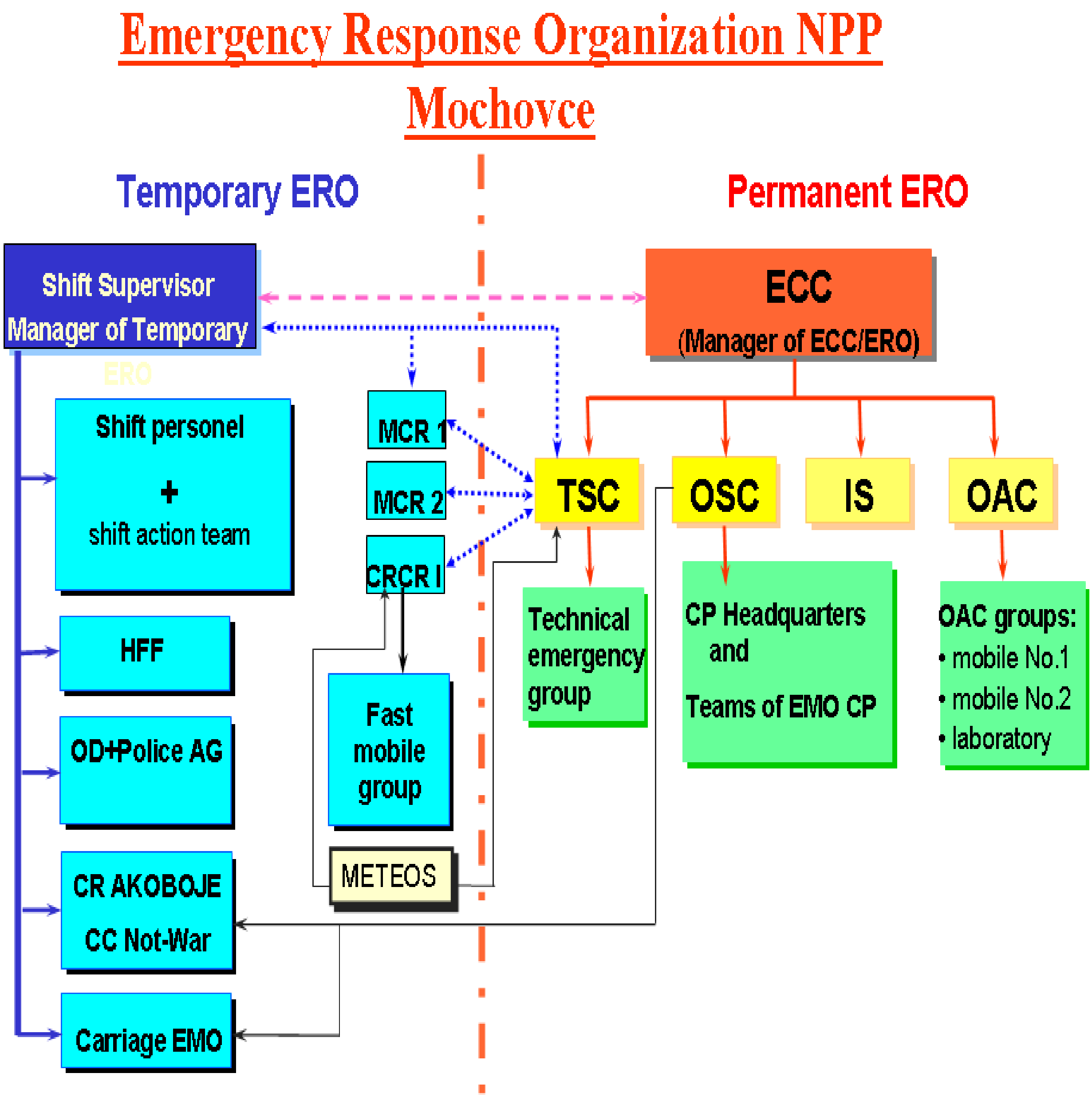


Figure 64 - Emergency Response Organization NPP Mochovce

Shift Supervisor, after events are classified according to severity – in accordance with the On-site Emergency Plan – is initially assigned the duties of an interim ERO manager. This person notifies and summons members of On-site Emergency Response Organization (ERO) and local and state competent authorities in accordance with the approved Plan of Notification for the Relevant Degree of Classified Event. During the first phase personnel of the relevant shift shall perform the actions in accordance with the standard operational procedures and procedures specified in the On-site Emergency Plan. Based on Shift Supervisor´s decision the warning and notification systems are activated.

Once the Emergency Control Centres (ECC) in Mochovce NPP are alerted the Shift Supervisor hands over these duties to the ***Emergency Control Centre Manager*** and then the Shift Supervisor manages operational activities.

Appropriate technological-organizational and protective measures are prepared and performed by the members of ERO. The Emergency Response Organization in Mochovce NPP is activated in case of 2nd and 3rd degree, during 1st degree of radiation event, or if FO (physical protection) is violated during day operation, and if one of the following events occurs:

- primary circuit leakage,
- large leakage from SG feedwater or SG steam outlet systems,
- high radioactivity that could be the contamination and irradiation exceeding legal limits,
- loss of the automatic reactor trip functions,
- explosions and fire involving potential risks to safety related systems and components,
- incidents related to fuel handling,
- abnormal events related to reactor core reactivity, a potential risks to the environment,
- black-out events,
- hermetic confinement pressure exceeding design limits.

Basic classification of an emergency according to severity is done by shift engineer and ERO members. ERO members in function of dosimetrists are always called to the plant in case of a classified event – radiation event, i.e. classification was done using data from stationary radiation measuring system or from portable monitoring system and laboratory analysis (including mobile laboratory data).

The assessment of the impact of an accident and its classification are based on the classification system using evaluation of criteria. Based on probabilistic analyses, as well as prognosis of event development, technological data are monitored - symptoms that the event can lead to real consequences. The objective of classification procedure is to prevent real impact using beforehand established effective measures so as to prevent not permitted development of fission reaction and not permitted release of radioactive matters and ionizing radiation to the working, or living environment.

For prognosis of radiation situation sophisticated application software in ERO centres are used – RTARC, ESTE programs which use algorithms to determine source elements according to type and measurement of monitored technological and radiation data of the impaired unit as well as teledosimetric evaluation system of radiation in the surroundings.

RTARC - EMO - regarding dispersion of radioactive contaminants the programs of RTARC 4.5-GIS system are designed for transmission up to 30-40 km. The

Gaussian dispersion model is used for atmospheric pollutants, while dry fall-out and wash-out by precipitation for aerosols and individual iodine forms are included, as well as the impact of complex terrain on dispersion of radioactive contaminants from the nuclear facilities in atmosphere - it means impact of terrain elevations and roughness (flat terrain, towns, hills...) on radioactive contaminants in NPP surroundings. Depending on source characteristics thermal uplift and shadow effect of main reactor building are considered.

ESTE – EMO - Lagrangian trajectory model decribing movement of centre of gravity of discrete puffs, PTM (puff trajectory model) is used. The model uses method for calculation of dispersion of radioactive substances emitted in atmosphere and the model is suitable also for large-distance modelling (hundreds of kilometers). In general, intensity of emission from NPP is variable with time (regarding amount and composition) and continual or discrete. The emission is simulated in the model using series of immediate puffs that move further in atmosphere in the shape of spreading discrete clouds (DO). The Gaussian model for dispersion of substances in atmosphere is used to describe atmospheric diffusion in horizontal direction. The numerical method to solve semiempirical equation for atmospheric diffusion is used to describe atmospheric diffusion in vertical direction. The mathematic model considers also mechanisms of radioactive transformations, precipitation wash-out and dry fall-out. Moreover, it is able to calculate dispersion of radioactive substances from the emission point up to 300 km and considers also shadow effect of all buildings located at NPP and terrain segmentation in NPP surroundings.

The analytic procedures (algorithms) of the program use also knowledge, methods and procedures presented in the following documents:

- NUREG-1228: Source Term Estimation During Incident Response to Severe Nuclear Accidents, 1990
- IAEA-TECDOC-955: Generic Assessment Procedures for Determining Protective Actions During a Reactor Accident, 1997
- NUREG/BR-0150: Response Technical Manual, RTM, 1995
- NUREG-1741: RASCAL 3.0: Description of Models and Methods, 2001
- Impact of complex terrain in mathematic modelling of emission dispersion from industrial plants and NPPs, CSSR, author: Škulec,Š., et al, SHMÚ Bratislava,1988

In case of declaration of the emergency, the nuclear power plant staff starts fulfilling predefined procedures to eliminate the emergency and restore safety, or to eliminate its impact.

The ERO members are subjected to specific dose limit for emergency. These limits are in compliance with the Ministerial Order No. 345/2006 (recommendations of IAEA SS 115 are respected). PPE (TYVEK, respiratory protection), iodine prophylaxis pills, film badge dosimeters and electronic personal dosimeters (EPD) are provided.

These members are trained in their activities for ERO and take part in theoretical preparation and subsequently in drills and practising.

4.2.3 Emergency Events Classification System

In compliance with UJD Decree No. 55/2006 Coll. the events are classified in accordance with their possible severity and radiation consequences in three degrees:

1st degree - "the alert state"

It is a state in which fulfilment of safety functions is jeopardized or damaged, safety barriers are damaged or not functioning, there is a danger of radioactive material release or radioactive material was released that can lead or leads to unpermissible irradiation of persons in civil buildings of the nuclear facility and in case of unfavourable development of the situation there is a danger of radioactive material release outside the civil buildings of the nuclear facility

2nd degree - "on-site emergency"

It is a state that can lead or leads to radioactive material release outside of civil buildings of the nuclear facility and on its territory.

3rd Degree - "Off-site emergency / General Emergency"

It is a state that can lead or leads to serious radioactive material release to surroundings of the nuclear facility.

The above definitions enable to classify events based on a prognosis, i.e. symptoms of possible events according to severity.

The detailed procedures are included in the documentation intended for ERO, which set scope, accountability and procedures of emergency preparedness.

In conformity with legislation in force and specific regulations, the local or state bodies and organizations are established to safeguard protection of the population within a 20 km radius from the point of accident in accordance with the Plans of Population Protection. An integral part of the On-site Emergency Plan is determination of external bodies and organizations that in case of an accident provide assistance for NPP during emergency response based on a contract. Each of the organizations has their own equipment and fully trained employees.

4.2.4 Protective Measures

Priorities of protection during an emergency are defined as follows:

1) Protection of the plant personnel and persons legally moving on NPP territory;

2) Protection of reactor unit, avert core melting and mitigation of the consequences;

3) Protection of population living in the plant surroundings;

4) Protection of environment.

The following measures are implemented to protect the priorities in case of an emergency:

- monitoring of personnel and other persons´ movements at the site;
- notification of ERO members and officials of public service, self-government and regulatory bodies;
- warning of personnel and other persons at site;
- gathering and sheltering of personnel and persons that are at site, including use of protective aids;
- iodine profylaxation;
- evacuation of persons from the plant;
- warning and notification of population in 5, 10, 20 km Planned Protective Zones;
- recommendations of protective measures for population prepared by ERO at NPP that are subsequently reviewed by the relevant emergency commissions.

4.2.5 Emergency response facilities and equipment

The emergency response facilities which are a part of the emergency preparedness system are specifically adopted and equipped to support the activities of the personnel involved in the organization of on-site or off-site emergency response. The general structure of emergency response organisation involves both the nuclear power plant personnel and the staff of off-site organizations, public service and regulatory bodies.

4.2.6 Off-site Emergency Response Centres

The Emergency Response Centre of UJD (Nuclear Regulatory Authority of the Slovak Republic) in Bratislava provides technical support to the Central Emergency Headquarters established by the Slovak Government.

The Emergency Response Centre receives technological and radiation data from NPP on-line in the agreed scope. It is connected by communication means to ERO centres of SE-EMO. It also provides technical support to emergency commissions of county councils. The procedures related to management of the Centre, as well as to giving support for efficiency of the regional emergency response, or national emergency response, for implementation of effective protective measures, are available in the Centre.

The Slovak Headquarters of the Radiation Monitoring Network established by the Ministry of Health as the centre of off-site radiation level evaluation (SÚRMS) – evaluates the radiation impact on the environment. It was established to analyse monitored field data and coordinate radiation off-site activities. The centre personnel provides also recommendations to protect population in the plant surroundings.

The personnel are consisted of manager, emergency monitoring coordinator, assistant, radiation control coordinator and representatives of UJD, Public Health Office and local emergency commissions.

4.2.7 On-Site Emergency Response Centres

During emergency situations at SE-EMO the ERO management centres are as follows:

- Main Control Room (MCR)
- Emergency Control Centre (EEC)
- Operation Support Centre (OSC)
- Technical Support Centre (TSC)
- Information Centre (IC)
- Off-site Assessment Centre (OAC).

In case that the buildings of the emergency centres situated at the plant cannot be used the centre members will work in the back-up facilities that are prepared in LRKO Levice building (Off-site Radiological Control Laboratory).

Main Control Room (MCR) – this room is designed to control and monitor all activities on technological equipment of the relevant unit.

Emergency Control Centre (ECC) - is a workplace of a control group that coordinates activities of the EMERGENCY RESPONSE ORGANIZATION units when taking the actions to mitigate and limit the consequences of an accident of any severity degree.

The ECC staff consists of ECC manager, assistant, emergency planning representative, support assistant and local UJD inspector - representative of Nuclear Regulatory Authority.

Technical Support Centre (TSC) – provides in-depth diagnostics, risk assessment and technical assistance to the main control room because of having all necessary information from hardware in this centre. The centre controls the actions of technical emergency group which provides technical assistance.

The TSC staff consists of TSC manager, technological engineer, TSC dosimetrist and I&C representative.

Operation Support Centre (OSC) is a workplace of a professional group assigned to prepare and establish the approved protective actions on the territory of nuclear facility and in EMO locality.

The OSC staff consists of OSC manager, OSC dosimetrist, fire brigade representative, and maintenance and supply coordinator.

Information Centre (IC) – is a workplace of IS members that prepare and spread information about an accident to public through media - mass media as well as company broadcasting system to inform employees.

The IC staff consists of manager, IS coordinator and communication coordinator (spokesperson).

Off-Site Assessment Centre (OAC) - is a workplace located outside the territory of nuclear facility of a group appointed to monitor radiation situation and estimate doses in NPP surroundings and prepare inputs for recommendations in order to protect public. It is an emergency unit of the monitoring network controlled by the Headquarters of Radiation Monitoring Network. It is called up in case of an accident at EMO nuclear facility at any time, based on Headquarters of Radiation Monitoring Network decision in case of radiation hazard from other nuclear facilities.

The ECC, TSC, OSC and IS centres are located under administrative building in the civil protection shelter. The OAC is located in LRKO Levice building (Off-site Radiological Control Laboratory). These facilities are always activated in case of the 2nd and 3rd degree event. In case of 1st degree event they are activated only if the event is a radiation accident or FO (physical protection) violation during day shift.

Back-Up Emergency Control Centre (BECC) - is a workplace located outside NPP locality - in LRKO Levice building – it is used if ECC, TSC, OSC and IS at NPP are not inhabitable and after it is activated it can fulfil the functions and mission of ECC,TSC, OSC and IS. All positions of ECC,TSC, OSC and IS work also in BECC.

The plant is provided with facilities and means for emergency response. The facilities for emergency response that are maintained in a stand-by state to be used in case of a 1st degree event – ALERT state – only in case of a radiation event, ON-SITE EMERGENCY STATE and/or OFF-SITE EMERGENCY STATE include:

1) Interim ERO Workplaces:
   - Shift Supervisor workplace;
   - Shift foreman of the plant radiation control workplace ;
   - MCR technologist workplace at MCR1;
   - MCR technologist workplace at MCR2;
2) Emergency Control Centre (ECC);
3) Technical Support Centre (TSC);
4) Operation Support Centre (OSC);
5) Information Centre (IS);

6) Off-site Assessment Centre (OAC);
7) Back-up Emergency Control Centre (BECS);
8) Permanent shelters;
9) Civil protection assembly points;
10) Plant Health Centre (PHC);
11) Back-up Plant Health Centre (B-PHC);
12) Notification and Warning System (VYR-VAR system);
13) Nuclear facility buildings with permanent service;
14) Communication means.

The individual interim ERO workplaces are equipped with:

- equipment for performance of actions under normal operation;
- computers of ERO information network, printers;
- communication networks for taking actions during an emergency state (emergency telephone, fax-telephone);
- documentation for taking actions during an emergency state;
- basic protective aids for individual personnel.

ECC, TSC and OSC are equipped with:

- hardware and software enabling, using data from technological information network, to monitor, evaluate and display information on technological process, on-site and off-site radiation situation and plant state;
- communication means for performance of activities (telephone, emergency telephone, mobile telephone, stentophone radiostation, fax, intra-company office computer network, intranet, internet, radiorelay network, pager);
- auxiliary technical equipment (diesel generator, UPS, air-conditioning unit, monitoring system to monitor radiation situation in ECC rooms, recording device, printer, plotter, copying machine, TV receiver, radio receiver, video recorder, projector with a screen etc.);
- logistic equipment (office furniture, panels, posters, maps, office supplies);
- documentation for performance of activities;
- basic protective aids for individual ECC, TSC and OSC personnel.

IC is equipped with:

- communication means for performance of activities (telephone, mobile telephone, fax, pager);
- auxiliary technical equipment (network printer, copying machine, TV receiver and radio receiver are located in ECC and OSC rooms);
- logistic equipment (office furniture, panels, posters, maps, office supplies);
- control desk of intra-company radio to broadcast information at nuclear facility and in EMO locality;
- documentation for performance of activities;
- basic protective aids for individual IS personnel.

OAC is equipped with:

- hardware and software enabling, using data from technological information network, to monitor, evaluate and display information on technological process, on-site and off-site radiation situation;
- communication means for performance of activities (telephone, mobile telephone, radiostation, fax, intra-company office computer network, internet, pager,);
- auxiliary technical equipment which shared with BECC;
- logistic equipment (office furniture, panels, posters, maps, office supplies);
- documentation for performance of activities;
- basic protective aids for individual OAC personnel.

BECC is equipped with:

- hardware and software enabling, using data from technological information network, to monitor, evaluate and display information on technological process, on-site and off-site radiation situation and plant state;
- communication means for performance of activities (telephone, mobile telephone, stentophone radiostation, fax, intra-company office computer network, internet, radiorelay network, pager);
- auxiliary technical equipment (diesel generator, UPS, air-conditioning unit, recording device, printer, plotter, copying machine, TV receiver, radio receiver, video recorder, projector with a screen etc.);
- logistic equipment (office furniture, panels, posters, maps, office supplies);
- documentation for performance of activities;

- basic protective aids for individual BECC personnel.

The required equipment is provided also in the shelters and at assembly points, in the plant health centre, notification and warning centre and at NPP workplaces with permanent service.

4.2.8 Warning and Notification System

The autonomous VYR-VAR (Warning and Notification) system is implemented in the plant buildings (bounded spaces) at NPP territory and in NPP surroundings - in threatened area (open space). It is continuously in operation during plant lifetime.

The VYR-VAR system is consisted of two separate, independent systems, warning system and notification system. The systems provide remote wireless selective control, continuous monitoring of equipment operability and in case of primary source failure the back-up power supply provides warning and notification of endangered persons at least for a period of 72 hours.

Checking, activation and control of the warning and notification system is performed through Warning and Notification Control Centre (VYR VAR CC) This centre communicates also with many various localities using telephone lines and/or radio.

Technical device of the WARNING system is an electronic siren with an acoustic warning signal and verbal information.

In general, a signal of the Warning system is an appeal for all persons that are in the area of danger to look for further information provided by the notification system and to respect the broadcast instructions.

The basic technical device of the NOTIFICATION system is a one-way receiver /Pager/ controlled by a separate communication channel. This channel is common with PAGING system in EMO integrated radio communication network. An integral part of the notification system is a notification server that provides secondary notification through fixed telecommunication network and mobile network. The system provides delivery of verbal information, while reception shall be confirmed by an identification code, which means there is a feedback in the system.

The notification by Paging system is made to ERO members that are alert and officials of villages, towns ,districts and counties in the area of danger.

The population in the area of danger will receive further instructions through radio or television broadcasting in accordance with the Agreement between the Ministry of the Interior of the Slovak Republic and SE a.s.

5.0 OTHER MEASURES

No other measures besides the proposed ones were identified as necessary for the prevention, elimination, minimization and compensation of the impacts on environment and health.

6.0 STATEMENT ON TECHNICAL-ECONOMICAL FEASIBILITY OF MEASURES

All the described measures have been properly taken into account during feasibility assessment phase of the project and their implementation has been evaluated as viable from both technical and economical point of view.

V COMPARISON OF PROPOSED ACTIVITY WITH ZERO ALTERNATIVE AND OTHERS

1.0 ESTABLISHMENT OF CRITERIA AND DEFINITION OF THEIR RELEVANCE TO SELECTION OF AN OPTIMUM ALTERNATIVE

During assesmen proposed activitiy foro comparation with so called zero alternbative the following criteria were setting up based on their importance:

- impact to public;
- operational risks;
- compliance with existing limits;
- impact of land used of the area;
- production of electricity;
- impact on landscape;
- direct impact on environment; and
- impact on nature.

2.0 SELECTION OF OPTIMAM ALTERNATIVE OR RANKING OF THE ASSESSED ALTERNATIVES DEPENDING ON THEIR SUSTAINABILITY

Zero variant

The zero variant to the proposed activity corresponds to the environmental baseline characterized by the presence and operation of EMO12. In case the proposed variant will not be realized (zero variant) the following consequences have to be considered:

- Slovak Republic will continue in status of electricity importer of,
- Situation will cause lowering of energy safety of the Slovak Republic,
- Adverse impact on imployment in the region
- Adverse impact on living standards of inhabitants in the region
- Adverse impact in decreasing of stability of the comunity

Proposed variant

Based on a request from the proponent, Slovenske elektrarne NPP Mochovce, Units 3 and 4, dated the 15th of June 2008, the Ministry of Environment of Slovakia abandoned the request of alternative solutions for the proposed activity, except of zero variant.

This has been confirmed by the Ministry of Environment by the letter to Slovenske Elektrarne a.s. No. 7451/2008-3-4/hp dated July the 31st 2008.

The justification of such a request is based on the peculiarity of Mochovce NPP. As already mentioned, the power plant was designed and its construction has been launched and realized as a four-unit NPP with common civil structures and technological components to be shared by all the four units. From the civil structures point of view, the plant is built up to 70%.

All the environmental evaluations for the issuance of permits, have been carried out taking into account the likely impacts and the needs of four units.

From the point of view of all the external services and infrastructures, the site of Mochovce is already capable of bearing Units 3 and 4.

Moreover, due to the advanced stage of completion, Mochovce site represents a one off opportunity to cover in a short time the significant gap between demand and supply of electric energy on the Slovak network.

Due to the above mentioned reasons, it appears clear that the completion and operation of Mochovce Units 3 and 4 has no reasonable alternatives. A detailed justification follows.

Mochovce NPP was designed and its construction has been launched and realized as a four-unit NPP with common technological components.

In consideration of the degree of MO34 project completion, together with the already existing operating civil structures, representing the necessary operational systems needed for operation of Units 1 and 2, Units 3 and 4 can be connected with civil structures of Mochovce NPP after minimal modifications. Current state of units 3 and 4 in Mochovce NPP is as follows:

- civil part – completed up to 70%;
- technological part – completed up to 30%.

Due to the high degree of completion of the civil part and mutual interlacing of civil structures with operating Units 1 and 2, it is not possible from an economical point of view as well as from a time management point of view to site (locate) assumed Unit 3 and 4 in another locality.

Protection against ionizing radiation, physical protection and emergency planning

Additional arguments supporting protection against harmful effects of ionizing radiation, physical protection and emergency planning conditioning completion of units 3 and 4 located in immediate proximity of EMO12 are reported below.

Operation of EMO12 as well as future operation of units 3 and 4 in Mochovce NPP is and will be subject to constant and very strict supervision of national and international authorities with regard to protection against harmful ionizing radiation. Limits for radioactive discharges have been fixed by the National regulatory Authority for EMO12. These limits are defined in such a way not to damage any of the environmental components including human health. It has to be pointed out that during normal operation of Units 1 and 2, there are no appreciable radiological impacts on population living in the close surroundings.

For this purpose, a set of systems for radiological protection is implemented and based on the following principles:

- Activity using ionizing radiation and assuming possible health detriment should be balanced by assumed positive contribution to a given person or the company; (more good than harm principles);
- Human exposure by any individual radiation source should be maintained as low as reasonably achievable (ALARA);
- Individual exposure resulting from combination of all relevant radiation sources should be ruled by requirement that none of the employees is exposed to radiation risks unacceptable under normal circumstances;
- Central radiological control system (CRCS) represents measuring and information system providing means for interconnection with other information systems in NPP; it will be used for all units on Mochovce NPP site. Measured data are transmitted to:
  - NPP control rooms (radiation monitoring control room EMO12, radiation monitoring control room MO34, main and emergency control rooms in MO34) and emergency response centres (emergency control centre and backup emergency control centre) – measured radiation values are presented in suitable form and on required display means;
  - Other technological and whole-site power plant information systems (diagnostic, chemistry, TIS, etc.) – information exchange among these systems enables more detailed evaluation of NPP safety and reliable operation;
- Common monitoring program of SE-EMO widespread area (monitors impacts on EMO12 surroundings and final deposit of LRAW) will be also used for monitoring of NPP MO34 impacts (after completion and commissioning);
- All calculated individual dose values from designed SE-EMO releases (EMO12 and MO34) at normal operation are lower than 0.25 mSv – goal value for acceptance criteria for MO34 project and radiation limits defined in Governmental order of SR No. 345/2006 Coll.;
- Area covering approximately 20 km around NPP (for operation of 4 units) is provided with system of stations and teledosimetry stations for monitoring of radioactivity around NPP equipped with measuring system, extraction of environmental samples and their measuring and evaluation; this system has been operated for several years by trained and qualified personnel from LRKO Levice;

- Operational NPP EMO12 and MO34 employs and will employ qualified personnel with the required knowledge, required trainings and skills pursuant to valid legislation.

Identical principles and arguments can be implemented also in physical protection and emergency planning and preparedness, e.g.:

- Technical means of physical protection for SE MO34 are identical with those used in SE EMO and described in valid document "Physical protection plan of SE EMO";
- Common physical protection centre is used both for SE MO34 and SE EMO;
- Software is extended for control of four-unit PP arrangement;
- Valid agreement on mutual cooperation in emergency planning and preparation on Mochovce site between SE-MO34 and SE-EMO; agreement principles reflect in internal documents of both plants. These documents are closely interconnected with internal emergency plan of SE-EMO in field of personnel protection – use of equipment and mans of NI SE-EMO, preparation of personnel trainings, drills and practice exercises;
- Emergency response control process in the case of real situations is managed by the emergency response organization in SE-EMO for the whole EMO location.

Concept of assessment of environmental components in NPP Mochovce

During the construction of nuclear installation the emergency planning and preparedness are fully in compliance with particular Slovak legislation and internal procedures of the SE, a.s.

Concerning the valid agreement on mutual cooperation, MO34 has elaborated an internal document/directive MO34/2/SM-014.01 Emergency Planning and Preparedness, which is in line with On-site emergency plan HO – 0005 VHP NPP Mochovce that describes relations to individual emergency response units within the whole Mochovce site. Based on these relations emergency planning and preparedness at MO34 and their activities are directly managed by EMO emergency response organization.

Evaluation concept of environmental components on Mochovce NPP site

Concept of surface water extraction balance is characterized by one common decision permitting water extraction pursuant to the basic design for units 1 to 4 NPP EMO. Operation of 2 units used 42% of permitted amount.

Complete water chain – decarbonization, chemical water treatment – was designed and constructed for four-unit arrangement. Water objects for all four units passed the use permit inspection (intake object – Hron pumping station, pressure piping, water storage tanks 2 x 6,000 m^3, supply piping, decarbonization, chemical water treatment plant, chemical storage, etc.) as part of completion of the 2nd construction of units 1 and 2 EMO.

Potable water source consists of two wells in Červený Hrádok with a chemical water treatment plant for removal of iron and manganese, pressure piping, water storage tank, supply piping and distribution piping. Capacity of water source and potable water treatment plant has sufficient reserve for operation of all four units. Also wastewater discharge system is designed as common with divided canalization (sewage, rainwater, oiled water, special – industrial).

All of them are equipped with water treatment plants constructed and operated as part of units 1 and 2, and they will also serve for connection of systems of units 3 and 4.

Sewage canalization has been used since commissioning of units 1 and 2 in Mochovce NPP. It's linked to the biological wastewater treatment plant with sufficient capacity for all four units. This water treatment plant has high treatment efficiency – above 90%. Oiled water is discharged from potential contamination sources (turbine hall workshops, handling facilities with oil products, etc.) to gravity separator; from here, water is pumped to 2nd treatment stage – flocculation. Treated water is returned to production process. Special industrial canalization is used for removal of tritium water diluted with blowdown from technological processes and then discharged to wastewater piping.

Sewage, industrial, rainwater canalization is connected to one wastewater piping via common outlet measuring object used for measuring the volume of discharged water and is equipped with extraction equipment for mixed samples pursuant to decision of the County environmental office Nitra on wastewater discharge. This object is also used for measuring the activity of discharged wastewater with regard to parameters defined by UVZ SR.

The power plant has a common waste system used for collection and storage of wastes from power plant operation and then transported for disposal. Waste system capacity is sufficient for operation of four units.

Safety aspects of MO34 project

SE, a.s. has reviewed the basic design of Units 3 and 4 of Mochovce NPP. This task was conditioned by a proposal of solution complying with the requirements of valid Slovak legislation and requirements of international organizations, e.g., IAEA and current engineering practice, including EUR requirements and requirements documented in WENRA (Western European Nuclear Regulators' Association).

Based on the above facts we can point out that the optimal alternative is represented by the proposed activity, where all four units of Mochovce NPP will be in operation.

Conclusions

Considering the characteristics of MO34, the technical and organizational measures for protection of inhabitants and environment nearby the nuclear power plant, and on the basis of data coming from the operation of EMO12, it is expected that additional impacts on the environment coming from the proposed activity will be negligible.

VI PROPOSED MONITORING AND POST-DESIGN ANALYSIS

1.0 PROPOSED MONITORING FROM THE BEGINNING OF COSTRUCTION, DURING THE CONSTRUCTION, DURING OPERATION AND AFTER TERMINATION OF OPERATION OF PROPOSED ACTIVITY

Monitoring is controlled by the regulation *"Programme of radiation monitoring in the vicinity of Mochovce NPP (*EMO/2/NA-052.01-02*)"* that describes the radiation monitoring around NPP Mochovce in a radius of 20 km from the plant.

A teledosimetry system (TDS), equipped with 24 teledosimetric and 15 stable dozimetric stations, monitors the dose rate of gamma radiation, the volume activity of aerosol, the volume activity of radioactive Iodine and supplementary data on the state of the environment.

The monitoring system has been set up for the whole site of Mochovce, hence, once in operation, Units 3 and 4 will be covered as well.

The details of the monitoring plan can be found in Section C, part II, Chapter 17 of the present Report.

2.0 PROPOSED CHECKING OF COMPLIANCE WITH DEFINED CONDITIONS

In order to assist in determining if the environmental and cumulative effects of the Project are as predicted in the EIA Report and to confirm whether the impact mitigation measures are effective and thus determine if new mitigation strategies are required, a follow-up and monitoring program is proposed, as described in the following 2.1 and 2.2 chapters.

2.1 Purpose of the follow-up and monitoring Program

The follow-up program would incorporate current Mochovce monitoring programs and other environmental studies, as appropriate.

Accordingly, the follow-up program should achieve the following three goals:

- *Confirm assumptions in the analysis of the EIA Report;*
- *Verify the predictions and assessment of the environmental effects; and*
- *Verify the effectiveness of implemented mitigation measures.*

New mitigation measures would be justified if either the implemented mitigation measures were found to be ineffective, or if the actual environmental effects were greater than predicted in the EIA Report. This process would help ensure continual improvement in the environmental performance of Mochovce NPP.

The plan for the follow-up program was developed in two steps.

First, each of the likely effects of the Project identified in Section C, Part III of this Report was reviewed to determine how the predicted effect could be confirmed. The focus of the review was to identify which components of the environment might be incorporated into the follow-up and monitoring program. Secondly, each of the mitigation measures was reviewed to determine how its effectiveness could be monitored.

The following section provides an initial outline of the follow-up monitoring program. The results of the follow-up and monitoring program will be regularly reported and, if necessary, used to develop new mitigation measures.

2.2 Scope and principal elements of the Follow-up Program

The scope of any follow-up program should be focused on providing information needed to verify EIA predictions and mitigation effectiveness, particularly as related to likely effects carried into the significance determination step in the assessment process.

Follow-up studies and monitoring should be focused on specific effect hypotheses. This would allow results to be evaluated and any appropriate corrective action to be taken in a timely manner.

Two phases of follow-up studies/monitoring are proposed as follows:

- Pre-operational Phase; and
- Operational Phase.

Pre-operational studies/monitoring would be intended to supplement or confirm the existing information used to define project improvements and mitigation measures. This would improve the basis for subsequent comparison with follow-up studies/monitoring carried out after MO34 is put in operation.

Other specific studies (i.e. Radioecological analysis) could be initiated before the operating activities. These studies are intended to provide environmental information which, together with the existing information could be used to improve the *Operational phase* monitoring.

Operational phase studies/monitoring would be initiated soon after the commissioning of Unit 3 and 4. They would be intended to provide environmental information which, together with the pre-commissioning baseline information, could be used to determine actual effects and provide a basis for determining the validity of the EIA predictions, the effectiveness of the implemented measures, and whether any additional or new mitigation measures are required.

Table 134 provides a preliminary listing of the follow-up activities suggest for the relevant environmental components (including general indication of location, duration, and frequency) aimed at verifying the predicted effects and effectiveness of the project improvements and mitigation measures. The program elements in Table 134 rely heavily on existing or planned monitoring programs.

Table 134 - Preliminary elements of Project Follow-up Program

Environmental Component	Effect	Description	Location	Duration and Frequency	Objective
Atmospheric Environment	Non-radioactive parameters				
	None				
	Radioactive parameters				
	Dose to workers Dose to public	Monitor dose to workers Monitor annual dose to critical group members	Site Study area Local study area	OngoingExisting radiological Monitoring Program Existing radiological Monitoring Program	Determine effectiveness of project improvements and mitigation measures to ensure that dose are ALARA Verify predicted effects
Geology and Seismicity	None				
Hydrology, Hydrogeology and Aquatic Environment	Non-radioactive parameters				
	Hron River water quality	Monitor pollution levels and physical parameters	Regional study Area	Seasonal	Determine effectiveness of project improvements and mitigation measures Verify predicted effects
	Fish habitat	Monitor presence of fish species downstream the dam Monitor effectiveness of fish stocking	Regional study Area	Seasonal	
	Radioactive parameters				
	Groundwater quality	Monitor tritium in shallow wells	Local study area	Seasonal	Verify predicted effects
Vegetation, Flora and Fauna, Natural Reserves and Protected Areas	None				

Environmental Component	Effect	Description	Location	Duration and Frequency	Objective
Land Use and Cultural and Historical Heritage	None				
Social Analysis	Perception of the Power Plant	Monitor of information provided to visitors and community	Regional study Area	periodically	Monitor social attitude and perception

VII METHODS USED FOR ASSESSMENT PROCESS OF PROPOSED ACTIVITY ON ENVIRONMENT AND METHOD AND SOURCES OF DATA ON CURRENT ENVIRONMENTAL CONDITIONS IN THE AREA WHERE PROPOSED ACTIVITY IS TO BE UNDERTAKEN

1.0 ASSESSMENT METHODOLOGY

1.1 Introduction

Environmental Assessment is a tool to provide effective means of integrating environmental factors into the planning and decision making processes in a manner that promotes sustainable development and minimizes the overall impact of a project. The methodology used for this EA is based on systematic consideration of the systems, works and activities presented in section A, Chapter II “Basic Data on Proposed Activity”.

Each of the identified project works and activities is first screened in the context of several environmental components to determine its potential for interaction with the environment. A focused description of existing environmental conditions is then prepared. Where Project-environment interactions are identified, each interaction is systematically screened to determine if measurable changes to the existing environmental conditions are likely. Changes could be either beneficial or adverse. Where measurable changes are identified, a detailed assessment is conducted to characterize the effect.

Where adverse effects are identified, mitigation measures are presented to reduce, control or eliminate the effects. Following an evaluation of these mitigation measures, the residual effects are determined. Finally, a follow up program is recommended to confirm the results of the EA and to allow the adequacy of mitigation measures to be verified.

This section describes the methods used to identify and evaluate the effects associated with the Project, including a description of:

- Environmental components;
- Spatial boundaries;
- Temporal boundaries;
- Valued Ecosystem components (VEC);
- Assessment of environmental effects;
- Significance of residual effect.

1.2 Environmental Components

For the purpose of this EA, the environment is comprised of the following environmental components. They include the biophysical and social features most likely to be affected by the Project:

- **Atmospheric Environment**: represents air quality, with respect to radiological and non-radiological parameters, including noise, and considers meteorological and climatic conditions;
- **Geology and Seismicity**: represents geological, hydrogeological and seismic conditions;
- **Hydrology and groundwater**: represents conditions and quality, with respect to radiological and non-radiological, parameters of surface waters and groundwater; it also includes the aquatic environment;
- **Terrestrial environment**: represents land-based biota and habitat (vegetation, fauna and ecosystem);
- **Land use and cultural and historical heritage**: including transportation network; and
- **Socio-Economic Conditions**: represent population, economic base, infrastructures and services, recreation and communities, resource use.

EIA is generally understood to be an instrument for preventive environmental policy-making. It should provide an adequate information basis for decision making on activities affecting the environment.

The idea in EIA is to make the decisions that have important environmental consequences as rationally as possible, but also to offer the general public a possibility to participate in the evaluation and decision processes. From this point of view EIA on the whole assumes a sociological relevance.

According to the main reference on Social Impact Assessment, represented by Guidelines and Principles For Social Impact Assessment, prepared by The Interorganizational Committee on Guidelines and Principles for Social Impact Assessment (U.S. Department of Commerce, May 1994), a Social Analysis has been performed for better understanding of the social consequences of the projects to human populations.

For each component the subcomponents, which represent potential pathways or mechanism for the transfer of an effect to VEC, are identified.

The baseline conditions for each environmental component are described individually in Sections C, Part II. There are, however, inter-connections among the components and these are illustrated in Figure 59.

All of the physical and biological components subsequently link to people via effects on human health and/or on socio-economic conditions.

1.3 Spatial Boundaries

The scope of assessment requires that the study areas considered in the EIA encompass the environment that can reasonably be expected to be directly or indirectly affected by the project, or which may be relevant to the assessment of cumulative effects and the effects from future lifecycle phases of the facility. The following three general study areas were suggested in section C, Chapter I "Definition of Boundaries area of Concern":

- *Site Study Area*: this area, centred on the plant site with a radius of about 3 km, includes facilities, buildings and infrastructure at the Mochovce site, including the licensed buffer zones (Protection zone) for the site on the land. This zone, where it is forbidden to reside permanently, has been set by Decree of Region Health Officer No. H-IV-2370/79 from 15.10.1979 (Map 3 and Figure 36);
- *Local Study Area*: this area is defined as that area existing outside the site study area boundary, where there is a potential for impacts in the unlikely events of abnormal operating conditions. The Local Study Area has a radius of 10 km centred on the Mochovce site (Figure 36);
- *Regional Study Area*: this area is defined as that conservative area within which there is the potential for cumulative and social-economic effects and it approximately corresponds with a 50 km radius area around the site, limited to National borders. The size and configuration of the applied study areas varies by environmental component. Each is described, including the rationale for its determination, in the appropriate subsections (Figure 36).

Even if some of environmental effects of the project, including malfunctions or accidents and some cumulative environmental effects, are likely to involve the Local Study Area or the Regional Study Area, the main additional environmental effects that may occur during operational phase are likely to be observed within the Site Study Area (Protection zone).

Table 135 shows the correlations between considered environmental components and spatial general study areas.

Table 135 - Environmental spatial boundaries reasonably expected to be directly/indirectly affected

Environmental component	Spatial boundaries environment that can reasonably be expected to be directly or indirectly affected	
Atmospheric Environment	• Local atmosphere	*Local Study Area*
	• Human health, human health workers and members of the public	*Local Study Area*
	• Pathway to terrestrial environment VECs quality	*Local Study Area*
	• Pathway to aquatic environment VECs	*Local Study Area*
Geology and Seismicity	No interaction between project activities and component	
Hydrology and Hydrogeology	• Aquatic temperature	*Local Study Area*
	• Aquatic quality	*Regional Study Area*
	• Human health and members of the public	*Regional Study Area*
	• Pathway to aquatic environment VECs	*Regional Study Area*
Terrestrial Environment	• Vegetation communities and specie	*Local Study Area*
	• Wildlife habitat	*Local Study Area*
	• Pathway to aquatic environment VECs	*Local Study Area*
Land Use and Cultural and Historical Heritage	• Land resources	*Regional Study Area*
	• Land use	*Site Study Area*
	• Pathway to socio-economic conditions VECs	*Regional Study Area*
Economic and Demographic Conditions	• Population and employment	*Regional Study Area*
	• Economic activities	*Regional Study Area*
	• Municipal Finance, infrastructure, services	*Regional Study Area*

1.4 Temporal Boundaries

The temporal boundaries for the assessment define the time periods for which likely environmental effects of the Project are considered. For purposes of this EIA, the Project life-cycle extends from 2013 to about 2053. A detailed schedule of the Project activities is shown in Table 136. The commissioning activities are scheduled for 2012. Commercial operations of both Unit 3 and 4 are scheduled to begin in 2013. The operation life of MO34 is expected to be 40 years.

The baseline conditions of the existing environment are generally considered to be those existing in 2006-2008 within the study areas. Where appropriate, relevant historical data have been used to supplement current data.

The EIA guidelines require that a preliminary decommissioning plan has to be included in the assessment. The preliminary plan will document the preferred decommissioning strategy, including a justification of why this is the preferred strategy. It will also include end-state objectives; the major decontamination, disassembly and remediation steps; the approximate quantities and types of waste generated; and an overview of the principal hazard and protection strategies envisioned for decommissioning.

Table 136 - Proposed time-scale for the placing of main orders, installations and start-up, particularly the conclusion of initial contracts with suppliers of the commencement of construction work, and the planned commissioning date.

Activity	*Date*
Restart of civil construction works at site	November 2008
Contract award of the Engineering Procurement Construction Management (EPCM) for the conventional island	June 2009
Contract award of the nuclear island (turnkey lump sum contract)	June 2009
Contract award for the steam turbines	June 2009
Start of commissioning activities	May 2012
Fuel loading on Unit 3	October 2012
First synchronization of Unit 3	December 2012
Commercial operation of Unit 3	February 2013
First synchronization of Unit 4	September 2013
Commercial operation of Unit 4	October 2013

1.5 Valued Ecosystem Components (VECs)

The Valued ecosystem components are features of the environment selected to be the focus of the EA because of their ecological, social and economic value and their potential vulnerability to effects of the Project.

A VEC is considered to be the “receptor” for both Project-specific and cumulative effects.

An initial screening of the physical works and activities of the project was conducted to identify those that may interface with the environment and to select a preliminary list of VECs.

The list of identified VECs applied in conducting the EIA is reported in Table 137.

Social aspects of the environment, while not VECs, are identified separately in terms of their valued components. All other environmental components were assessed with respect to specific features of the natural environment (e.g. water, quality or air quality) and their roles in providing pathways and mechanisms for effects on the VECs (the inter-relationships of the environmental components have been shown on Figure 59).

Table 137 - Selected Valued Ecosystem Components

Environmental component	***Valued Ecosystem Components***
Atmospheric environment	• Local atmosphere • Human health, human health workers and members of the public
Geology and Seismicity(1)	No direct effects between project activities and component
Hydrology and Groundwater	• Human health and member of the public • Hron river and other water sources quality • Aquatic species
Terrestrial Environment	• Vegetation communities and species • Wildlife habitat
Land Use and Cultural and Historical Heritage	No direct effects between project activities and component
Socio-Economic Conditions	• Socio-economy • Population and employment • Economic activity

(1) While the project does not have any direct effects on geology and seismicity, the effects of potential seismic events are fully assessed in Section C, Part II.

1.6 Assessment of environmental effects

The assessment of environmental effects involves four steps (Figure 65) that progressively refine the focus of the assessment on the project's physical works and activities that may affect the environment, and the features of the environment that may be affected.

In Table 138 the results of a first screening for plausible project-environment interactions are reported.

Step 1

Initial Screen of Physical Works and Activities

- Identify project physical works and activities that may interface with environment
- Identify malfunctions and accidents that may affect the environment

Step 2

Description of existing conditions

- Describe the existing environment for each considered component

Step 3

Assess Likely Effects

- Describe likely effects of project/environment interactions
- Describe cumulative effects of project in combination with other projects and activities
- Identify of mitigation measures

Step 4

Determine Significance of Residual Effects

- Identify project/environment effect
- Evaluate residual effects to determine Significance

Figure 65 - Steps for the assessment of environmental effects

Table 138 - Summary of first screening for plausible project-environment interactions

Project Release and Waste	Atmospheric Environment			Acoustic Climate	Geology and Seismicity	Hydrology and Hydrogeology					Terrestrial Environment		Land Use and Cultural and Historical Heritage		Socio-economic conditions			
	Air quality	Local climate	Radiation	Noise	No interaction between project activities and component	Surface water temperature	Surface water quality	Aquatic habitat	Groundwater quality	Radiation	Vegetation communities and species	Wildlife habitat	Land use (No interaction between project activities and component)	Cultural and Historical Heritage (No interaction between project activities and component)	Population and economic base	Community service	Residents and communities	Municipal finance and administration
Operation of nuclear systems	•		•			•	•	•	•	•	•	•			•	•	•	•
Operation of non-nuclear systems	•	•		•														
Radioactive waste management			•							•								
Non-radioactive waste management							•	•										
Spent fuel management	•		•							•								
Workforce															•	•	•	

1.7 Significance of residual effects

Residual environmental effects are those that remain after the preceding assessment process, including the application of mitigation to eliminate, reduce or control the adverse effects of the project where appropriate.

The significance of each residual effect was established within a framework of criteria and effect levels. To ensure a consistent and reproducible evaluation, the common criteria are used for all residual effects within all environmental components. The definition of the level of effect within each criterion varies by environmental component to recognize that the units and range of measurement are distinct for each component.

Each residual environmental effect was assessed within the following criteria (Table 139):

- Magnitude: the size or degree of the impact compared against baseline conditions;
- Extent: the area over, or throughout which, the effects will occur;
- Duration: the time period for which the effect will last;
- Frequency: the rate of reoccurrence of the effect (or conditions causing the effect);
- Degree of reversibility: the degree to which the effect can be or will be reversed (typically as measured by the time it will take to restore the environmental feature).

Table 139 - Effects criteria and significance levels

Effects Criteria	Effects Level Definition		
	Low	**Moderate**	**High**
Magnitude *(of effect)*	Effect is evident only at, or nominally above, baseline (existing) conditions.	Effect exceeds baseline (existing) conditions, however, is less than regulatory criteria or published guideline values.	Effect exceeds regulatory criteria or published guideline values
Geographic Extent *(of effect)*	Effect is limited to the Site Study Area as defined for the environmental component (3 km radius)	Effect extends into the Local Study Area as defined for the environmental component (10 km radius)	Effect extends into the Regional Study Area as defined for the environmental component (~50 km radius)
Timing and Duration *(of effect)*	Effect is not evident	Effect is evident during the operational period	Effect extends beyond operational period
Frequency *(of conditions causing effect)*	Conditions or phenomena causing the effect occur very infrequently; or are effectively a one-time event (several times per year)	Conditions or phenomena causing the effect occur at regular although infrequent intervals (several times per month)	Conditions or phenomena causing the effect occur at regular, frequent or continuous intervals (daily)
Degree of Reversibility *(of effect)*	Effect is readily reversible during the completion phase	Effect is reversible during operational phase	Effect is not reversible and remains after the operational phase

VIII DRAWBACKS AND UNCERTAINTIES IN KNOWLEDGE ENCOUNTERED DURING PREPARATION OF ASSESSMENT REPORT

Regarding environmental impact assessment process for the proposed activity, there are no substantial issues in knowledge about which sufficient information does not exist, and additional analyses of other areas or environmental components have not been reasonably necessary. Moreover all the available recent data have been considered.

For the above reasons, no remarkable drawbacks nor uncertainties have been encountered during the preparation of the assessment report.

No insufficiencies or uncertainties are known which would significantly impact the land analysis database, the subsequent impact assessment or the final standpoint which will be the result of the submitted assessment report. The overall level of uncertainty is consistent with the available documentation regarding data about the future operation of the NPP and data about environmental baseline.

On the other hand, however, the results in Annex 4 of the elaborated radiological study can have reasonably a high level of certainty because they were taken from a comparison with the currently operational Units 1 and 2.

Even though there could be inaccuracies or uncertainties with the report which bring a certain level of inaccuracy to the elaborated data, they have no impact on the understandability or on the overall results of the assessment. They are for example data on the number of inhabitants in the community, their activity, individual age groups, employment rates and so on. This data is recorded based on district by the Statistical Office and the National Labour Office. Accurate data is always available every ten years from the census.

The input data on the amount of diagnosed malignant tumours rely upon the reports which are issued annually by the National Oncologic Register of the Slovak Republic. According to MKCH the range of diagnoses has become more accurate; the average age of the inhabitants is increasing, and the diagnostics and health care have improved during the monitored period.

At present Slovenské elektrárne, a.s. stores the spent fuel in the existing facility JAVYS a.s. in Jaslovské Bohunice, but this part of the fuel cycle will be solved in the form of a new industrial facility in Mochovce, a so-called spent fuel buffer store (based on dry storage). The decision on a suitable alternative will be made in the next 10 years considering the fact that spent fuel from MO34 will have to be stored in this facility after 2016. An assessment report was elaborated in 2003 for the location of the buffer store at the Mochovce NPP. In the concluding standpoint from June 2004 the Slovak Ministry of Environment recommended its realization. There is sufficient amount of time for the project preparation, safety report and investment needed.

Other sources of the uncertainties result from the fact that the national infrastructure for handing of RAW and spent fuel in Slovakia, for which depositing of spent fuel is an integral part, does not correspond to the infrastructure common in Western Europe or even Central and Eastern Europe. The only subject that deals with this aspect of the operation in Slovakia is its principal producer. Nevertheless, this is obviously not their priority activity. As of today, it is the state that is responsible for the long-term aspects of handing RAW and spent fuel, especially for final disposal (this responsibility exists even in the Slovak Atomic Act). The state realizes this responsibility by delegating or naming a subject other than the principal producer.

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0.5 ÚJD SR - DECISION no. 246/2008 - Number: 684/320-231/2008 - Trnava, August 14, 2008

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X GENERAL FINAL SUMMARY

The general final summary is reported in the Annex X.

July 2009

SLOVENSKÉ ELEKTRÁRNE, a.s. "NUCLAR POWER PLANT MOCHOVCE VVER 4 X 440 MW - 3RD CONSTRUCTION

General Executive Summary

ANNEX X

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I INTRODUCTION

This General Executive Summary reflects the overall summary of information and data included in the Environmental Impact Assessment Report (EIA) for the proposed activity:

"Nuclear Power Plant Mochovce VVER 4 x 440 MW – 3rd Construction"

that has been elaborated pursuant to National Council Act No. 24/2006 Coll. as amended and supplemented by other acts,

The activity has been assessed in compliance with Annex 8 of the EIA Act, item 2**. Energy Industry**, indent 4:

Nuclear power plants and other facilities with nuclear reactors (with the exceptions of the research facilities for production and conversion of fissile and enriched materials whose maximum thermal power does not exceed 1 kW of constant thermal power).

The location of NPP Mochovce is on Figure 1

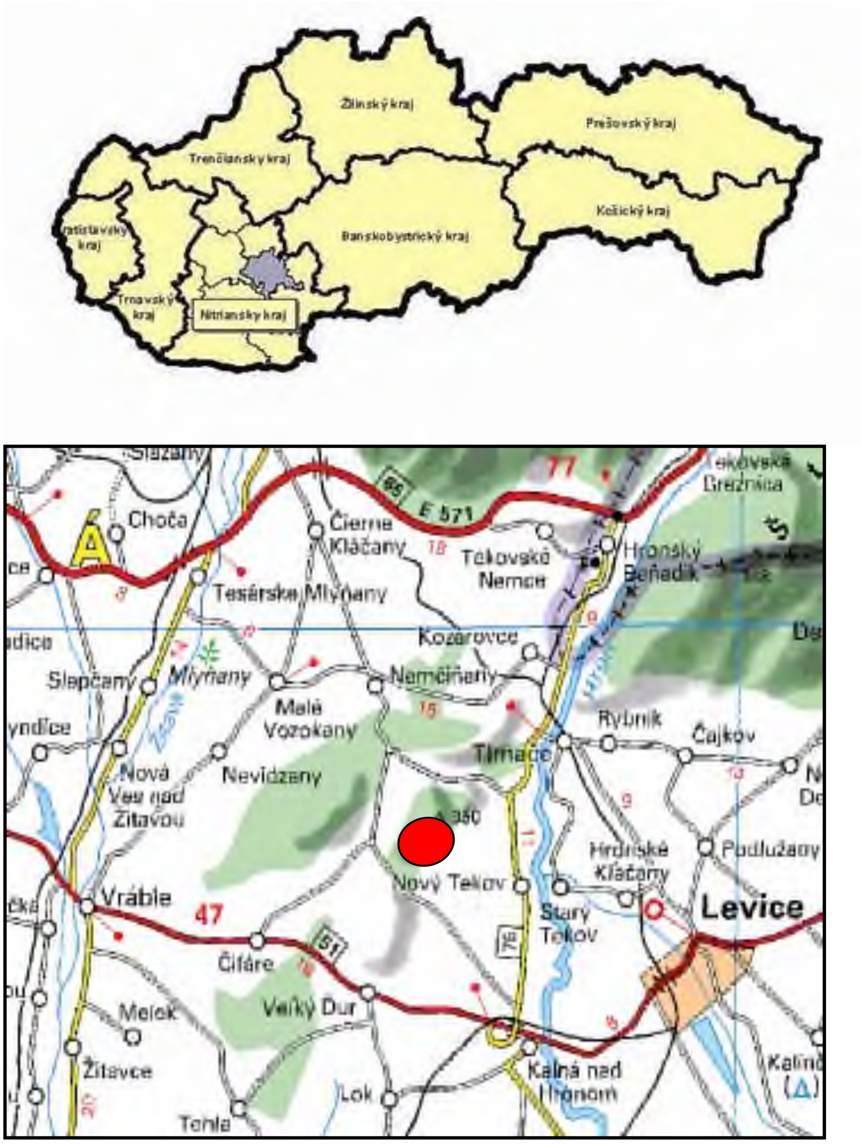


Figure 1 - General location of the site

1.0 PROGRAMMATIC FRAMEWORK

The present Report focuses on likely additional environmental effects of an existing facility, as a result of the completion and operation of Units 3 and 4.

The Environmental Impact Assessment is performed in compliance with appendix 11 of Slovak Act. No. 24/2006 “On the assessment of the effects on the environment and on the modification and enlargement of some laws”.

Key environmental aspects are discussed in this chapter: environmental management, general permitting, land use planning implying the safeguarding of the long-term harmony of the natural and cultural value of the three main components of the natural environment: land, water and air.

Land use planning methodically and comprehensively solves the functional use of land. It specifies principles of its organization and material and temporal coordination of construction and other activities that affect the development of the land

1.1 Coverage of the demand for electricity

The Slovak Republic has been an exporter of electricity for 7 years (2000 - 2006). The shutdown of two nuclear units in Bohunice (V1) has changed the situation and Slovak Republic has become an importer of electricity. The shutdown of Bohunice Nuclear Power Station V1 is a consequence of the political decision taken during the negotiation of the Preaccession Treaty with the EU. The Slovak Republic committed to shutting down two units of the Nuclear Plant V1 Bohunice, in the period 2006-2008. With the shutdown of these two units, the total capacity of NPPs has been reduced by 880 MW.

Also, based on the Directive EC 2001/80/CE (on the limitation of emissions of certain pollutants into the air from large combustion plants), several thermal units will be decommissioned in the SR. It is not economic to modify the old thermal plants with the aim of attaining the requirements of the air protection law (Act. No. 478/2002). The expected reduction of the existing installed thermal power for environmental reasons is about 242 MW.

In the document “System Adequacy Forecast” by UCTE (2007) it is indicated that the usable potential RES (Renewable Energy Sources) suitable for electricity production leaded the Government of the SR to commit to a minimal target of electricity production from RES of 19% by the year 2010. Biomass belongs among the most promising renewable resources. Even taking into account the high usage of the hydro energy potential of the SR (at present approx. 60%), there is still potential for hydro electricity production. For various reasons the possibilities for using wind energy to produce electricity in the SR are limited.

The outlook of net electricity generation from 2007 to 2020, based on forecasted development of installed capacity in the Slovak Republic, is as shown in Figure 2.

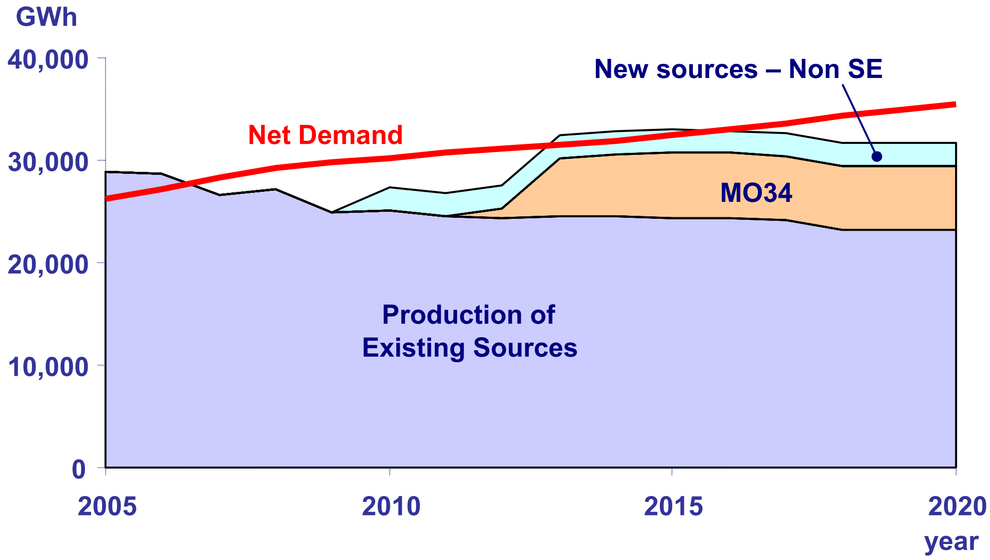


Figure 2 - Forecast for net Electricity demand and production in Slovakia

1.2 EIA law in the EU and the SR

The EIA Directive on Environmental Impact Assessment of the effects of projects on the environment (85/337/EEC) was introduced in 1985 and was amended in 1997 (97/11/ES). Member States had to transpose the amended EIA Directive into their own legislation by 14 March 1999 at the latest.

The primary purpose of the EIA Directive was to introduce general principles for the assessment of environmental effects, with a view to supplementing and coordinating development consent procedures governing public and private projects likely to have a major effect on the environment.

The history of EIA in the SR dates back to 1992, when the Environment Act was adopted (effective as of 16 February 1992). This contained very general rules for the assessment of environmental impacts of certain projects. With effect from 1 September 1994, a new legislation regulating EIA applied with the Old EIA Act, which repealed all provisions of the Environment Act regarding EIA. Act No. 127/1994 on EIA was published in April 1994 and came into force in September 1994. The Slovak Ministry of the Environment has confirmed that this Act does not apply to projects for which the licensing process began prior to its entry into force.

With effect from 1 February 2006, the EIA Act 24/2006 Coll. was adopted, fully repealing and replacing the Old EIA Act. The EIA for projects is very similar to the procedure under the Old EIA Act, but with certain deadlines being shortened. There are no major deviations from the principles regarding EIA for individual projects as set out in the Old EIA Act.

In Figures 3 and 4 are schematically illustrated respectively the main players for the EIA process for the Project.

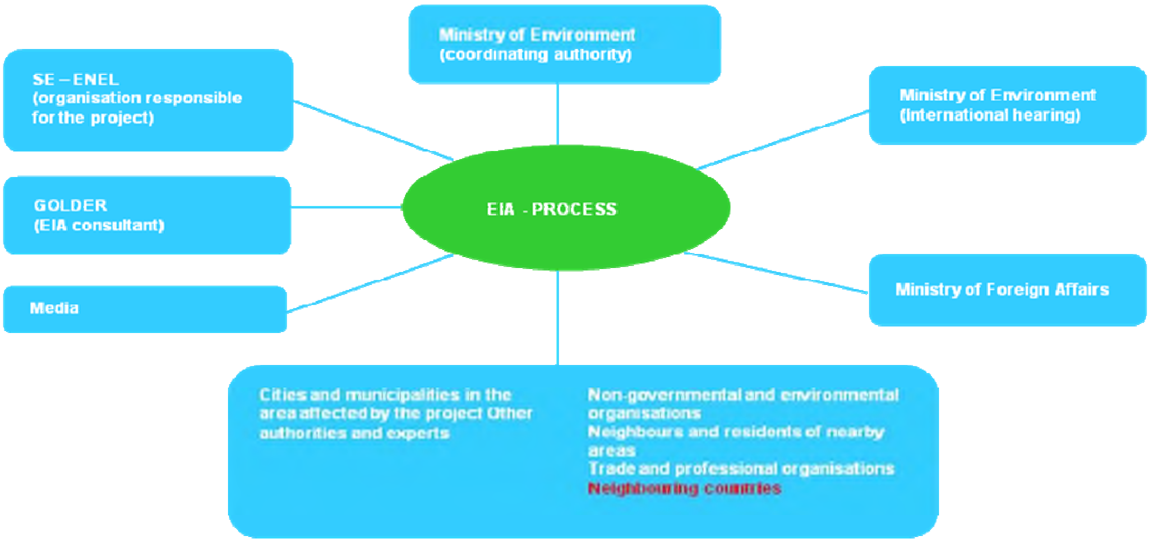


Figure 3 - Main players of Mochovce NPP EIA.

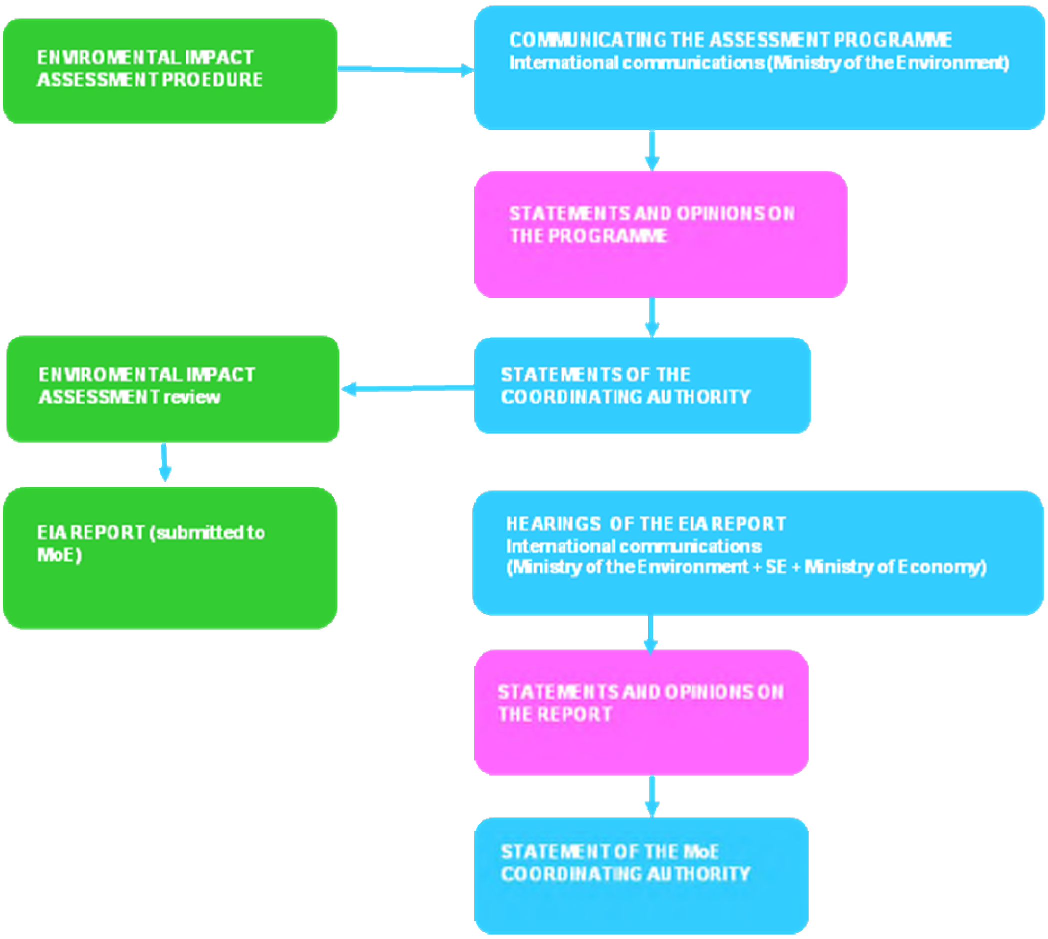


Figure 4 - Planning of the main steps of Mochovce NPP EIA process

1.3 Land use planning and Operation Permits

Land use planning methodically and comprehensively solves the functional use of land. It specifies principles of its organization and material and temporal coordination of construction and other activities that affect the development of the land.

Land use planning implies the safeguarding of the long-term harmony of the natural and cultural value of the land. In particular regarding environmental care and protection of its main components - land, water and air.

Key phases for the operation of Mochovce NPP are:

- land use procedures and land use decision; and
- operational authorization.

1.3.1 Construction Authorization

Authorizations for the launching of the construction were issued by Levice environmental office between March 1983 and November 1986 based on the various phases of the overall construction design. These permits were issued with the approval of the former Czechoslovakian atomic energy commission on the basis of an initial safety report. The issued construction license requires written approval of other state bodies.

Construction and operational authorizations for the individual stages of construction were granted with the approval of the offices of regional hygiene, occupational health and safety inspectorate, district fire protection office, the telecommunication directorate and the civil protection body.

Construction Permit No. Výst. 2010/86 for MO34 was issued by the District National Committee in Levice on the basis of the Land Planning Decisions on 12 November 1986, and it became final and conclusive on 28 January 1987. The deadline for completion of MO34 set out in the original Construction Permit has been extended as follows:

a) until 31 December 2005 by the Regional Authority in Nitra No. 97/02276-004 dated 5 May 1997; and

b) until 31 December 2011 by a Decision of the Regional Construction Authority in Nitra No. 2004/00402-007 dated 15 July 2004, becoming final and conclusive as of 3 August 2004.

Recently, the Nuclear Regulatory Authority (ÚJD SR, which, according to the Atomic Act 541/2004, is also the Building Authority for Nuclear Installations), by means of its Decision No. 246/2008 dated 14th August 2008, has set as a binding condition for the proposed activity, to complete the construction by 31st December 2013 (thus extending the validity of the Construction Permit for Completion of "Nuclar power plant mochovce VVER 4 X 440 MW - 3rd Construction").

1.3.2 Authorization for operation

According to the Slovak Atomic Act No. 541/2004 Coll., the authorization for operation shall be issued by the ÚJD (Úradu Jadrového Dozoru - Slovak Nuclear Regulatory Authority). In order to be authorised to use (operate) the facility MO34, an operational authorization would have to be issued in accordance with the relevant provisions of the Atomic Act. ÚJD shall issue authorisation for commissioning of nuclear installation within six months from submission of a complete application.

Besides the documents required by the ÚJD, there are other documents that have to be provided. The Slovak Public Healthcare Authority issues a list of "decisions" and “permits” in the field of protection against ionizing radiation, pursuant to the Public Healthcare Act. These “decisions” and “permits” are independent of the authorisations issued under the Nuclear Act, but it will be required to obtain them in addition to any authorisation issued under the Nuclear Act. The permits are issued for a period of five years, and may be extended for another period of equal length.

1.3.3 SR Public Health Authority condition for operation

According to the decision of Public Health Authority of the Slovak Republic No. 000ZPZ/6274/2006, starting from 2 November 2006 the conditions for operation of EMO12 shall observance and meet of the following limits:

- yearly limit activity of radionuclide activity in emissions;
- yearly and volume activity limits for radionuclide activity in wastewater;
- reference levels: a) investigation level for releases to atmosphere; b) interference level for release to atmosphere; c) investigation level for releases to wastewater; d) interference level for release to wastewater;

other requirements are:

- continual monitoring;
- dose loads for balancing and evaluation.

The permit is valid until 1 November 2011.

1.3.4 Terrestrial system of ecological stability

The terrestrial system of ecological stability (TSES) legally categorizes the evaluation of the state of the landscape (in particular their biotic formation). The basic TSES documents are the General, supraregional TSES for Slovakia (1992), regional TSES documentation for the former Slovak districts (1993-1995) and the National Ecological Network of Slovakia (1996).

In the Slovak Republic several methods are used for evaluation of environmental (ecological) quality of the territory and their positive and negative factors. All of these methods have markedly regional dimensions and differentiate the territory of the Slovak Republic from the point of view of various criteria. A large territorial unit plan for the Nitra region was approved in a governmental decree of the Slovak Republic issued in 1998, as a regional TSES.

1.4 International Treaties and obligations

Nuclear Third Party Liability

In Slovak Republic compensation for nuclear damage is covered by general regulations on liability for damage, except as otherwise stipulated in the act or an international agreement to which the Slovak Republic is bound.

Liability for nuclear damages is dealt with in the act 541/2004, Coll.. This act contains very detailed provisions on third party liability for nuclear damage, which largely transpose the provisions of the 1963 Vienna Convention on Civil Liability for Nuclear Damage. The Slovak Republic acceded to the Vienna Convention and the 1988 Supplementary Protocol on the Application of the Vienna Convention and the Paris Convention on 7 March 1995.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT)

The Slovak Republic signed the Comprehensive Nuclear-Test-Ban Treaty on September 30, 1996 and ratified the treaty on March 3, 1998. In co-operation with the Ministry of Foreign Affairs, Ministry of Defence and the Slovak Academy of Sciences objectives, resulting mainly from the plenary sessions of the Preparatory Commission for the Treaty Organisation and from the meetings of their working groups, were provided. UJD actively contributed to the On-Site International Inspection Operational Manual.

Convention on Nuclear Safety

The Convention on Nuclear Safety was adopted on 17 June 1994 by a Diplomatic Conference convened by the International Atomic Energy Agency at its Headquarters from 14 to 17 June 1994.

The Convention was drawn up during a series of expert level meetings from 1992 to 1994 and was the result of considerable work by Governments, national nuclear safety authorities and the Agency's Secretariat. Its aim is to legally commit participating States operating land-based nuclear power plants to maintain a high level of safety by setting international benchmarks to which States would subscribe.

Slovakia has been the first state in the world with nuclear power plant in its territory to ratify the Convention on Nuclear Safety.

The obligations of the Parties are based to a large extent on the principles contained in the IAEA Safety Fundamentals document "The Safety of Nuclear Installations". These obligations cover for instance siting, design, construction, operation, the availability of adequate financial and human resources, the assessment and verification of safety, quality assurance and emergency preparedness.

Slovakia is also a member of the Convention on Management of Spent Nuclear Fuel and radioactive Waste.

Duties towards the European Commission under the Euratom Treaty

Under EU law, some activities pertaining to the nuclear facility have to be communicated to the Commission. According to Article 41 of the Euratom Treaty, entities have to communicate investment projects relating to new installations and also to replacements or conversions which fulfil the criteria as to type specified in Annex II of the Euratom Treaty. The investment projects to be communicated to the Commission under Article 41 are further specified in the Investment Projects Regulation. This communication has already been transmitted to the Commission for MO34 completion on July the 16th 2007.

SE received a positive standpoint from European Commission in July 2008. The standpoint covers also the recommendations that should be used during the construction from the safety point of view.

Previously, during the phase of integration of Slovak Republic in the European Union, the Slovak Government issued report, in January 2000, of its New Energy Policy Progress. In nuclear matter, relatively to completion of units 3 and 4 of Mochovce Nuclear Power Plant, in accordance with the conclusions from discussions with the European Commission and in line with Governmental Resolution No. 5 of 12 January 2000, a proposal for completion of construction of the 3rd and 4th unit of Mochovce Nuclear Power Plant was, at that date, submitted.

1.5 The coherence of the project with regional planning

The current state of the MO34 construction is:

- Civil part is complete up to 70%;
- Mechanical equipment supply is complete up to 30%;
- Electrical and I&C equipment supply is negligible.

1.5.1 Permitting

The original Construction Permit No. Výst. 2010/86 for MO34 was issued by the District National Committee in Levice on the basis of the Land Planning Decisions on 12 November 1986. This Permit has been renewed firstly on May the 5th 1997 by letter of the Regional Authority in Nitra No. 97/02276-004 and further by Decision of the Regional Construction Authority in Nitra No. 2004/00402-007 dated 15 July 2004.

Recently, the Nuclear Regulatory Authority (ÚJD SR, which, according to the Atomic Act 541/2004, is also the Building Authority for Nuclear Installations), by means of its Decision No. 246/2008 dated 14th August 2008, has set as a binding condition for the proposed activity, to complete the construction by 31st December 2013 (thus extending the validity of the Construction Permit for Completion of MO34). The authorization for the commissioning of units 3 and 4 requires completion of the EIA process for the proposed activity.

1.5.2 Safety improvements

The existing valid Construction permit, and specifically the extension granted on July the 15th 2004 with the Decision No. 2004/00402-007, requires SE to perform some safety improvements to the original Basic Design with the scope to further increase the level of nuclear safety compared to Mochovce units 1 and 2.

The required safety improvements have been included in the project and are described in the Design Framework of the present EIA Report.

2.0 DESIGN FRAMEWORK

2.1 Overview of EMO12 operational background

The Mochovce project history started off as early as the 1970s when the then Czechoslovakia started to perform geological surveys for the identification of suitable sites to construct a new atomic power plant. The future power plant had to sit on seismically stable geological formations. An essential condition was the proximity to a source of water to cool the plant and replace the evaporated water. Neither large-scale industrial enterprises nor urban agglomerations were to be located nearby. Upon taking account of all the factors, a definitive decision was taken - the site in the municipality of Mochovce was chosen to construct the nuclear power plant. This area was best to meet all the siting conditions.

The preparation work was launched in June 1981 and the proper construction of the NPP in November 1982. The original construction plan envisaged for the utility to be commissioned in the late 1980's. As compared with other installations of a similar type, the NPP Mochovce design already involved several principal improvements such as a seismically resistant attachment of technologic equipment.

Nevertheless, the original technologic process control and management system was found under the final phase of the plant construction to fail to comply with the current stage of knowledge. It had to be replaced with a new system supplied by the German company Siemens, the reliability of which had already been verified in practice. At the time of its application it represented the world's top-class and had already been successfully installed at atomic power plants in Germany.

In the early 1990's lack of funds affected the completion. The search for financial resources abroad proved the only option to ensure further progress of works. Following demanding negotiation, the Slovak Government approved in September 1995 a model for completion and funding of Units 1 and 2. Under it, the completion is implemented to the extent of the original project and with the original contractors.

However the entry by foreign and high-profile companies such as Electricité de France, Siemens or Framatome was conditional on a complex assessment of both the project and overall status of the plant equipment. The Mochovce NPP had undertaken at the time a host of examinations and opened its gates to expert missions from the most reputable institutions worldwide. Experts analysed the principle of the technical equipment and its safety functions. The result of joint efforts by Slovak and foreign experts was a nuclear safety improvement programme and its implementation even prior to the plant start up.

Unit 1 has now supplied electricity to the network since the summer of 1998 and Unit 2 was finally put into operation in late 1999.

2.2 Project description

According to the original design, Mochovce NPP consists of 4 units of VVER 440 type (Vodo Vodni Energeticeskij Reaktor) pressurized water reactors of the Russian type V 213. MO34 follow directly the EMO12 units and will use the auxiliary systems already in operation which are common for all 4 units.

EMO12 have been commercially operated since 1999 and 2000 respectively.

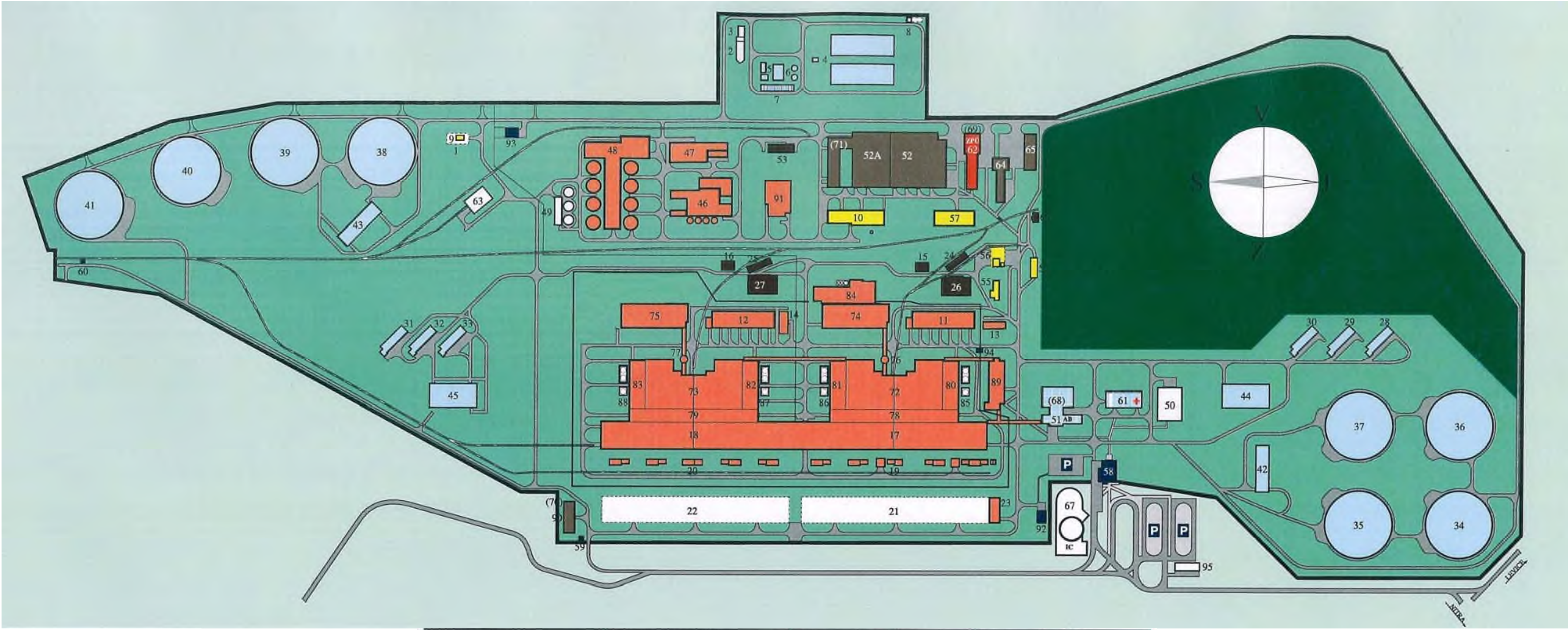
Construction works for MO34 started in 1986 with the laying the foundations of the main buildings (reactor building, longitudinal electrical building, basement of transformers, cooling towers, vent stack) and continued up to 1992. In 1992 construction works were suspended. From 1992 to 2000 maintenance and conservation of suspended equipment and components and of civil structures were carried out by the original main suppliers and constructors. From 2000 to-date the preservation and protection works have been performed on the basis of programs approved by the NRA of the SR.

The current status of the MO34 construction is:

- Civil parts are up to 70% complete;
- Machinery is up to 30%;complete ;
- Electrical and I&C equipment are up to 1% complete.

Figure 5 shows a layout of Mochovce NPP in which the following main building structures can be identified:

- 73: reactor building (72 for EMO12);
- 79: longitudinal compartment of electrical equipment (78 for EMO12);
- 17-18: turbine-generator hall;
- 38-41: cooling towers (34-37 for EMO12);
- 12: diesel generator building (11 for EMO12);
- 75: auxiliary operation building (74 for EMO12);
-
- 84: final processing of liquid radioactive waste building (for all four units).



Object	loc.	n. Name of object	Object	loc.	n. Name of object	Object	loc.	n. Name of object	Object	loc.	n. Name of object
320/1-01		1 Fence of regulation gas station	568/1-01		26 Petroleum management of 1st MPU	631/1-01		51 Administrative building and canteen	803/1-01		76 Ventilation stack of 1st MPU
362/1-06		2 Storage reservoir of industrial sewerage	568/1-02		27 Petroleum management of 2nd MPU	640/1-01		52 Workroom (HND store)	803/1-02		77 Ventilation stack of 2nd MPU
362/1-07		3 Oil separator on industrial sewerage	580/1-01		28 Cooling ventilation tower I/1	641/1-01		53 Oil and combustible storehouse	805/1-01		78 Electrical equipment rooms (EER) – lenghtwise1st MPU
363/1-01		4 Safety reservoirs of storm sewer	580/1-02		29 Cooling ventilation tower I/2	642/1-01		54 Technical gas storehouse	805/1-02		79 EER – lenghtwise 2nd MPU
366/1-01		5 Repumping station of sewage	580/1-03		30 Cooling ventilation tower I/3	643/1-01		55 Oxygen and nitrogen generation	806/1-01		80 EER – crosswise 1. unit
367/1-01		6 Sewage disposal plant	580/1-04		31 Cooling ventilation tower II/1	643/1-02		56 Hydrogen storehouse	806/1-02		81 EER – crosswise 2. unit
367/1-02		7 Sludge bed	580/1-05		32 Cooling ventilation tower II/2	646/1-01		57 Outdoor store and scarp yard	806/1-03		82 EER – crosswise 3. unit
368/1-01		8 Associate object of waste water measuring	580/1-06		33 Cooling ventilation tower II/3	650/1-01		58 Main lodge and police station	806/1-04		83 EER – crosswise 4. unit
393/1-01		9 Regulation gas station	581/1-01		34 Cooling tower I/1	652/1-01		59 Subsidiary lodge by the secondary entry	808/1-01		84 Processing and Ra waste disposal
441/1-01		10 Auxiliary boiler house	581/1-02		35 Cooling tower I/2	652/1-02		60 Subsidiary lodge by the siding	810/1-01		85 Supercasualty charge 1. unit
442/1-01		11 Dieselgenerator set I (DGS)	581/1-03		36 Cooling tower I/3	653/1-01		61 Medical centre	810/1-02		86 Supercasualty charge 2. unit
442/1-02		12 Dieselgenerator set II	581/1-04		37 Cooling tower I/4	656/1-01		62 Firehouse	810/1-03		87 Supercasualty charge 3. unit
442/1-03		13 HP Compressor plant I	581/1-05		38 Cooling tower II/1	700/1-01		63 Engine dock	810/1-04		88 Supercasualty charge 4. unit
442/1-04		14 HP Compressor plant II	581/1-06		39 Cooling tower II/2	701/1-01		64 Transport – garage, wash stand	840/1-01		89 Operational building
442/1-05		15 Oil management station 1st MPU (Main production unit)	581/1-07		40 Cooling tower II/3	701/1-02		65 Motor truck garage	881/1-01		90 Metrological centre
442/1-06		16 Oil management station 2nd MPU	581/1-08		41 Cooling tower II/4	703/1-01		66 Fuel store – petroleum pump	882/1-01		91 Compressor plant
490/1-01		17 Machine room 1st MPU	584/1-01		42 Central pump room of cooled water 1st MPU			67 Information bureau	940/1-01		92 Guardhouse 1
490/1-02		18 Machine room 2nd MPU	584/1-02		43 Central pump room of cooled water 2nd MPU	780/1-01		68 Civil defence under administrative building	940/1-02		93 Guardhouse 2
510/1-01		19 Transformer ground 1st MPU	584/1-03		44 Pump room of ITW (Important technical water) in the 1st MPU	780/1-02		69 Civil defence under firehouse	784/1-01		94 Small lodge
510/1-02		20 Transformer ground 2nd MPU	584/1-04		45 Pump room of ITW in the 2nd MPU	780/1-03		70 Civil defence under metrological centre			95 INPAKO admin. building
522/1-01		21 Outdoor distribution 100 and 400 kV 1st MPU	590/1-01		46 Chemical water treatment (CHWT)	780/1-04		71 Civil defence under workrooms and stores			Railway
522/1-02		22 Outdoor distribution 100 and 400 kV 2nd MPU	592/1-01		47 Store and bottling room of chemicals	800/1-01		72 Reactor building of 1st MPU			
529/1-01		23 Central electric survey	593/1-01		48 Decarbonization	800/1-02		73 Reactor building of 2nd MPU			
566/1-01		24 Petroleum DGS I and oil bottling house	599/1-01		49 Sludge management of CHWT	801/1-01		74 Auxiliary operation building of 1st MPU			
566/1-02		25 Petroleum DGS II bottling house	630/1-01		50 Simulator building	801/1-02		75 Auxiliary operation building of 2nd MPU			

Figure 5 - Layout of Mochovce Nuclear Power Plant Units 1&2 and Units 3&4

2.3 Description of the process

MO34 will have two individual operational nuclear units, both containing separate nuclear and thermal parts. Both MO34 units will be directly linked to the first two operational units - EMO12. The operational auxiliary systems can be used in all four units of the complex.

The process for the production of electrical power in Mochovce NPP incorporates three principal heat transfer cycles:

1. in the first cycle, heat derived from the fuel is used to boil water to produce steam: the section of the plant that performs this function is known as the Nuclear Steam Supply System;
2. in the second cycle, the steam is used to drive turbines, which are connected to generators that produce electrical power: this section of the plant is known as the Power Conversion System;
3. in the third cycle, the remaining energy in the steam is rejected as heat: the section of the plant associated with this process is known as the Cooling Water (or Heat Rejection) System.

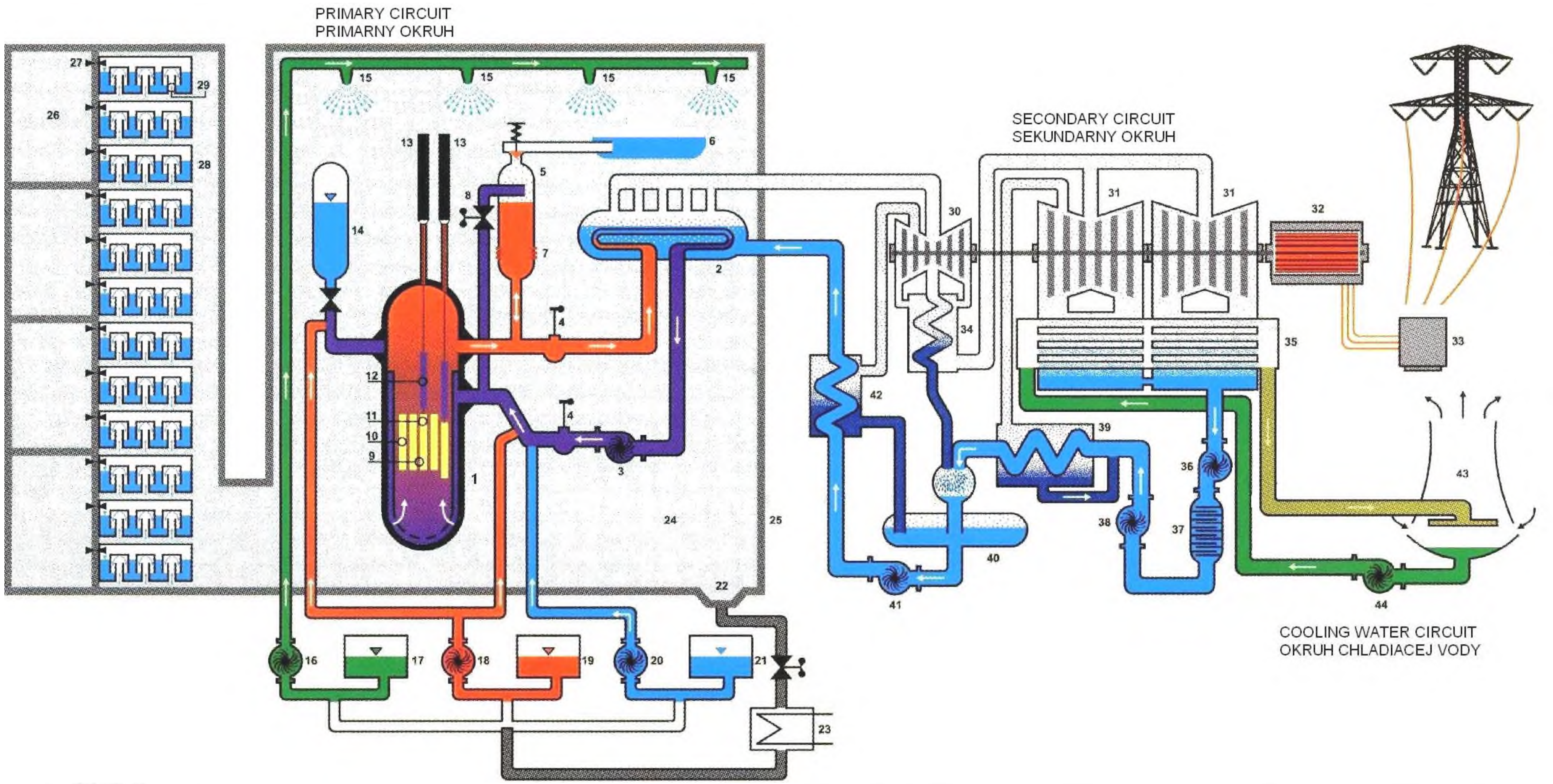
Figure 6 illustrates the general arrangement of the three heat transfer cycles for a nuclear power station based on the Russian VVER-440 Model V213 reactor unit. The two main circuits, the primary one and the secondary one, can be distinguished. Table 1 contains the basic technical data for a 440 MW unit.

The **primary circuit** of each unit is housed in the reactor building. The primary circuit is formed by the reactor and six coolant loops; each loop consists of a hot leg with an isolation valve, a steam generator (SG) and a cold leg with a reactor main circulation pump and an isolation valve (Figure 7). The reactor main circulation pumps recycle pressurized water to remove heat from the reactor core. The pressurizer establishes and maintains the reactor coolant system pressure within the operational conditions and allows compensation for reactor coolant volume changes during operation. SGs are the interface between the nuclear system (primary circuit) and the steam system (secondary circuit). Each SG is a tubular evaporator of horizontal design.

The fuel in fuel assemblies is placed in the reactor pressure vessel (RPV), where chemically treated water runs through channels in the fuel assemblies and removes the heat generated by the fission reaction. The water temperature at the exit from the reactor is about 297 °C (temperature increase through the reactor is about 29 °C).

The **secondary circuit** connects the nuclear steam supply system (NSSS) to the power conversion system. The steam generated in the six SGs is piped through 6 high pressure steam lines from the reactor building to the turbine hall. The turbine hall, shared by all four units, is oriented parallel to the reactor buildings. For each unit the hall houses two turbo-generator sets with one high-pressure and two low-pressure sections.

The exhausted steam condenses in the turbine's main condenser, which is cooled by the circulating **cooling water** system. The condensate is then sent back to the SGs..



Legend

1 - Reactor - Reaktor
2 - Steam generator - Parogenerátor
3 - Reactor coolant pump - Hlavné cirkulačné čerpadlo
4 - Main isolating valve - Hlavná uzatváracia atmatúra
5 - Pressurizer (steam section) - Kompenzátor objemu (KO) (parná časť)
6 - Pressurizer relief tank - Barbotážna nádrž
7 - Pressurizer (electric heaters) - Kompenzátor objemu (elektroohrieváky)
8 - Pressurizer injection - Vstreky KO
9 - Reactor core - Aktívna zóna
10 - Fuel assembly - Palivová kazeta
11 - Automatic control rod (ACR) (fuel section) - Automatická regulačná kazeta (ARK) (palivová časť)
12 - ACR (absorber section) - Automatická regulačná kazeta (ARK) (absorpčná časť)
13 - ACR drives - Pohony ARK
14 - Hydroaccumulators - Hydroakumulátory
15 - Spray system - Sprchový systém
16 - Spray pump - Sprchové čerpadlo
17 - Spray system tank - Zásobná nádrž sprchového systému
18 - Low-pressure (LP) emergency pump - Nízkotlakové havarijné čerpadlo
19 - LP emergency system tank - Zásobná nádrž nízkotlakového havarijného systému
20 - High-pressure (HP) emergency pump - Vysokotlakové havarijné čerpadlo
21 - HP emergency system tank - Zásobná nádrž VT havarijného systému
22 - Containment suction sump - Sanie z hermetickej zény
23 - Spray system cooler - Chladič sprchového systému
24 - Containment - Hermetická zóna
25 - Reinforced concrete containment wall - Ochranná obálka
26 - Bubble-condenser tower air trap - Záchytná komora barbotážnej veže
27 - Check-valve - Spätná klapka
28 - Bubble-condenser tower - Barbotážna veža
29 - Bubble-condenser tower flumes - Žlaby barbotáznej veze
30 - HP stage of steam turbine - VT diel parnej turbíny
31 - LP stage of steam turbine - NT diel parnej turbíny
32 - Electrical generator - Elektrický generátor
33 - Unit transformer - Blokový transformátor
34 - Steam separator and re-heater - Separátor a priehrievač pary
35 - Condenser - Kondenzátor
36 - Condensate pump (stage 1) - Kondenzátne čerpadlo 1°
37 - Condensate treatment - Bloková úprava kondenzátu
38 - Condensate pump (stage 2) - Kondenzátne čerpadlo 2°
39 - LP regeneration - Nízkotlaková regenerácia
40 - Feedwater tank - Napájacia nádrž
41 - Main electric feedwater pump - Hlavné elektronapájacie čerpadlo
42 - HP regeneration - Vysokotlaková regenerácia
43 - Cooling tower of circulating water - Chladiaca veža cirkulačnej vody
44 - Circulating water pump - Čerpadlá cirkulaènej vody

Figure 6 - Principle of electrical production in a NPP (VVER type)

Table 1 - Basic technical data of 1 unit of reactor type VVER 440/213

GENERAL	
Number of operation units: 2 Type of reactor: VVER 440/V-213 (pressurised water) Reactor thermal power: 1,375 MWt	Rated unit power: 440 MWe Inherent consumption: 35 MW (8% of rated power) Unit efficiency: 29.5%
Reactor Pressure Vessel	**Steam Generator**
Inner diameter: 3,542 mm Wall thickness: 140 + 9 mm Height: 11,805 mm Weight (internals excluded): 215,150 kg Material: alloyed steel Cr-Mo-V	6 per Unit Type: PGV-213 Amount of generated steam: 450 t/h Outlet steam pressure: 4.64 MPa Outlet steam temperature: 267 °C Feedwater temperature: 158÷223 °C
Reactor Core	**Turbogenerator**
Fuel operating assemblies: 312 Number of control assemblies: 37 Total weight of fuel (UO_2) in core: 42 t Enrichment for standard type fuel (1^{st} core as for EMO12): 3.6%, 2.4% and 1.6% depending on position in the core Advanced type of Gadolinium doped fuel radially profiled with an average enrichment of 4.87% is considered from the 2^{nd} campaign of MO34.	2 per Unit Type: 220 MWe Stages: 1 high pressure, 2 low pressure Rated speed: 3,000 rpm Terminal voltage: 15.75 kV
Primary Circuit	**Condenser**
Number of cooling loops: 6 Coolant flow rate: 42,600 m^3/h Nominal pressure: 12.26 MPa_{rel} Coolant temperature at the reactor outlet: 297.3 °C Coolant temperature at the reactor inlet: 267.9 °C Total volume: 250 m^3	Circulating water flow rate: 35,000 m^3/h Maximum temperature of coolant water: 33 °C
EMERGENCY SYSTEMS	
PASSIVE	**ACTIVE**
Hydroaccumulators (4x)	**High pressure system (3x)**
Total volume: 60 m^3 Volume of water: 40 m^3 Volume of nitrogen: 20 m^3	Pump flow rate: 65 m^3/h Pump discharge pressure: 13.5 MPa
Bubbler-condenser tower	**Low pressure system (3x)**
Total volume of bubbler-condenser well: 13,800 m^3 Volume of 4 gas traps: 16,140 m^3 Volume of 12 bubbler-condenser tanks: 1,380 m^3	Pump capacity: 800 m^3/h Pump discharge pressure: 0.72 MPa
	Spray system (3x)
	Pump capacity: 380-520 m^3/h

Efficiency improvements of MO34 Units

Due to higher performance reached by new components (turbogenerators and other technological parts) that will be installed in MO34 secondary circuit, for each unit, the efficiency will be increased up to 31.7%, without any change in the primary circuit.

The reactor rated thermal power (1375 MWt) being equal, the electric gross power output will be 471 MWe (corresponding to 436 MWe net power output).

The most important improvements and their environmental benefits consist of:

- New turbines of higher efficiency and other optimizations in the secondary thermal cycle (leading to a decrease of the thermal discharge to the environment as a consequence of the decrease of the thermal power dissipated in the condenser);
- New titanium tubes in condensers (leading to higher performances of the component and hence to a lower steam pressure for the inlet water to condensers);
- New natural draft cooling tower package (leading to higher thermal performances of the component and hence to a lower inlet water temperature to condensers);
- New natural cooling tower drop retainers (leading to a decrease of the water consumption).

The general reduction of the thermal discharges (about 7%) into the environment can be estimated as the percent increase of the original efficiency (29.5%).

Moreover, the increase of the NPP efficiency (the electric generated energy being equal) will allow:

- an extension of the nuclear fuel life;
- a decrease of the production of radioactive waste;
- a decrease of the radioactive discharges.

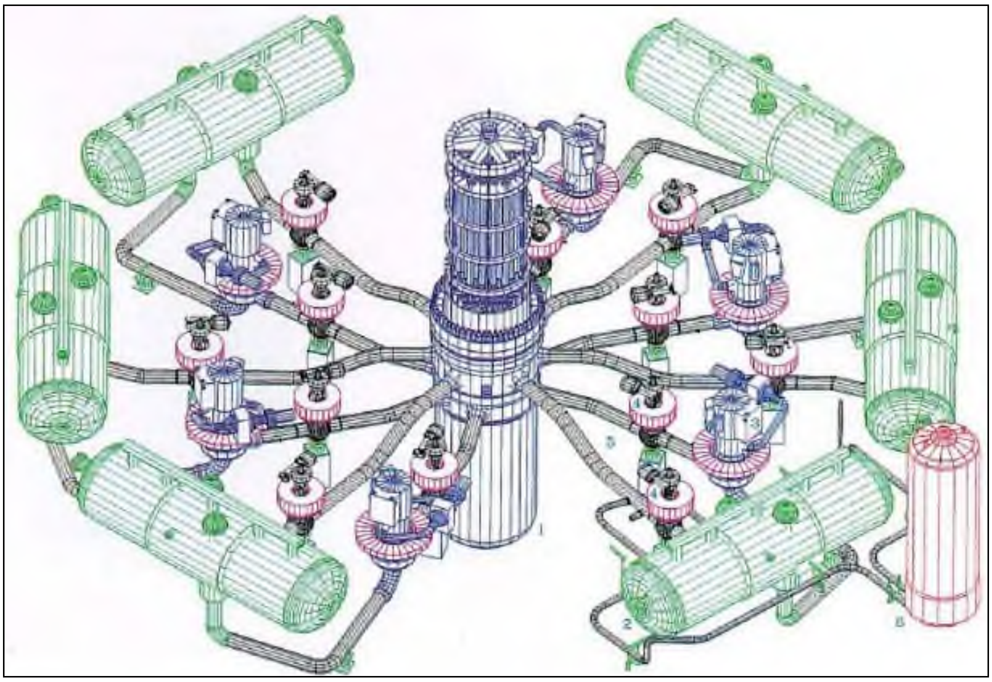


Figure 7 - Primary circuit representation with the six coolant loops

2.4 Description of the main systems

2.4.1 Nuclear Steam Supply System (NSSS)

The NSSS consists of the reactor, the reactor coolant system, and a number of auxiliary and safety systems.

Heat is generated by the process of nuclear fission with the uranium dioxide fuel. The neutron moderator for the fission process is demineralised borated water; this also acts as the primary coolant.

The fuel is placed in an assembly known as the reactor core, which is housed in the reactor vessel. The coolant water passes up through the core, removing heat from the surface of the tubes and thereby maintaining the temperature at the centre of the fuel (at full power) at approximately 1,200 °C.

Control of the nuclear chain reaction is achieved by movement of CFAs and by varying the concentration of boric acid in the reactor coolant.

In order to remove the heat from the core the reactor is equipped with a coolant system. The reactor core is housed in a steel pressure vessel with a stainless steel internal lining. Reactor coolant passes through the core, removing heat from the fuel, and then enters one of six main coolant loops (the primary circuit). The temperature of the reactor coolant is about 297 °C and, to prevent it boiling, it is maintained at a pressure of 12.26 MPa (around 125 atmospheres) by means of a pressurizer connected to one of the coolant loops.

The heated primary coolant enters the SG heat exchanging pipes. These pipes are surrounded by water which is itself heated and produces steam. In this way heat is transferred from the reactor coolant water (the primary circuit) to the power conversion system (the secondary circuit), without mixing of the two fluids. The primary coolant then returns to the core via the main coolant pumps.

The Auxiliary and Safety Systems of the NSSS are provided in order to ensure that the reactor can be safely shut down and kept shut down whenever required and to have the ability to keep the fuel elements cool, and thereby intact, under all circumstances. The Auxiliary and Safety Systems includes: Chemical and Volume Control System, RHR System, ECCS, Equipment Confinement, Auxiliary Feed-Water System and Component cooling systems.

2.4.2 Power Conversion System

The power conversion system consists of various water and steam systems and two steam turbines for each reactor unit. Demineralised water (secondary circuit water) is pumped from the turbine condensers to the SGs, where it passes over tubes containing reactor coolant water. Heat transferred through the walls of the tubes causes the secondary system water to boil, producing steam at a temperature of approximately 260 °C and pressure of about 4.6 MPa. This steam is collected in a common main steam header.

Steam from the main header passes via pipelines into the turbines, where it gives up approximately one third of its acquired energy in rotating the turbines and the connected electrical generators. The steam is then condensed in turbine condensers by passing it over tubes containing circulating water, to which it gives up the remaining two-thirds of its acquired heat energy.

2.4.3 Electrical systems

Each generator of the steam turbine generator set produces electric power at a voltage of 15.75 kV. A segregated bus bar connects each generator to a main transformer (15.75/420 kV). The generated electric power of each Unit of MO34 is transmitted through a separate single outer 400 kV line to Velký Ďur substation.

Power for internal uses of each unit is normally supplied by 2 auxiliary transformers (15.75/6.3 kV) which are connected higher voltage side to the segregated bus bar and lower voltage side to the 6.3 kV bus bars of the unit power distribution system.

If the 400 kV network fails and the switching to house load operation cannot be achieved, the power supply is taken from a 110 kV transmission auxiliary source. Two 110 kV lines connect the power plant to the Velky Ďur switchyard. For each unit there is one auxiliary transformer 110 kV/6.3 kV/6.3 kV with two secondary windings connected to the 6 kV bus bars of the unit power distribution system.

The 6 kV bus bars are interconnected so that auxiliaries of one unit can be supplied in emergency conditions from other units of the NPP.

Some of the 6 kV bus bars are dedicated to essential and safety systems. These essential bus bars can furthermore be supplied by onsite power sources composed of 3.5 MVA standby emergency diesel generators.

To assure power supply to 1st category systems (essential systems), batteries and inverters are employed.

2.4.4 Instrumentation and Control (I&C)

MO34 will use the latest commercially available digital technology. Digital electronics technology is characterized by its vastly increased functionality, improved reliability and reduced maintenance requirements.

The best practices deriving from operational experiences of Slovakian NPPs and International NPPs will be used for MO34.

The modern Human Machine Interface (HMI) will enhance operator response in any plant condition. Also expert systems shall be used to diagnose plant conditions and to advise operators.

The Safety Parameter Display System (SPDS) will be a dedicated interface for the operator, to provide all essential information for the most effective management of the plant, even in the most unlikely accident conditions.

2.4.5 Cooling Systems

In order to minimize the thermal heat dissipation to the river Hron, a closed-loop circulating water-cooling system is used, where heat exchange is performed in wet natural draft cooling towers (Main cooling system). Heated water from the condenser heat exchangers is directed to natural-draught cooling towers. There are four wet natural draft cooling towers for each of the twin reactor units. All the condensers cooling water pumps for two reactor units are located in a common pump station. The steam condenser system in the secondary circuit is cooled by the heat rejection circuit, which contains treated water. Water will be extracted from a reservoir on the river Hron at Veľké Kozmálovce, approximately 5 km from Mochovce.

Fresh water, to replace that possibly lost from the cooling water circuit by evaporation and the smaller volume of blowdown water purged from the circuit, will be taken from the reservoir on the river Hron via a pumping station to twin storage tanks, each with a volume of 6,000 m^3. From the tanks water flows under gravity via two pipelines for treatment and then is fed into the cooling water circuit.

An essential water cooling system is also present and it is used as ultimate heat sink to remove the reactor core residual heat and is cooled by wet forced draft cooling towers. There are 3 independent and 200% redundant essential water cooling systems.

2.4.6 Seismic resistance

The Mochovce plant is built to an anti-seismic design, which means that the most important buildings and process equipment are seismically resistant up to the level of the Design Basis Earthquake for the site (site design basis earthquake ZPA - Zero Period Acceleration - is equal to 0.15 g). By seismic resistance is understood the assurance of reactor coolant system integrity, including safe reactor shutdown and its continuous cool-down during and after earthquake.

2.4.7 Safety systems

To maintain a reactor in a safe shut-down condition and prevent any uncontrolled release of radioactive materials into the environment, the following critical safety functions will be fulfilled:

- sub criticality;
- core cooling;
- heat removal by the ultimate heat sink;
- reactor cooling system integrity,
- confinement integrity;
- coolant inventory.

The fulfilment of these safety functions is ensured by safety systems, which have to perform the required function even in the case of loss of off-site power and following a seismic event. In case of loss of the external electricity source, the emergency diesel generation station (containing six 3.5 MVA diesel generators, i.e. 3 per each unit) ensures the electricity supply to the safety systems.

The safety systems provide even in critical situations protection of plant personnel, and of the population around the plant, against the effects of ionizing radiation from the plant.

For this purpose, the electric equipment of safety systems is supplied by power from Category I (vital power) or Category II (essential power) sources and is seismically qualified. The safety systems have 200% back-up, i.e. each system consists of three identical independent systems of which one alone is sufficient to perform the intended safety function.

The main systems relevant for the safety of the plant in different operating conditions can be summed up as follows (Figure 8):

- High pressure and low pressure injection systems including a passive injection system (boric acid accumulators): these systems belong to the Emergency Core Cooling System (ECCS) which assures core cooling and negative reactivity injection in the case of primary circuit rupture;
- Containment Pressure Suppression System (Bubble condenser and spray system): this system performs the fundamental function of controlling the pressure after an accident in the containment, guaranteeing its integrity;
- Emergency residual heat removal system: it has to ensure the core residual heat and primary circuit accumulated heat removal during the unit cool-down at the normal, transient and accident conditions;
- SG emergency feed water system: this system supplies the steam generators with feed water in the case of low water inventory in the secondary side;
- Essential service water system: is classified as safety system. System provide persistent cooling water supply for cooling equipment which ensure NPP safety during each unit modes, including quick unit shut-down process (DSG cooling, cooling of containment equipments, in reactor hall, equipments in turbine hall). System is back-up to 200 %, i.e. including 3 equivalent
- Boron make-up and control system: it controls the inventory of coolant and it is used to maintain the optimal chemical characteristics of the reactor coolant; in particular it ensures:
  - coolant supply to reactor coolant pump seals;
  - reactor coolant system make-up to compensate non-organized leaks from reactor coolant system (RCS) and return of organized leaks into RCS;
  - correction of reactor coolant chemistry, change (increase/decrease) of H_3BO_3 concentration during normal operation and under accident situations;

- Hydrogen catalytic recombiner and burning system: this system controls the hydrogen concentration in the containment as an additional measure for severe accident management (hydrogen may be produced during an accident by the reaction of water with metals at high temperature);

- Reactor cavity flooding system: this system ensures external Reactor Pressure Vessel cool-down in case of severe accidents;

- Fire protection system.

Legend

1 Reactor
2 Steam generator
3 Reactor coolant pump
4 Main isolating valve a1 hot leg
5 Main isolating valve a1 cold leg
6 Pressurizer
7 Pressurizer relief valve tank
8 Hydroaccumulators
9 HP safety injection pump
10 LP safety injection pump
11 Spray pump
12 Boric acid solution storage tanks
13 Hydrazine hydrate tank
14 Boric acid solution storage tanks
15 Water-jet pump
16 Heat exchanger
17 Sprays
18 Containment
19 Corridor between containment and bubble-condenser tower
20 Bubble-condenser tower
21 Air traps
22 Steam entrance to the bubble-condenser channel
23 Bubble-condenser channel area
24 Bubble-condenser channel
25 Check-valve
26 Check-valve

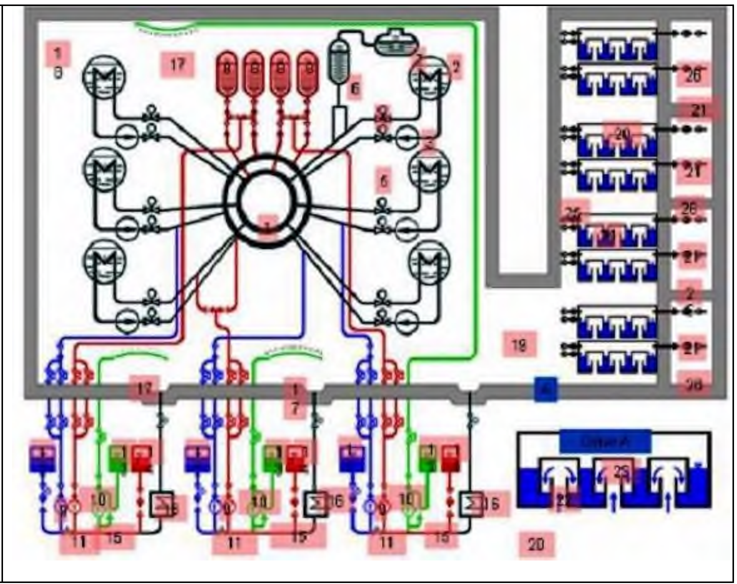


Figure 8 - Safety system scheme

The emergency reactor protections are important protections and control safety systems which assure the function of the reactor trip (*reactor trip system* and *diverse reactor trip system*).

The task of the reactor trip function is to achieve the set conditions, to automatically insert control rods in the reactor core and thus to assure the reactor trip.

The Units of Mochovce 3 & 4 are equipped with reactor limitation system. The reactor limitation system activates protection of an automatic reactor protection system to decrease the reactor thermal power depending on the achieving of set conditions.

The concept of twin reactor units allows for very efficient handling of fuel and radioactive waste. The plant safety features and the fire protection are improved as well. To maintain unit operation the auxiliary systems are installed close to the units. Additional facilities such as the nuclear auxiliary building, the diesel generator station, the compressor building, the service water and the fire fighting pump station also play a relevant role in ensuring a high level of safety of the NPP.

2.4.8 Proposed safety improvements

The safety improvements of MO34 have been conceived mainly on the basis of the IAEA document "IAEA-EBP-VVER-03, Safety issues and their ranking for VVER-440 model 213 Nuclear Power Plants", and taking EMO12 as the starting point for their further improvement.

Two important aspects need to be pointed out when considering the MO34 safety improvements:

- the main purpose of the IAEA document was to provide "a reference for the development of plant specific safety improvements and for the evaluation of measures proposed and/or implemented": hence, the document was mainly intended to be used as a support in the safety upgrade of operating plants;
- EMO12 is already 100% compliant with the IAEA recommendations.

For these reasons, within the framework of MO34 project, all the IAEA recommendations will be followed and exceeded, as specific design changes have been implemented for the completion of the construction works.

In particular, the most important modifications concerning nuclear safety can be summed up as below described.

- **Design measures for Severe Accident Management**: within MO34 project, not only the IAEA recommendations have been fully met, but additional measures have also been considered, as severe accidents are dealt with at the design level. In fact, specific design modifications have been identified on the basis of a large amount of analyses, in order to:
  - ensure the integrity of the RPV through external cooling;
  - avoid high-pressure core melt scenarios;
  - ensure containment integrity, through long-term cooling and management of the burnable gases in the containment atmosphere; and
  - improve the Post-Accident Monitoring System.
- **Improvements of I&C and electrical equipment**: state-of-the-art I&C will be installed in MO34. In particular, an advanced digital control system will be used, with an increase of control and monitoring capacity of the NPP. The human-machine interface will also be improved, for a more efficient monitoring and control of the plant safety status. Concerning electrical equipment, the use of solid-state technology for electric systems will improve the overall reliability of the plant: in addition, electrical interconnections between the different units and improved connections to the HV grid will reduce the impact on safety of the loss of offsite power.
- **Seismic upgrade**: following the requirements of the Slovak NRA, the MO34 design will be improved in order to achieve a higher seismic resistance of the plant. Seismic design zpa is 0.15 g.

- **<u>Design measures for the reduction of internal hazards</u>**: the MO34 design will address all the IAEA issues concerning internal hazards, including those deriving from:
  - fires;
  - internal flooding;
  - turbine missiles; and
  - high-energy pipe break.
- **<u>Improved design of safety systems and safety-related equipment</u>**: several design improvements have been considered for some safety systems (e.g., ECCS, EFWS) and for components of primary relevance for safety (e.g., Steam Generators, pressurizer safety valves, etc), as a result of the operational feedback of EMO12 and on the basis of the IAEA recommendations, in order to:
  - increase the reliability and separation of safety systems; and
  - increase the lifetime of components important for safety.

2.4.9 Measures dedicated to Severe Accident Management

The design Mochovce NPP includes systems for Severe Accident Management: these systems, such as the hydrogen catalytic recombiners and igniters and the Reactor cavity flooding system described above, ensure that accidents involving significant core damage, even if very unlikely, are safely managed, preventing significant radioactive releases to the environment.

2.4.10 Containment

MO34 is equipped with a containment system of pressure-suppression type, which relies on a large amount of cold water to condense steam released from the Reactor Coolant System as a consequence of an accident. A similar technology is widely used by other reactors, such as General Electric, Siemens and ASEA Atom (now ABB) BWR's.

The VVER-440/213 containment system is intended to prevent the escape of steam and fission products and to facilitate steam condensation, thereby reducing the pressure after the break of any single primary system pipeline, including the double-ended rupture of 500 mm inner diameter pipes.

The containment system is composed of (Figure 9, Figure 10):

- reinforced concrete accident localization structure, providing confinement function of the system;
- bubbler condenser, providing passive pressure-suppression function; and
- water droplet spray system, providing active pressure-suppression function and radioactivity removal function.

The accident localization compartments include a sealed set of interconnected compartments surrounding selected primary system components (steam generators, inlet and outlet piping, pumps, isolation valves, pressurizer and the major portion of the reactor vessel) and additional compartments containing bubbler condenser.

Compartments housing technological systems constitute a part of the reactor building.

Bubbler condenser rooms are located in an additional building (bubbler condenser tower), connected to the reactor building by a rectangular tunnel.

The reinforced concrete walls of the VVER-440/213 are approximately 1.5 m thick. All walls and roofs of the localization compartments have internal steel lining. Reinforced concrete structures, the airtight entrance doors and penetrations are designed for the 0.15 MPa overpressure.

The bubbler condenser comprises twelve levels of water filled trays. Each level contains 163 m^3 trays. The trays hold borated water with the concentration 12 g/l. Total water inventory inside the bubbler condenser amounts to 1,250 m^3. Outer surfaces of adjacent trays form vertical weirs that are capped by a downward facing trough submerged in water. The inside walls of the trays and troughs form water-filled vertical channels, approximately 50 cm long.

The reactor building spray system (RBS) provides a water spray to the reactor compartment following a LOCA or steam line break, to limit containment pressure and to minimize the release of radioactive iodine and particulates to the environment. The RBS is composed of three identical and completely independent trains, each of them with a capacity of approximately 400 m^3/h.

The efficiency of the containment system in rapidly reducing the accident pressure by combination of pressure suppression system and containment spray allows termination of releases to the environment in a very short time, as fully demonstrated by Research programs sponsored by IAEA, OECD and European Commission through Phare programs, while other containment designs have to cope with overpressurization for days and weeks after an accident. MO34 containment will be equipped with safety systems, so that the integrity of the containment will be ensured during and after an accident. In addition, the MO34 project includes several design improvements, in compliance with the most recent and demanding international safety requirements, which are specifically aimed at preserving the structural integrity of the containment even for extremely-unlikely accident scenarios (“Severe Accidents”) which, nonetheless, are the most critical and challenging for the containment.

In particular, the design measures defined for MO34 will:

- avoid the uncontrolled burning of the hydrogen which is generated during a Severe Accident (by using hydrogen recombiners/igniters);
- avoid high-pressure core-melt scenarios (through a dedicated line for fast depressurization of the primary circuit);
- avoid RPV failure (through the in-vessel retention of the molten core by reactor-cavity flooding and external core cooling);

thus practically eliminating the accident sequences which could seriously jeopardize the containment structural integrity.

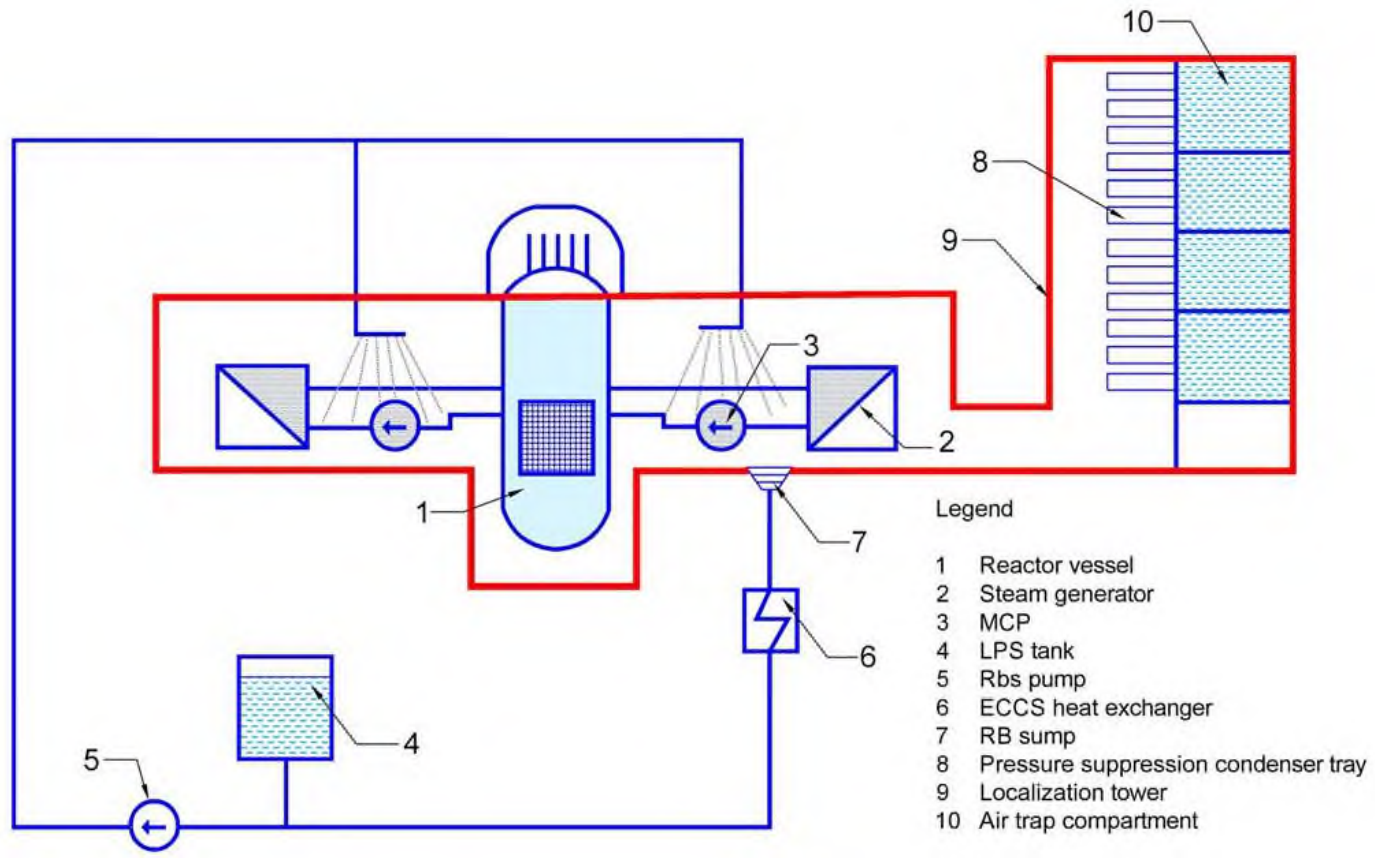


Figure 9- Schematic diagram of VVER-440/213 containment system

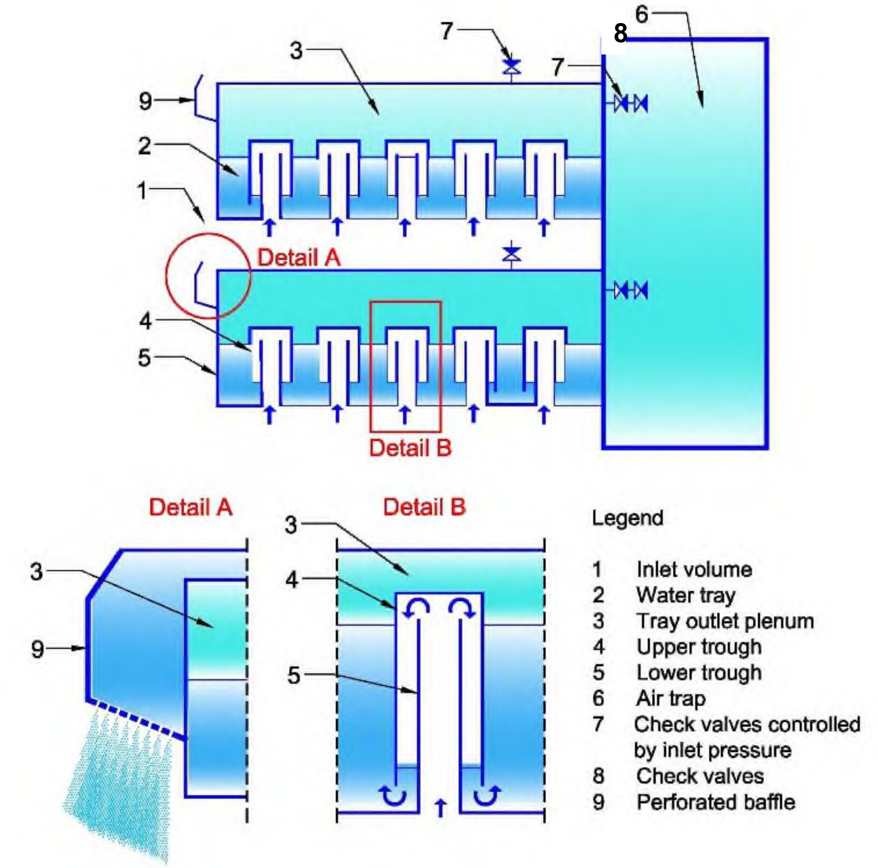


Figure 10 - Details of air trap compartment of VVER-440/213 containment system

2.5 Fuel

The fuel in form of fuel assemblies is placed in the RPV, where chemically treated water runs through channels in fuel assemblies and removes the heat generated by the fission reaction. The water exits the reactor at the temperature of about 297 °C. The used fuel is uranium dioxide (UO_2). Nuclear units operate in campaigns and periodically the reactor is shut down for refuelling.

SE nuclear reactors at NPP Bohunice, both VVER 440/213 type, started their operation with fuel of Russian fabrication and construction. For the first core of MO34 the same configuration as at Bohunice Unit 3. will be used in order to have an optimal power distribution. In accordance with original design nuclear fuel as the initial cores of Bohunice and EMO12, as well as fuel produced for the refuelling in approximately 12 month cycles, consisted of fuel assemblies with enriched uranium 1.6%, 2.4% and 3.6%. Such fuel was used in 3-4 year cycles and the maximum burn-up of discharged fuel assemblies reached approximately 40 MWday/kgU. From 1999 all units started progressively to use a radial profiled fuel with an average enrichment of 3.82% ^{235}U. From 2006 EBO V2 and EMO12 started to use second generation fuel with 3.84% ^{235}U and 4.25% of average enrichment with burnable gadolinium absorber (burnable absorber of thermal neutrons). In addition to the above types of fuel, starting with the second campaign it will be used an advanced type of Gadolinium doped fuel with an enrichment of 4.87% ^{235}U. The use of gadolinium allows to smooth the growth of energy in the reactor core from the beginning of campaign where too many neutrons are emitted to the end of the campaign where more neutrons are needed to allow the use of less fissionable products. With such a fuel it is possible to operate with a 5÷6 year cycle and the fuel burn-up should reach values of 48÷52.6 MWday/kgU.

The adoption of Gadolinium in nuclear fuel elements allows, therefore, reducing tritium production and consequently tritium discharges in wastewater streams.

In the VVER 440, Model V213, the reactor core is composed by:

- 312 Independent Fuel Assemblies (IFA);
- 37 Control Assemblies (30 Absorber Assemblies and 7 Regulation Assemblies).

The 37 Control Assemblies (or Fuel Follower) are divided in 6 groups, five with six assemblies for group and the 6th with the 7 regulation assemblies.

Figure 11 shows the layout of the first core for MO34.

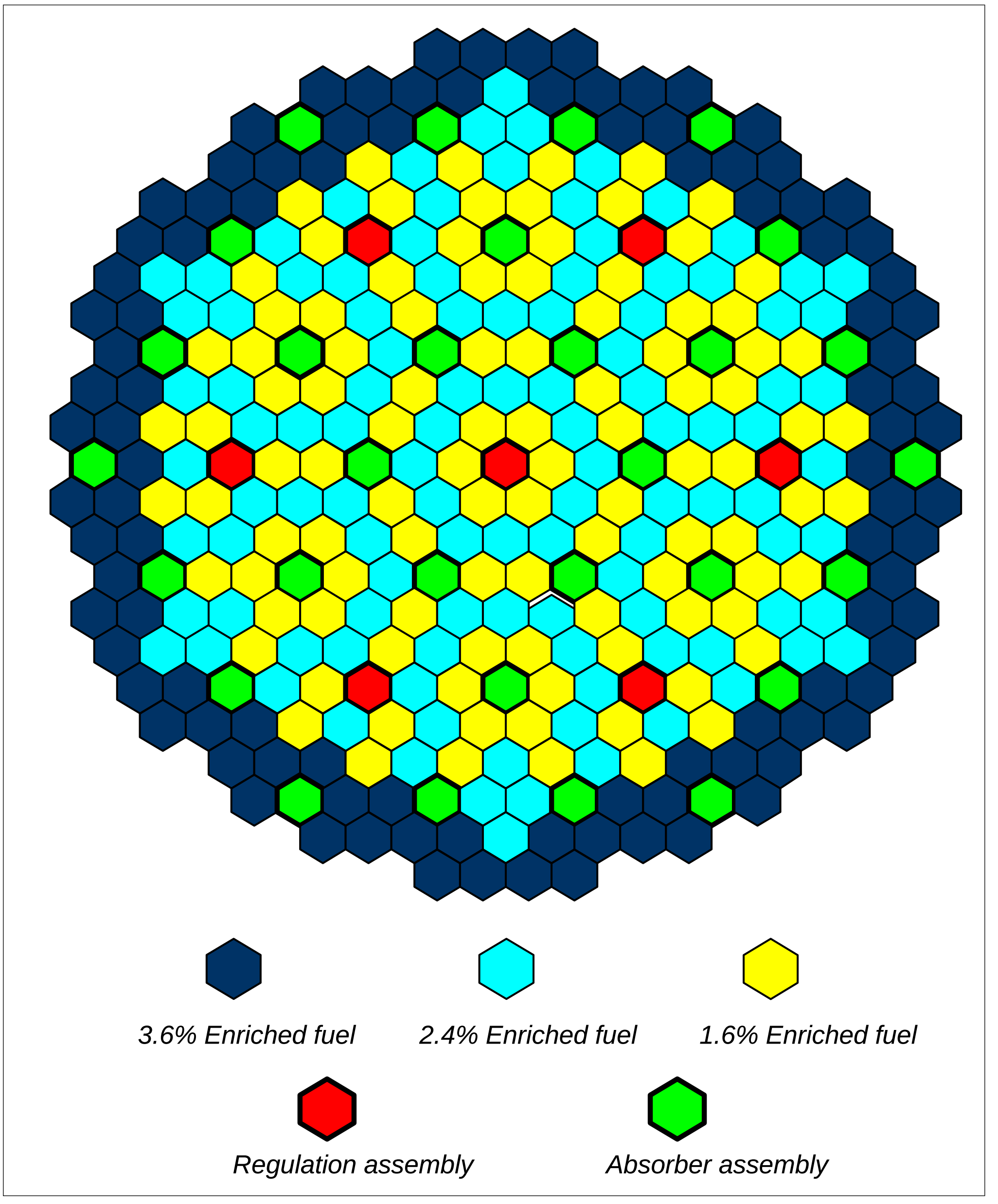


Figure 11 - Layout of the first core for MO34

Control Fuel Assembly (CFA) is composed by two parts – fuel (lower part) and absorber (upper part). Fuel part is located in the core and absorb part (contain Boron to absorb neutrons) is located over the core. To reduce the power of reactor is shift down in to the core.

Each fuel assembly is made up of 126 fuel rods and a central channel for the instrumentation. Ten spacer grids are used in order to assure the position of each rod. Inside each fuel rod there are annular pellets of enriched uranium dioxide, to produce power by fission. The space between the inner surface of the tube rod and the pellets is filled with helium to compensate for the external pressure.

Each fuel assembly is covered by a shroud, as shown in Figure 12.

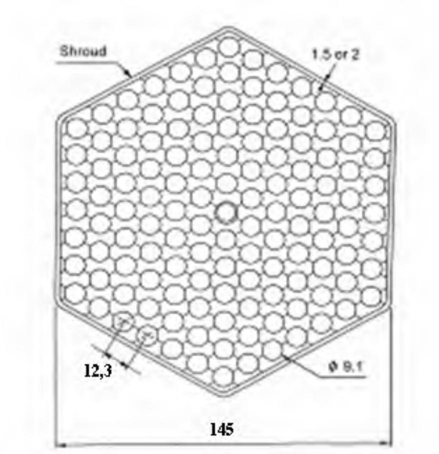


Figure 12- Fuel assembly cross section

The fuel follower of hexagonal shape is made of boron-steel.

2.5.1 Fresh fuel transport and handling

Presently a special railway train serves to transport fresh fuel. Each wagon carries eight containers, each of which holds four fuel assemblies/fuel followers. Upon arrival at the power plant the fuel is transferred into fresh fuel storage where it is checked (visually, geometrically), and either put into temporary storage racks, transport containers or into cylindrical magazines in preparation for refuelling. These magazines each hold 30 assemblies. During refuelling, the magazines are transported by crane to the receiving part of the fuel storage pool. The fresh fuel is transferred from the magazine to the core by a refuelling machine.

When the fuel is ready for discharge, it is transferred from the core to the storage pool using the refuelling machine.

2.5.2 Spent fuel management

Spent fuel treatment conception is set in accordance with Final part of nuclear power industry strategy on its long term storage (cca 50 years) and on its consequent disposal in a deep underground disposal site.

Nuclear power plants in the Slovak Republic are operated in the so-called open fuel cycle. At present it is not possible to apply the closed fuel cycle, as VVER-440 reactors operated in the Slovak Republic are not licensed for the use of MOX fuel (mixture of Uranium and Plutonium oxide). This means that the spent fuel is not reprocessed (Figure 13).

Under the assumption of the shutdown of EBO V1 and the 40 year EBO V2 operation period, EMO12 and MO34 will produce 24 698 spent fuel assemblies which correspond to approximately 2960 tonnes of spent fuel converted into the heavy metal contents. Out of that number, the EBO V1 and V2 productions will be 12 384 pieces of spent fuel assemblies and the EMO12 and MO34 productions will be 13 104 pieces of spent fuel assemblies.

The spent fuel storage in an interim storage facility is an inevitable technological stage whose aim is to reduce the amount of heat and activity produced by spent fuel assembles prior to their reprocessing or prior to their conditioning and insertion in disposal containers and the carriage to the deep underground disposal site. The Interim Spent Fuel Storage Facility in Jaslovské Bohunice is used for that purpose for the EBO V1 and V2 spent fuel and for a part of the Mochovce NPP spent fuel at present. The first spent fuel carriage from Mochovce NPP to the JAVYS Interim Spent Fuel Storage Facility was made in April 2006.

A dry storage facility construction is assumed for the spent fuel storage at Mochovce NPP, based on the principle of two-purpose transport-storage containers. The original assumed commissioning date was the year 2009. The intention to build the Mochovce NPP dry storage facility assumed spent fuel transports (approximately 2 year spent fuel production) to another site (to the JAVYS Interim Spent Fuel Storage Facility). The Mochovce NPP Interim Spent Fuel Storage Facility environmental impact assessment (EIA) process was successfully completed in 2004 resulting in a positive final position issued by the Ministry of Environment of the Slovak Republic. In 2003, however, SE, a.s., decided to make use of the free capacity in the JAVYS Interim Spent Fuel Storage Facility in Jaslovské Bohunice that will remain free after the premature shutdown of NPP V1 reactor units in 2006 and 2008 and to postpone the beginning of the construction to 2017. The capacity in question is approximately 1,500 fuel assemblies which is sufficient for about 10 years of Mochovce NPP operation (under the assumption that 75 spent fuel assemblies will be removed from the reactor core on an average yearly and the spent fuel assemblies will be stored in KZ-48 compact containers in the Interim Spent Fuel Storage Facility).

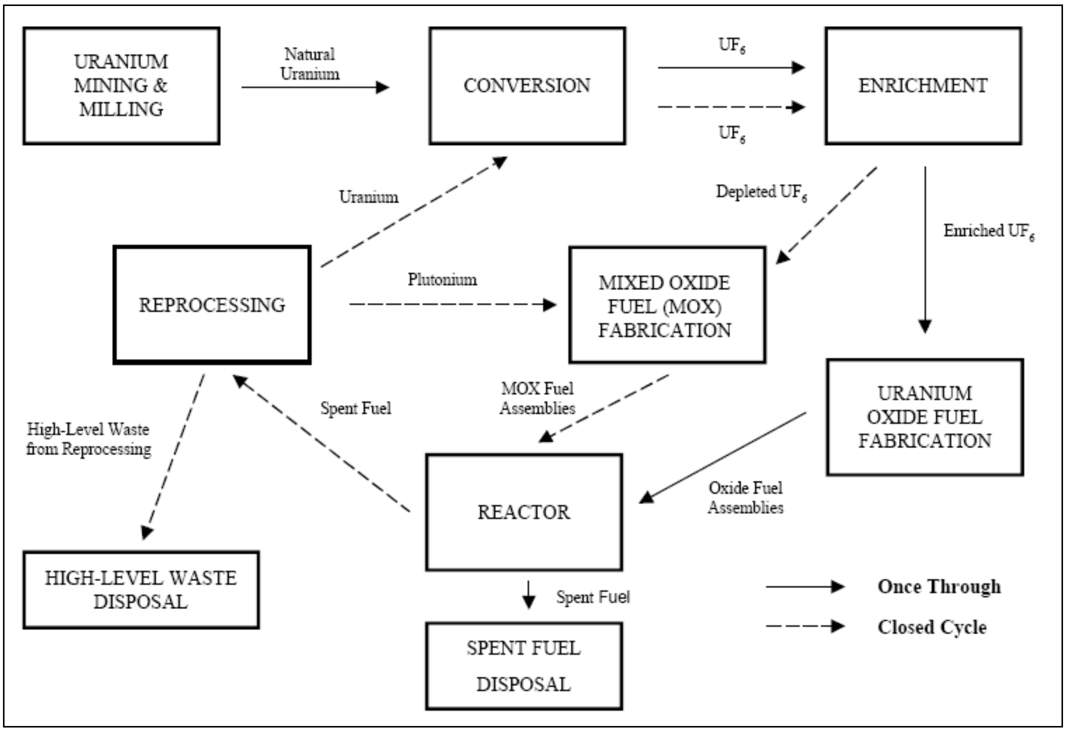


Figure 13 - Open and closed fuel cycle

2.5.3 Spent fuel storage in main reactor building hall

Yearly, after termination of planned campaign, a part of spent fuel is removed from the reactor and placed to the spent fuel pit situated in the reactor vicinity. The need for the spent fuel storage in the spent fuel pit results from the residual heat production in the fuel that continues even after its removal from the reactor core. The spent fuel stays in the spent fuel pit approximately 6 to 7 years. The Mochovce NPP spent fuel is stored in a compact storage lattice in vertical positions enabling a good cooling by the circulation of the cooling medium, i. e., the aqueous solution of boric acid with the concentration of 12 g/kg at least. The solution temperature is maintained on values up to 50 °C. The compact storage lattice capacity is 640 positions/storage places for each pit. The base of the storage lattice is formed by hexagonal absorption tubes manufactured with addition of stainless steel with up to 2% of Boron in which spent fuel assemblies and hermetic enclosures are inserted. There are positions dedicated for placement of the round hermetical capsules on the compact storage lattice edge.

Spent fuel assemblies for which a cladding damage was detected are stored in hermetic capsules. The hermetic enclosure structure ensures the following:

- a reliable isolation of gaseous fission products leaking through the damaged fuel assembly cladding;
- the residual heat removal;

- a safe transport and handling of a fuel assembly; and
- the long-term storage of the spent fuel with a damaged fuel cladding.

A further storage space for spent fuel (reserve storage lattice) is used in case of a short-term storage of fuel assemblies removed from the reactor core during revisions or repairs of internal reactor parts. The reserve storage lattice for spent fuel is manufactured with stainless steel and it is positioned above the compact lattice and its capacity is 296 fuel assemblies and 54 hermetic capsules.

The above described elements of the spent fuel storage system in the spent fuel pools are made of stainless steel. The Mochovce NPP storage pits are covered with one stainless steel liner with the thickness of 3 mm.

The heat is removed from the space when the spent fuel is stored by means of two separated cooling circuits that are equivalent as for their power outputs. Each of them alone is able to remove efficiently the heat produced by spent fuel assemblies found in the storage lattice and the maximum heat load during the operative fuel transfer from the reactor vessel to the reserve lattice.

The water warmed up by spent fuel assemblies is removed from the pit water level and from container shaft to the heat exchanger and after cooling down it is pumped by a pump back to the pit and container shaft. The maximum pit water temperature must not exceed 50 °C.

The pit, the reactor shaft and the container space are interconnected during refueling of the active core and filled completely with a boric acid solution of the concentration of 12 g H_3BO_3/kg H_2O at least, up to the highest level +21,0 m. High level of the boric acid solution ensures core subcriticality, reliable heat sink during refueling and creates adequate shielding to avoid external personnel's irradiation at the same time.

2.5.4 Anticipated Mochovce interim spent fuel storage facility

The construction of a dry storage facility (Figure 14) is assumed for NPP Mochovce based on the principle of two-purpose transport-storage containers. The assumed commissioning date is 2017. The Mochovce NPP Interim Spent Fuel Storage Facility environmental impact assessment in compliance with Act No. 127/1994 Coll., was successfully completed in 2004.

The subsequent stages are as follows: the design preparations, the technology selection, the land-use proceeding and, subsequently, the implementation.

By that time the free capacity in the JAVYS, a.s. Interim Spent Fuel Storage Facility will be used assuming the gradual spent fuel carriage from NPP Mochovce by three KZ-48 annually, alternately from Units 1 and 2.

Simplicity of operation is the major advantage of the dry interim storage facility, especially if using containers. Spent fuel is stored in dual purpose transport-storage containers.The capacity of this kind of storage facility can be modified in a simple way, because it depends on number of storage containers. Dry interim storage containers are located in a building, which primary function is to secure cooling of containers and its protection against atmospheric exposure.

Dry spent fuel storage is usually chosen where spent fuel reprocessing is not considered. The advantages of long-term dry spent fuel storage are following:

- no active systems are required (or a minimum number - e.g., the pressure monitoring system);
- low maintenance requirements;
- a simple operation and the possibility to adapt to modified Customer's requirements;
- less secondary wastes; and
- low inherent accident risk resulting for the storage principle.

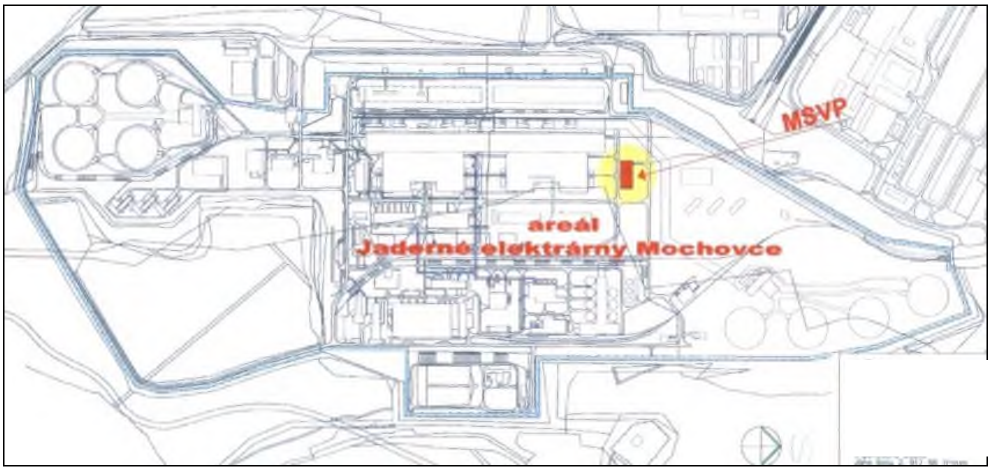


Figure 14 - Location of the anticipated Interim Spent Fuel Storage (MSVP in figure)

Civil structure

Spent fuel containers will be stored in a building whose primary function is to ensure the cooling of the containers and their protection against climatic influences. The additional biological shielding is the secondary, however not necessary, function. The interim storage facility building will be equipped with necessary handling means.

The heat that is produced by the stored spent fuel will be removed from the containers by natural ventilation. The interim storage facility building will be interconnected with other facilities on the site by roads and a railway siding. The electric power supply will be provided from the existing power plant equipment. The building will also be connected to fire water pipeline circuits on the Mochovce NPP site.

The storage facility building consists of the technical zone, receipt area and the storage space itself. The technical zone consists of the access hall, changing and sanitary rooms, electric switch room and a store room. The building will also include a storage room for transport means.

The receipt area consists of an empty container storage zone and a container preparation and inspection zone. The receipt area is sized to hold a truck with a semi-trailer or a railway wagon capable of carrying a container. The crane parking position is situated in the receipt area.

Spent fuel container

The Mochovce NPP Interim Spent Fuel Storage Facility will be built on the basis of two-purpose containers enabling both the spent fuel transport and storage. Fuel assemblies are stored in a dry inert atmosphere. The fuel assemblies must ensure the following major functions:

- a safe confinement of radioactive substances;

- the provision of the spent fuel subcriticality;
- the provision of the fuel cooling and residual heat removal;
- the provision of shielding; and
- the protection of spent fuel assemblies against external impacts and risks.

In addition to the fuel assembly cladding, the container body equipped with a double closing system also prevents radioactive substances from leaking into the environment. The subcriticality of stored spent fuel assemblies is ensured by the layout of the assemblies in the container and is calculated conservatively for the fresh fuel. The heat produced during the storage is usually removed by a passive air flow. The reference two-purpose transport-storage container for the dry interim spent fuel storage facility consists of the following parts:

- the metallic monolithic container body providing the biological shielding and structural integrity of assemblies during:
  - the whole storage period;
  - the on-site transport;
  - potential transport to the reprocessing plant or to the spent fuel disposal site;
- the storage basket (receiver) where fuel assemblies are placed in the defined position;
- the closing system (consisting of two screwed-on lids) including doubled seals;
- the container leakage monitoring system.

Neutron absorbers made of plastics are also inserted in the container body and lids.

Monitoring system

The storage rooms will be monitored for gamma and neutron radiation. The monitoring system will be equipped with lamp and acoustic alarm signals that will be activated in case of exceeding the permissible levels for normal operation. The storage containers will be equipped with the tightness monitoring system that ensures the internal space tightness inspection and early indication of possible loss of tightness.

Auxiliary systems

Container Repair and Maintenance System

During the normal operation of the interim storage facility, maintenance actions will only be taken to a limited extent. They will especially consist in visual inspections and filling the helium receiver of the pressure monitoring system, or in the removal of deposited dust from the surface of containers. After some storage period it may be necessary to restore the container coatings.

The visual inspections can also be ensured by means of cameras installed in the storage hall and on the crane. The filling of the pressure monitoring system receiver with helium can be performed in the preparatory zone of the receipt area.

It will be possible to remove the secondary upper lid leakage in the Interim Spent Fuel Storage Facility. Activities for which it is necessary to open the primary container lid will be performed outside the interim storage facility building (in the Reactor Hall).

Ventilation system

The task of the interim storage facility building ventilation system is to remove the residual heat produced by spent fuel assemblies in containers and to ensure that the maximum design values will not be exceeded. The ventilation is ensured by the natural air flow and circulation (a passive system). The air enters through shutters at the bottom part of the perimeter wall and gets out through holes in the ceiling structure of the interim storage facility.

Drainage system

The function of the drainage system is to lead the potential liquid radioactive waste to the collection tank. Following the dosimetrical control, the waste will be either discharged to the sewer system or carried and processed by the liquid radioactive waste processing system.

Fire protection System

The dry interim storage facility will make use of the NPP Mochovce site fire protection system.

On-Site container handling

After the termination of the storage in the spent fuel pool, the spent nuclear fuel will be carried to the Interim Spent Fuel Storage Facility. All handling actions related to spent fuel preparations for the placement in the Interim Spent Fuel Storage Facility will be taken in the NPP Mochovce Reactor Building. Spent fuel assemblies will be inserted in containers in the transport container shaft. They will be carried in the containers to the Interim Spent Fuel Storage Facility and stored there in the containers. The spent fuel is inserted in containers in the water environment whose parameters are identical to those of the cooling water in the spent fuel pit. The following actions will be taken after the spent fuel is inserted in the containers and the containers are closed and transferred to the service point:

- the cooling medium will be pumped out from the containers,

- the containers will be dried out, and
- the container tightness test will be performed.

Those actions are aimed to fill the container and prepare it for the carriage to the Interim Spent Fuel Storage Facility.

Both the insertion and removal of the fuel to and from the containers will only be performed by means of the refuelling machine at the spent fuel pit in the Reactor Building of the relevant reactor unit. The container decontamination will also be performed in those rooms.

The containers will be carried from the Reactor Building to the Interim Spent Fuel Storage Facility by a truck with a semi-trailer or by a railway wagon in the horizontal position. The container will be lifted by a crane from the transport means in the receipt area and placed in the vertical position to the preparatory zone. After the required inspections and handling are performed, the container will be transported to its storage position in the storage space and connected to the system monitoring the gas pressure in the container (container tightness inspection).

2.5.5 Deep underground geological disposal site for spent fuel

The spent fuel disposal, following the relevant preparations (the transfer to the storage container, welding up, etc.), in a disposal site built in deep underground geological formations of appropriate properties (or the carriage abroad, if enabled by legislative and economic conditions) will be the final phase of the spent fuel management in the open cycle.

The deep underground geological disposal principle consists in, after a storage period, placing the spent fuel and high-activity radioactive waste in an engineering construction in a big depth in a stable geological environment in order to ensure a permanent isolation of stored materials from the environment without any intention to retrieve the materials in the future. In principle, it is possible to design the disposal site so that the stored waste is retrievable prior to the closing of the disposal site or for some time after the closing.

A system of multiple engineering and natural barriers (the multi-barrier principle) in the deep underground geological disposal site ensures the isolation of wastes from the biosphere and a high degree of safety.

Regarding the research-development activities related to the deep underground disposal in the Slovak Republic, the following objectives can be highlighted:

1) a detailed geological exploration of sites with crystalline rock and clay environments that were identified during preceding programme stages based on results obtained by means of light geological methods, but also deep bores;

2) the draft concept of the deep underground disposal respecting the spent fuel and radioactive waste parameters after the storage, rock environment properties in the given sites, the long-term safety of the disposal site after the termination of its operation and closing based on a combination of storage container properties, engineering barriers and geological environment and the minimalisation of impacts on the environment;

3) safety analyses for the draft concept of the deep underground disposal;

4) the reduction in number of exploration sites and the selection of candidate site and stand-by sites.

The development programme for deep geological disposal was launched 1996. It came from federal programme that has been modified for condition within Slovak territory. Programme was financially covered by SE, .a.s. and coordinator was DECOM Slovakia Ltd. The Programme was stopped in 2001. It is expected that the main responsibility will be taken by a new established state agency for disposal of RW.

2.6 Resources consumption at the installation

2.6.1 Land

Further development of the Mochovce NPP, units MO34, has a minimal demand for new land usage. The majority of the construction (70%) is already built and used by the existing site for operational areas of EMO12. The existing auxiliary operations will also be utilized i.e. water mains etc. A minimal amount of land will be required for the construction of the required independent electrical network for connection to the Veľký Ďur distribution plant.

2.6.2 Water

Surface water

Water for the operation of Mochovce NPP is extracted from the dam at Veľké Kozmálovce on the Hron River approximately 5 km from the site (Decision of the district authorities in Banská Bystrica, No. 1094/2/177/405.1/93-M from 6.7.1993).

The volume of extracted water is given based on the water needs of the circulating cooling system of the condensers and depends on the season and external climate conditions. Operation of all four units at Mochovce NPP would require the consumption of water from the dam in Veľké Kozmálovce in the average volume of $Q_{\varnothing}$ = 1.5 m^3/s, to the maximum volume of Q_{max} = 1.8 m^3/s.

Bigger parts of solids from the withdrawal structure are collected from the extracted water, first through a coarse 3 to 5 cm hack at the inlet of the piping, and then refined, through a 16 mm hack at the entrance of the pumping station. This second set of hacks is cleaned by an automatic device and the impurities are gathered into a 3.2 m^3 tank. Water deprived of mechanical impurities is pumped from the pumping station to two reservoir tanks, each with a volume of 6.000 m^3 at the Mochovce NPP.

A total volume of supplemented water consists of the water loss due to evaporation from the cooling towers in the range of 0.85 m^3/s to 1.33 m^3/s depending on the external air temperature and humidity. A further part of the water in the range of blow-down from 0.18 m^3/s to 0.36 m^3/s is supplemented for the purpose of keeping the chemical regime in the cooling circuit. The water is discharged into the industrial drainage system, and then to the waste piping of EMO.

Consumption of surface water in 2004 - 2008

The volume of consumed surface water in 2004-2008 is given in Table 2. In 2008, the total amount of surface water extracted was 20,626,000 m^3 from the source at Veľké Kozmálovce, which is in conformity with the yearly limits permitted by the water authorities valid for 4 units to the amount of 47,304,000 m^3/year. Once Units 3 and 4 are in operation, extraction of surface water will be doubled.

Table 2 - Volume of consumed surface water in relation to the production of electrical energy

Year	Water consumption [m^3]	Production of electric energy [MWh]	Specific water consumption [m^3/MWh]
2004	17,615,583	5,482,865	3.21
2005	19,313,417	6,239,944	3.09
2006	18,949,001	6,320,254	2.99
2007	19,994,286	6,828,737	2.93
2008	20,626,000	6,890,967	2.99

The quality of extracted surface water depends on the water reservoir at Veľké Kozmálovce, which serves for the supply of utility water to the Mochovce NPP.

A deterioration in the quality of water from the water reservoir V. Kozmálovce leads to a higher consumption due to worsening of the parameters of treated water. The deterioration of water quality is caused by sediments in the water reservoir. Their amount is estimated to be about 50% of the volume of the reservoir.

It resulted from the analysis of water consumption for operation of all four units that the permitted average consumption of 1.5 m^3/s - representing the amount of 47,304,000 m^3 per year, as stated in the valid licence, will not be exceeded.

The volume of water in V. Kozmalovce water reservoir will be sufficient for water needs of four units in operation. It is necessary, however, to monitor sedimentation in the reservoir.

Groundwater

Groundwater is extracted from two wells, HMG-1 and HMG-1/A, owned by SE in Červený Hrádok approximately 8 km away from Mochovce NPP. The maximum permitted take-off is 18 l/s for HMG-1 and 15 l/s for HMG-1/A. After treatment, the groundwater is used for drinking.

Groundwater is extracted on the basis of a decision issued by the Western Slovak Regional State Commission in Bratislava No. PLVH-4/1746, 1747/1984-8 of 29 April 1985.

Up to 2005 groundwater was mostly taken from the two wells in Červený Hrádok, and the remaining part from a substitute source in Kalná nad Hronom (Table 3). Since 2006, it has been supplied only from the drinking water source in Červený Hrádok. The supply of drinking water from the substitute sources was stopped in June 2005 following the decision of NPP management.

In 2008, the volume of pumped groundwater from the source at Červený Hrádok was 126,606 m^3, out of which 116,750 m^3 being effectively supplied to Mochovce NPP.

Currently the well at Červený Hrádok provides sufficient drinking water for the Mochovce NPP.

Table 3 - Volume of consumption of drinking water from the different sources in the period 2004-2008

Year	Volume of consumed drinking water [m^3]		
	Wells	Substitute source	Total
2004	353,940	47,167	401,107
2005	178,760	22,305	201,065
2006	96,183	=	96,183
2007	83,478	=	83,478
2008	91,378	=	91,378

The volume of extracted groundwater had a decreasing trend in 2005-2007. In 2008, the volume of extracted ground water slightly increased. However, no measures beyond common activities need to be taken.

2.7 Release of airborne effluents in normal conditions

One of the sources of gaseous discharges is the primary coolant decontamination system. The primary coolant becomes contaminated during the operation of the reactor through activation of the impurities present in the coolant and through fission products that may enter the coolant from a failed fuel element. The primary coolant decontamination system is designed to keep the activity level in the primary coolant system within specified limits.

The system operates at primary coolant system pressure. In addition, it also removes corrosion products that are present in the coolant. Part of the coolant is taken from the disconnectable section of each circulation loop, cooled in the heat exchangers and returned to the primary coolant system. In this process, non condensable radioactive gases are gathered and sent to the radioactive gas purification system.

The radioactive gas purification system removes radioactive gases. In the blow-down system, these gases are diluted with Nitrogen, removed from the primary circuit, and directed into the special gas cleaning system.

For releasing (discharging) gaseous and liquid radioactive substances into the ambient of the NPP, limits are determined. The purpose of these limits is to ensure that the discharge of radioactive products (whether liquid or gaseous) into the ambient of the NPP under normal conditions as well as abnormal operation does not cause the value of effective exposure of 0.250 mSv/year of individual citizens to be exceeded in the whole region due to the operation of the NPP.

2.7.1 Permit to release gaseous radioactive substances into the environment

The permit to release gaseous substances into the environment in the manner of their discharge in pollutants through a ventilation stack under normal conditions is given by a permit of the Office of Public Health Care of the Slovak Republic No 000ZPZ/6274/2006 of 2 November 2006.

This decision set the conditions for operation of EMO12 (Table 4) including the yearly limit of emitted activity of noble gases ($4.1 \cdot 10^{15}$ Bq), iodine radioisotope ^{131}I in total gaseous and aerosol forms ($6.7 \cdot 10^{10}$ Bq) and radionuclide mixtures (except ^{131}I) in aerosol with half-life greater than 8 days ($1.7 \cdot 10^{11}$ Bq).

In addition, it sets reference investigation levels for releases to atmosphere for radionuclides of noble gases ($1.1 \cdot 10^{13}$ Bq/day), iodine radioisotope ^{131}I in gaseous form ($1.8 \cdot 10^{8}$ Bq/day) and radionuclide mixtures in aerosol ($0.5 \cdot 10^{9}$ Bq/day) and also intervention levels for release to the atmosphere for radionuclides of noble gases ($5.5 \cdot 10^{13}$ Bq/day), iodine radioisotope 131I in gaseous form ($9.0 \cdot 10^{8}$ Bq/day) and radionuclide mixtures in aerosol ($2.5 \cdot 10^{9}$ Bq/day).

The decision also sets the requirement for continual monitoring of total bulk activity of noble gas radionuclides, total bulk activity of aerosol and bulk activity of iodine radioisotopes ^{131}I in gaseous form, in gas emissions; dose loads for balancing and evaluation of gaseous emissions, and the reporting requirements to the Office of Public Health Care of the Slovak Republic.

The decision is valid until the 1st of November 2011.

Table 4 - Yearly limits, reference investigation levels and intervention levels for releasing radioactive substances into the environment under normal conditions for EMO12

	Yearly limits	Reference investigation levels	Intervention levels
Radionuclide of noble gases	$4.1 \cdot 10^{15}$ Bq	$1.1 \cdot 10^{13}$ Bq/day	$5.5 \cdot 10^{13}$ Bq/day
Iodine radioisotope ^{131}I	$6.7 \cdot 10^{10}$ Bq	$1.8 \cdot 10^{8}$ Bq/day	$9.0 \cdot 10^{8}$ Bq/day
Radionuclide mixtures	$1.7 \cdot 10^{11}$ Bq	$0.5 \cdot 10^{9}$ Bq/day	$2.5 \cdot 10^{9}$ Bq/day

In 2008, for gaseous discharges, the percentage of using of the annual limit for noble gases was 0.037 %, for iodine ^{131}I 0.00027 %, and for aerosols 0.0049 % of the permitted annual limit for EMO 12.

2.7.2 Technical aspects

Gaseous radioactive substances from the hermetic zone and from some selected areas of the controlled zone are conducted through the ventilation system to the ventilation stack (one shared by both units, MO34). Exhaust gases are conducted through a system of filters.

Should there be aerosol or iodine in the hermetic areas there is a circulation filter system installed to reduce the volume of aerosol in order to protect the surroundings of Mochovce NPP against aerosol and iodine isotopes.

The ventilation systems are supplemented with a system of technical measures so they will function even if the environmental parameters are exceeded (in particular temperature and temperature load of the ventilation system, when heat extraction is provided by an independent system).

During normal operation the ventilation system is constantly monitored and the results of measurements of individual qualitative and quantitative parameters are recorded by an information system.

Ventilation of areas of the **hermetic zone** is provided by an independent air-conditioning system, which works independently of the regime of the operation of the NPP and the reactor. Air tight zones of the areas in the block are boxes, areas and rooms in the reactor to which the worst possible accident can not spread. Air tight areas are ventilated based on the presence (periodic, permanent) or absence of service staff. The ventilation system is for areas with an absence of service staff and periodic presence of service staff under pressure with a moderate circulation of air to areas with a potentially higher activity. Areas with permanent presence of the attendance staff do not have a guaranteed value of pressure difference compared to its surroundings.

The outflow system creates pressure in the ventilated areas by the flow of air from one area to another in the direction of cumulative activity. Filters are fitted to clean the air, including aerosol filters and also iodine filters. The ventilated air from the controlled zone is discharged to the atmosphere through an air-conditioning stack.

The safety system includes a ventilation system of the all active operations of the NPP.

The ventilation systems of active operations of Mochovce NPP (including the FSKRAO-LRAWTF) are led into a ventilation stack. At the end of the ventilation stack it is present a final quality control of the discharged air to the environment with continual measurements taken of 10% of air flown. In addition to the continual measurement the system is fitted with an air sampler for periodic analysis.

The effectiveness of the filtration ranges from min. 99.97% (for standard oily mist) to 99.5% for iodine filters (for methyl iodide).

All of the calculated values of individual and collective doses during normal conditions are under the limits pursuant to the Atomic Energy Act and the Act No. 355/2007 Coll. on Prevention, Protection and Promotion of Public Health and the Decree of the Government No 345/2006 on Basic Safety Requirements for Health Protection of Workers and population from Ionizing Radiation.

2.7.3 Radioactive discharges to atmosphere from other installations

The only installation at Mochovce NPP which emits to the atmosphere are the NPP itself with the ventilation system from units 1 and 2, and from the final processing of the liquid radioactive waste – FSKARAO (LRAWTF). This facility does not have its own air emissions. The ventilation system of the LRAWTF is connected to the ventilation system of Units 1 and 2 of the NPP. The pathway from the LRAWTF to the ventilation system of the NPP is monitored independently.

The safety report for the LRAWTF evaluated the impact on the critical group of inhabitants and concluded that the "systems provide a sufficient guarantee of negligible impact on the environment".

2.7.4 Monitoring of discharges

The main source of radioactive emissions to the atmosphere during operation are technological equipment for the treatment and degasification of cooling water from the primary circuit, which can reach the working environment through various ways through the air-conditioning system and the ventilation stack. Radioactive substances discharged to the atmosphere is made up of gas, aerosol and iodine. Total flow volume of discharge is approximately 5.10^5 m^3/hour.

Table 5 shows data obtained from measurements by instruments located in the ventilation stack and from laboratory analyses.

Table 5 - Balance of radioactive substances discharged to the atmosphere

Year	Noble gases		I-131		Aerosols	
	Annual limit [GBq]	4.1E+06	Annual limit [MBq]	6.7E+04	Annual limit [MBq]	1.7E+05
	Exhaust [GBq]	% of the annual limit	Exhaust [MBq]	% of the annual limit	Exhaust [MBq]	% of the annual limit
1998	7,890	0.192	77.25	1.2E-01	13.62	0.0080
1999	12,507	0.305	108.57	1.6E-01	24.13	0.0142
2000	14,412	0.352	56.53	8.4E-02	10.92	0.0064
2001	12,712	0.310	14.65	2.2E-02	17.77	0.0105
2002	11,419	0.279	14.93	2.2E-02	8.18	0.0048
2003	10,805	0.264	1.93	2.9E-03	12.52	0.0074
2004	3,145	0.077	2.18	3.2E-03	8.12	0.0048
2005	4,566	0.111	0.38	5.6E-04	20.53	0.0121
2006	3,061	0.075	0.43	6.4E-04	19.23	0.0113
2007	2,691	0.066	10.18	1.5E-02	10.28	0.0061
2008	1,517	0.037	0,18	2,7E-04	8.39	0.0049

2.8 Release of liquid effluents in normal operation

Discharge receptors of waste water coming from Mochovce NPP are:

- the Hron River, for waste water of EMO, and rainfall water collected in Mochovce NPP;
- the Telinsky Stream for water coming from the operational premises of MO34 (facilities of the construction site) and the de-sludged water from the Čifáre sludge bed after the drinking water treatment;
- the Širočina Stream from sludge lagoons after washing sand filters.

The main waste water source discharged to river Hron is represented by industrial wastewater (cooling water) from EMO12. The industrial wastewater can be divided into:

- waste water without radionuclides comprising cooling tower blow-downs and water coming from the regeneration of the installation for demineralised water production; and
- waste water with presence of low activity radionuclides, constituted by condensation of vapour coming from radioactive liquid treatment.

Waste water is led away by three types of drainage system (sewage, rain, and industrial special) into a common waste piping (Ø 1,000 mm, made of steel, along the full length covered by concrete) about 6,0 km long, by gravity force into the Hron River.

In 2008, a total amount of 4,812,820 m^3 water from the operation of EMO12, out of which 91,378 m^3 of sewage water, and the remaining 4,721,442 m^3 of industrial waste water (Table 6).

Table 6 - Discharged waste water into the Hron River from Mochovce NPP between 2004 and 2008

	2004	2005	2006	2007	2008
Discharged industrial wastewater [m^3]	4,285,390	4,969,195	4,762,647	4,367,000	4,721,442
Treated sewage wastewater [m^3]	363,466	157,609	96,000	83,000	91,378
Total discharged wastewater [m^3]	**4,648,856**	**5,126,804**	**4,858,647**	**4,450,000**	**4,812,820**
Permitted annual value [m^3] (*) for EMO12	**6,000,000**	**6,000,000**	**6,000,000**	**6,000,000**	**6,000,000**

(*) The permitted annual value for four units of Mochovce NPP is 12,000,000 m^3/year.

The volume of waste water discharged to the Telinské Stream from the Čifáre settling tank was 141,000 m^3 in 2008. The limit value set in the decision of Regional Environmental Authority /REA/ Nitra No. 2004/00408, from 22.7.2004 is 252,288 m^3.

The last group of wastewater related to the operation of the NPP is wastewater from drinking water treatment at Červený Hrádok. The volume of waste water discharged to the Širočina Stream was 810 m^3 in 2008. The limit value set in the decision of Nitra No.2003/015778, from 19.9.2003 is 10,000 m^3.

2.8.1 Permit to discharge liquid radioactive substances into the environment

The permit to discharge liquid radioactive substances from the installation under normal conditions is established by the permit of the Office of Public Health Care of the Slovak Republic No. 000ZPZ/6274/2006 of 2 November 2006.

This decision set the conditions for operation of EMO12 (Table 7) including the yearly limit of radionuclide activity in emissions for Tritium (1.2×10^{13} Bq) and for fission and activation/corrosion products (1.1×10^{9} Bq).

In addition, it sets limits for volume activities of liquid outlets releases to hydrosphere for Tritium (1.0×10^{5} Bq/l) and for fission and activation/corrosion products (40·Bq/l).

The decision is valid until the 1st of November 2011.

Table 7 – Yearly limits and volume activities limits for discharging radioactive liquids under normal conditions for EMO12

	Yearly limits	Volume activities limit
Tritium	1.2×10^{13} Bq	1.0×10^{5} Bq/l
Activation/corrosion products	1.1×10^{9} Bq	40 Bq/l

In 2008, for liquid radioactive discharges, the percentage of using the yearly limit for tritium was 65.47 %, and for other radionuclides (corrosive and fission products, transuranium) was 1.26 % of the permitted annual limit for EMO12.

2.8.2 Radioactive liquid effluents

Starting from the operational experience gained at EMO12, the amount of wastes deriving from the treatment of liquid radioactive substances, which can be expected during the assumed 40-year period of MO34, is reported in Table 8.

Table 8 - Assumed amount of wastes deriving from liquid radioactive treatment during the MO34 operation period

Waste type	Amount [m^3]
Radioactive concentrate	9,025
Low-activity sorbents	122
Medium-activity sorbents	204
Radioactive oils	9.5
Sludges	400
Sediments	8.5

From the radioprotection point of view, the conditionally active water containing tritium that is released into the environment after a dilution is the most significant low-activity liquid waste. Tritium is produced in the reactor core coolant and is a very low-energy β-emitter having a long transition half-life (12.34 years). The radioactive hydrogen isotope cannot be removed from the coolant using common purification processes. That results in the increase in its activity in the coolant.

The limit tritium concentration is based on the limit volumetric activity value in the primary circuit water 3.7×10^{9} Bq/m^3. Within the waste water purification system, all waste water originating from MRB, ASB and impure condensate tanks are collected in the subsystem of waste water collection tanks. The water is purified and mechanical, chemical and radioactive impurities are removed so that the water can be reused for internal needs of reactor units or discharged to the waste water sewer.

The mechanical purification is performed in the waste water purification subsystem. The waste water and impure condensate are deactivated in the evaporator subsystem by means of distillation. The impure condensate is thickened to the concentration of 40 g H_3BO_3/l in the evaporator and the concentrate is further purified in the boric acid regeneration system. The waste water is thickened in two evaporator stages to the concentration of 400 g/l (a piece of design data, the real value is 150 to 200 g/l) and the concentrate is pumped by means of the handling tank to a temporary liquid radioactive waste storeroom. The vapour condensate is drained to the condensate evaporator subsystem for purification and it is stored in purified concentrate monitoring tanks after the purification.

The waste water purity below the volumetric activity limit of 4.0×10^4 Bq/m^3 is achieved by the purification by means of sedimentation, distillation, filtration and ion exchange units, and by combination of those processes. The purified water (purified concentrate) collected in the monitoring tanks is radiochemically controlled. If the volumetric activity limit value is exceeded, the water is returned from the monitoring tanks back to the purification process for further purification. If the volumetric activity limit value is not exceeded, a major part of the water (approximately 133,000 m^3/year) is pumped from the monitoring tanks to the pure condensate tanks, a small part of the purified condensate with a satisfactory β volumetric activity (up to 4.0×10^4 Bq/m^3 without tritium) is discharged to the industrial sewer system in order to maintain the concentration in the primary circuit water.

The tritium volumetric activity in the water does not exceed 3.7×10^9 Bq/m^3. The assumed amount of water discharged from both EMO12 reactor units equals approximately to 3,200 m^3/year. Before the purified condensate is discharged to the industrial sewer system, the water containing tritium is diluted already in the Mochovce NPP by means of the cooling water so that the resulting water conforms to requirements specified by Decree No. 345/2006 Coll., on protection, support and development of he public health as last amended. Following the dilution, 192,000 m^3 of water containing tritium with the total activity of 1.2×10^8 Bq/m^3 are discharged from the nuclear power plant annually. The volumetric activity of 4.0×10^4 Bq/m^3, i. e., the value determined by the efficiency of purification processes, is the decisive criterion for the water discharged from TCCP and for the discharged regeneration water from steam generator blow-down purification plants.

The tritium volumetric activity values in the water discharged from the monitoring tanks (radioactive media purification stations) exceed the activity values of other β and γ radionuclides in all the waters discharged from the power plant by approximately 5 orders. The tritium water is discharged from the monitoring tanks in an organized manner by batches and after the preceding radiochemical control. Two monitoring tanks are assumed for NPP Mochovce to be discharged weekly.

The tritium water must be diluted 30 times by means of the following:

- cooling towers blow-down;

- waste water from the chemical water treatment plant containing also regeneration solutions;
- water from the waste water purification plant containing water originating from the Operational Building;
- water from the liquid organic waste purification plant;
- cooling water originating from the compressor plant;
- neutralised regeneration solutions originating from the steam generator blow-down treatment stations.

As for the optimisation of releases, it is important to ensure the automatic control of tritium water dilution. Limit values of summary activities specified for releases from operated VVER V213 reactor power plants into the environment are given in Table 9.

Table 9 - Annual releases and limit values for summary activities of tritium, corrosion and fission products in waste water in some operated power plants

Release type	Unit	EBO V2 (2005)	EMO12 (2004)
Tritium water ^3H	Bq/year	7.207×10^{12}	9.83×10^{12}
Corrosion and fission products	Bq/year	4.03×10^{7}	3.78×10^{6}
Annual limit value for tritium water releases	TBq/year	43.7	12
Annual activity limit value for corrosion and fission products in waste water	GBq/year	38	1.1

Based on the design, the levels of low-activity and conditionally active releases assumed for four Mochovce NPP reactor units are reported in Table 10.

Table 10 - Assumed annual average levels of low-activity and conditionally active releases for four Mochovce NPP reactors units

Source	Amount [m^3/year]	β volumetric activity without tritium [Bq/m^3]	Tritium volumetric activity [Bq/m^3]
Operational building	75,000	3.7×10^{3}	0
TCCP	22,000	5.5×10^{4}	0
Regeneration solutions from the steam generator blow-down treatment plant	6,000	5.5×10^{4}	0
Tritium water	6,400	5.5×10^{4}	3.7×10^{9}

V Tab. 11 sú uvedené hodnoty aktivity kvapalných výpustí počas desiatich rokov prevádzky EMO12

Table 11 - Activity of the radioactive liquid effluents discharged to river Hron during the last 11 years (1998 – 2008)

Year	Tritium		Activated/corrosive and fission products		Amount of the discharged water
	Annual limit 1,2E+04 GBq		Annual limit 1,1E+03 MBq		
	Discharge [GBq]	% of the annual limit	Discharge [MBq]	Discharge [GBq]	% of the annual limit
1998	1095	9.1	29.17	2.7	24751
1999	5772	48.1	50.63	4.6	47272
2000	10484	87.4	57.93	5.3	53321
2001	9248	77.1	72.41	6.6	48637
2002	9130	76.1	49.36	4.5	46620
2003	10714	89.3	40.88	3.7	52532
2004	9826	81.9	37.84	3.4	43830
2005	8959	74.7	59.58	5.4	40360
2006	10230	853	32.75	3.0	22220
2007	7458	62.2	13.01	1.18	21280
2008	7856	65.5	13.88	1.26	16800

2.9 Production of radioactive solid waste in normal conditions

The design basis related to the solid radioactive waste production and storage at 2x440 MW assumes values of 230 to 330 m^3/year.

The following approximate division of that amount by waste type is assumed by the design:

- 65% of compactable waste;
- 25% of non-compactable waste;
- 10% of HVAC filters.

Solid radioactive waste can be further divided into dry and wet wastes. Dry solid radioactive waste represents a mixture of different materials combined to a various extent (wood, paper, fabric, plastics, metal, building materials, thermal insulation, inserts from HVAC filters, etc.). High-activity in-core parts (non-fuel sections of control assemblies, thermocouples, etc.) form a specific part of dry solid radioactive waste. Wet solid radioactive waste is produced during the liquid radioactive waste treatment process; it includes saturated ionexes, sludges and crystallised salts.

Based on experience gained during the operation of EBO V2, as well as of EMO12, the amounts that can be really expected during the assumed 40-year period of MO34 operation are reported in Table 12.

Table 12 - Assumed amounts of solid radioactive waste to be produced during the whole MO34 reactor unit's operation period

Waste type	Amount (kg)
Solid radioactive waste intended for sorting(*)	170,000
Combustible radioactive waste	252,000
Compactable non-metallic radioactive waste	56,600
Compactable metallic radioactive waste	79,920
Wet rags	6,900
Total of solid radioactive waste	565,420

Note: Solid radioactive waste intended for sorting consists of combustible, compactable and non-compactable radioactive waste, the amount data relates to the state prior to sorting.

The assumed amounts of conditionally non-active waste, inserts from HVAC filters and the waste that will be allowed to be released into the environment due to its below-limit activity values is shown in Table 13.

Table 13 - Assumed amounts of solid radioactive waste produced during the 40 year period of MO34 reactor reduction plan units operation

Waste type	Amount
Conditionally non-active waste	232,500 kg
HVAC filter inserts	4,930(*) pieces
Radioactive waste released into the environment	237,500 kg

(*) Assumed amount taking into account the solid radioactive waste production

2.10 Environmental management system certification

In 2005 SE-MO34 completed, introduced and passed the Environmental Management System certification. The subject of MO34 certification is the maintenance of accepted property and preparation of units 3 and 4 completion.

The goal of introducing and applying EMS in SE-MO34 is to show the endeavour of continual improvement in relation to the reduction of impacts of activities performed in SE-MO34 on the environment by managing activities that result in such impacts.

There was a work group created to deal with the issue of EMS implementation preparation proceeding in line with the approved action plan.

In September 2005 there was a certification EMS audit performed at MO34. The certificate was issued on 4 October 2005.

In 2006, the concept of EMS certification in SE, a.s. changed, specifying that SE, a.s. would be certified as a whole. Recertification audit was held in SE, a.s. in June 2007. The certificate was issued on 30 Jule 2007. In line with the concept of periodical oversight and recertification audits SE, a.s. are audited each year by an accredited certification company.

Certificate pursuant ISO 14001:2004 is shown in the following Figure 15.

BUREAU VERITAS
Certification

BUREAU VERITAS 1828

Certification
Awarded to

Slovenské elektrárne, a.s.
Hraničná 12, Bratislava
Slovak Republic
and
Nuclear power plant Bohunice; Nuclear power plant Mochovce; Blocks 3 and 4 of nuclear power plant Mochovce; Power plant Nováky; Power plant Vojany; Hydroelectric power plant Trenčín;

Bureau Veritas Certification certifies that the Management System of the above organisation has been audited and found to be in accordance with the requirements of the environmental standards detailed below

Standards

ISO 14001:2004

Scope of supply

MANAGEMENT CONTROL AND SUPPORT OF ELECTRICITY AND HEATING POWER PLANTS. SALE OF ELECTRICITY. PRODUCTION AND SUPPLY OF ELECTRICITY AND HEAT BY NUCLEAR POWER PLANT BOHUNICE. PRODUCTION AND SUPPLY OF ELECTRICITY BY NUCLEAR POWER PLANT MOCHOVCE. MAINTENANCE OF HANDLED PROPERTY AND PREPARATION OF FINISHING THE CONSTRUCTION OF BLOCKS 3 AND 4 OF NUCLEAR POWER PLANT MOCHOVCE. PRODUCTION AND SUPPLY OF ELECTRICITY, HEAT AND PRODUCTS BY THERMAL POWER PLANT VOJANY AFTER COMBUSTION. PRODUCTION AND SUPPLY OF ELECTRICITY, HEAT AND PRODUCTS BY THERMAL POWER PLANT NOVÁKY AFTER COMBUSTION. PRODUCTION AND SUPPLY OF ELECTRICITY BY HYDROELECTRIC POWER PLANTS.

Original Approval: 26.07.2007
Subject to the continued satisfactory operation of the organisation's Management System, this certificate is valid until: **22.06.2010**
To check this certificate validity please call +421 2 5341 4165
Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organisation

Date: 30.07.2007

Certificate Number: **219432**

ANAB ACCREDITED

ISSUING OFFICE ADDRESS: Bureau Veritas Certification Slovakia s.r.o., Plynárenská 7/B, 821 09 Bratislava, Slovak Republic

Figure 15 - SE, a.s. ISO 14001/2004 certificate

SLOVENSKÉ ELEKTRÁRNE
Enel
Golder Associates

3.0 ENVIRONMENTAL FRAMEWORK

3.1 Location

Units 3 and 4 of Mochovce NPP are located in Central Europe in the southeastern region of Slovakia on the western boundary of the district of Levice, close to the operating EMO12 NPP. The MO34 site lies on the southwestern edge of the Kozmálovské vŕšky (hills) in the Hronskej pahorkatina (uplands). The elevation of the terrain is between 200 and 250 m above sea level. The coordinates of the center of the Mochovce NPP protection zone are:

- longitude 18° 27´ 35´´;
- latitude 48° 15´ 35´´.

From the point of view of the terrestrial and administrative arrangement of Slovakia the MO34 site lies in the eastern part of the Nitra region in the northwestern corner of the district of Levice, close to the boundary with the Nitra and Zlaté Moravce region, approximately 12 km from the municipality of Levice, which is the largest town in a 20 km radius of the NPP. Other municipalities are Tlmače which is 7 km away, Zlaté Moravce 14 km away, Nitra 27 km away and the outskirts of Slovakia's capital city of Bratislava are approximately 90 km to the west of MO34, i.e. 120 km by public roads. Budapest and Vienna are the closest cities with over 1 million inhabitants in a 200 km radius of MO34. The outskirts of Budapest are approximately 85 km to the southeast of MO34 and the outskirts of Vienna are about 145 km to the southwest. Other large agglomerations with more than 1 million inhabitants are Varšava to the north, Záhreb to the south, Kyjev to the east, and Prague to the west.

Slovakia shares its borders with five other countries: Hungary, Austria, the Czech Republic, Poland and the Ukraine. The approximate distance of the MO34 site from the individual state borders is included in the Table 14.

Table 14 - Distance from MO34 to individual state borders

Country	Distance from MO34 to state border
Hungary	37 km
Austria	110 km
Czech Republic	85 km
Poland	130 km
Ukraine	270 km

The closest state boundary is the border with Hungary. The Ipeľ River forms a natural boundary with Hungary in a 50 km radius of the site with the exception of the boundary between the municipalities of Šahy and Ipeľský Sokolec. The closest NPP is in Jaslovské Bohunice which lies approximately 64 km from MO34.

3.2 Reasons for location at given place

Mochovce NPP was designed and its construction has been launched and realized as a four-unit NPP with common civil structures and technological components to be shared by all the four units. That means that the site of Mochovce NPP has been conceived to host four units and all the environmental evaluations (which were necessary to obtain the siting and construction permits) have been carried out always taking into account the likely impacts and the needs of four units.

From the point of view of water needs, waste production, atmospheric releases and liquid discharges, electric grid, land use, infrastructures, roads, railway and all the external services, the Mochovce site is fully capable of bearing Units 3 and 4.

Moreover, due to the advanced stage of completion of Units 3 and 4, Mochovce site represents a one off opportunity to cover in a short time the significant gap between demand and supply of electric energy on the Slovak network.

Assessment of anticipated area development if the proposed activity was not undertaken

The site location for the construction of the four units at Mochovce was determined based on a land use decision and the subsequent construction permit.

Mochovce NPP was designed and its construction has been launched and realized as a four-unit NPP with common technological components.

The area is not expected to develop in a way other than how it will be with Units 3 and 4, due to the presence of Units 1 and 2 that prevent the area from developing in any other way.

3.3 Date of beginning and termination of construction and operation of proposed activity

Construction works for MO34 started in 1986 with the laying of the foundations of the main buildings (reactor building, longitudinal electrical building, basement of transformers, cooling towers, vent stack) and continued up to 1992. In 1992 construction works were suspended due to insufficient funds. At that time the civil parts were up to 70% complete and the machinery parts up to 30% complete. The basic technological equipment like the reactor vessel, the steam generators, the pressurizer, the safety systems and the main parts of the turbines were delivered to the site and partially installed.

From 1992 to 2000 maintenance and conservation of suspended equipment and components and of the civil structures were carried out by the original main suppliers and constructors. From 2000 to-date the preservation and protection works have been performed on the basis of programs following technical guidelines of the IAEA and approved by the Nuclear Regulatory Authority (ÚJD) of the Slovak Republic.

Expected time schedule to launch and complete construction and operation of proposed activity is as follow:

Beginning of construction:	1986
End of construction:	February 2012 (Unit 3) – July 2012 (Unit 4)
Beginning of commissioning:	October 2012 (Unit 3) – July 2013 (Unit 4)
End of operations:	February 2053 (Unit 3) – October 2053 (Unit 4)

3.4 Definition of Boundaries of Area of Concern

The concerned area of the project includes the following regions that can reasonably be expected to be directly or indirectly affected by the project, or which may be relevant to the assessment of cumulative effects and the effects from future operation of the facility. In the scope of assessment has been suggested following three areas:

- *Site Study Area*: this area, centred on the plant site with a radius of about 3 km, includes facilities, buildings and infrastructure at the Mochovce site, including the licensed buffer zones (Protection zone) for the site on the land. This zone, where it is forbidden to reside permanently, has been set by Decree of Region Health Officer No. H-IV-2370/79 from 15.10.1979;
- *Local Study Area*: this area is defined as that area existing outside the site study area boundary, where there is a potential for impacts in the unlikely events of abnormal operating conditions. The Local Study Area has a radius of 10 km centred on the Mochovce site;
- *Regional Study Area*: this area is defined as that conservative area within which there is the potential for cumulative and social-economic effects and it approximately corresponds with a 50 km radius area around the site, limited to National borders. The size and configuration of the applied study areas varies by environmental component. Each is described, including the rationale for its determination, in the appropriate subsections.

Even if some of environmental effects of the project, including malfunctions or accidents and some cumulative environmental effects are likely to involve the Local Study Area or the Regional Study Area, the main additional environmental effects that may occur during operational phase are likely to be observed within the Site Study Area (Protection zone).

3.5 Characteristics of Current Environmental Conditions in the Area of Concern

3.5.1 Air

Until 1999, there were performed measurements of regional air pollution and quality of rainfall waters by the Meteorological Observatory of the Slovak Hydro-Meteorological Institute being a part of Slovak regional stations national network in evaluated zone of the Mochovce power plant. Between 2000 and 2002, there were performed no measurements in the Meteorological Observatory of the Slovak Hydro-Meteorological Institute.

The imission situation of the region can be assessed on a base of results of measurements performed at the regional station of the Slovak Hydro-Meteorological Institute in Topoľníky, which is located in plain landscape of the Danubian Lowland. Results measured at this station were comparable with results measured at the Mochovce station during previous years.

In 2002, measured concentrations of basic polluters represented less than 20% of the critical level value (15 μg/Nm^3) for SO_2 as S and 31% of the critical level value (9 μg/Nm^3) for NO_2 as N, that are usually recommended for agricultural vegetables.

The average yearly levels of polluters measured at the Topoľníky station didn't exceed even permitted limit values according to the Public Notice No 705/2002 Coll.

Regional concentration level for sulphur dioxide in Topoľníky was 2.92 μg/Nm^3 SO_2 as S, which corresponds to 5.84 μg/Nm^3 SO_2. In accordance with the Public Notice No 705/2002 Coll., this is lower value than the Lower Limit for vegetation limit value assessment. In other words, the air quality shall be assessed in the regime 3 under the Lower Limit of the pollution of 8 μg/Nm^3 SO_2.

Following the emission limits under the Lower Limit of the assessment can be considered as fixed, while it is well possible to replace the direct measurement in zones out of agglomerations by model calculations, expertise estimations and indicative measurements.

There are more sources of basic polluters emissions in the Mochovce NPP surroundings interest zone, that take a part on several actual as well as potential, either local or regional, problems (rainfalls acidification, air quality decline, soils acidification etc.).

In frame of 79 districts of SR, the Levice district involving the essential part of the Mochovce NPP surroundings occupies the 43rd position for basic harmful substances production, the 33rd position for SO_2, the 43rd position for NO_2, the 33rd position for solid combustibles and the 38th position for CO production.

In terms of releases of non-radiological chemical substances, the Power Plant, as an NPP, is not a significant emitter to conventional air pollutants including NO_x, SO_x, CO_2 and particulate.

Avoided CO_2 and conventional air pollutants

It has to be highlighted that the Project has a beneficial effect on the terrestrial environment compared to alternative electrical generating plants that result in SO_x, NO_x and other emissions.

As it is well known, electricity produced by NPPs leads to the avoidance of CO_2 emissions into the atmosphere; this is a very useful contribution to the fulfilment of requirements listed in the Kyoto Protocol on reduction of greenhouse gas emissions.

With reference to year 2005, the energy produced by EMO12 was 6,240 GWh, and taking into account the average specific CO_2 emission factor (for efficient coal thermal plants) of approximately 800 kg/MWh, the avoided emission was equal to 5,000,000 t of CO_2.The same reduction will be achieved with the future operation of MO34.

3.5.2 Water Conditions

Surface water

Mochovce nuclear power plant is located in the Podunajská pahorkatina (Podunajské Hills) on the southwest margin of Štiavnické vrchy (Štiavnica Hills) in the upper reaches of Telinský Stream at an altitude of 242 m a.s.l.

The western part of the locality is included in the basin of the Nitra River, while the eastern part falls in to the Hron River basin. Telínský Stream, which passes through the protection zone of Mochovce nuclear power station, is part of the basin of the Žitava River.

The Velké Kozmálovice reservoir is formed by a dam situated 73.500 km from source of River Hron. The reservoir has been filled intensively by sediments from the time when the water construction was put into operation (1988). The total volume of the reservoir dropped by approximately 39% as a consequence of the sedimentation of fine grained material.

The operational levels in the reservoir oscillate in the range 171.50-175.00 m a.s.l. Permitted discharge of the minimum residual flow into the channel of Hron under the dam is $Q_{min} = 6.6\ m^3/s$ and into the channel of Perec $Q_{min} = 0.2\ m^3/s$.

Slovenský vodohospodársky podnik ensures the supply of the surface water from Veľké Kozmálovce for the Mochovce NPP. The principal task of the Velké kozmálovce waterworks is to supply surface water in the quantity of 1.8 m^3/s, and annual volume of 47,304,000 m^3 (in accordance with the valid decision No.10924/2/177/405.1/93-M from 9th of July1993) with the security of 99%. According to the valid manipulation order, approved by KÚ ŽP in Nitra No. 2007/00509 from 20th of July 2007, the supply of water to the NPP is a priority of the administrator of the Veľké Kozmálovce waterworks.

Surface water and groundwater pollution level

Surface waters quality in the area is potentially affected by discharges of polluted or insufficiently cleaned municipal water, as well as by the washing of agrochemical substances from surrounding fields. Groundwater quality is mainly affected by the river Nitra. Among other things it contains chemical elements and compounds such as iron (Fe), manganese (Mn), mercury (Hg), ammonia (NH4)+X, chlorides and hydrogen sulphide (H_2S).

Groundwater influenced by the river Hron is potentially contaminated by iron, manganese, aluminium, ammonia and humic substances.

The groundwater in the neovulcanites and their surroundings is relatively clean.

Results of the monitoring of water discharged from the RAW facility to Telinsky stream in 2006 are included in the following tables 15 and 16.

Table 15 shows a comparison of the qualitative indicators with the limit concentrations. The limit values of indicators in water discharged from surface water outflow which were set in the water authority's decision were not exceeded.

Table 15 - Comparison of qualitative indicators with limits for water discharge from the RAW facility

Indicator	Measured values		Permitted limit concentration
	min.	Max.	
pH	7.8	8.1	-
Conductivity [μS/cm]	160	250	-
tritium [Bq/l]	0.81	1.63	4,690
^{60}Co [Bg/l]	0.013	0.026	5.6
^{137}Cs [Bg/l]	0.012	0.019	5.7
$^{239+240}Pu$ [Bg/l]	<0.001	<0.008	0.139
^{90}Sr [Bg/l]	0.008	0.013	61.0
Total beta [Bq/l)]	0.11	0.33	-

(Source: Slovenské elektrárne, a.s.)

Table 16 - Percentage valuation of total activity of individual radionuclides in water from surface outflow at the RAW facility to LaP

Radionuclide	LaP [Bq]	Discharged activity [Bq]	LaP Filling [(%]
^{3}H	$1.88 \cdot 10^{10}$	$5.61 \cdot 10^{6}$	0.03
^{137}Cs	$2.28 \cdot 10^{7}$	$9.31 \cdot 10^{4}$	
^{60}Co	$2.24 \cdot 10^{7}$	$1.05 \cdot 10^{5}$	
^{90}Sr	$2.44 \cdot 10^{8}$	$6.40 \cdot 10^{4}$	0.03
^{239}Pu	$5.56 \cdot 10^{5}$	$1.16 \cdot 10^{4}$	2.10

(Source: Slovenské elektrárne, a.s.)

In groundwater, surface water and drainage water the activity of individual radionuclides ranges as follows:

^{3}H	< 2.2 [Bq/l]
total beta activity	< 1 [Bq/l]
^{137}Cs	< 0,026 [Bq/l]
^{60}Co	< 0,024 [Bq/l]
^{90}Sr	< 1 [Bq/l]
^{239}Pu	< 0,01 [Bq/l]

Liquid effluents coming from operation of Mochovce NPP are in compliance with Regulatory Limits.

3.6 Public attitude surveys

The main sources of information regarding the public level of knowledge and the perception of nuclear power, particularly for Mochovce NPP, are represented by:

- *Country Nuclear Power Profile*, by IAEA 2002;
- *Perception of NPP Mochovce by inhabitants of I and II Protective zone*, by Department of Geography and Regional Development of the University of Constantine Philosopher in Nitra, 2004;
- *Attitudes and perception of the company SE, a.s. by the population inhabitants of Slovakia*, survey conducted by GfK, 2004 and 2007;
- *Eurobarometer; and*
- *Public poll performed by Markant Agency for JAVYS, a.s.*

The above mentioned documents provide information at various levels, starting from a single opinion on the use of nuclear energy to a poll on the perception of Mochovce NPP by inhabitants of protective zones, and even a poll on the perception of nuclear energy and NPPs in the whole SR.

Perception of Mochovce NPP by inhabitants of the Protective zone I and II

In 2004, the Department of Geography and Regional Development of the University of Constantine Philosopher in Nitra carried out a survey of the perception of Mochovce NPP by inhabitants of Protective zone I and II.

The survey focused on:

- Level of knowledge of Mochovce NPP;
- Level of knowledge of the SE’s monthly “SE, a.s., News Mochovce “;
- Perception of threat;
- Opinion on completion of MO34;
- Opinion on the future of NPPs in the SR;
- Opinion on usage of nuclear power; and
- Level of knowledge of environmental impacts.

The survey was divided into 3 phases. The first one was a preliminary phase which included preparation of a questionnaire in close cooperation with the Mochovce NPP Infocentrum and a tour of Mochovce NPP with the aim of obtaining feedback on the effectiveness of the given information.

The second phase of the survey involved 32 settlements municipalities, including the towns of Levice and Vrable (table 17). In this survey 10% of the working inhabitants were questioned (1,149 totally in villages, altogether 1,149 people, 250 in the towns of Vráble and Levice, and 121 in Tlmače) so that the total of 1,770 people expressed an opinion in response to 25 questions related to Mochovce NPP.

Evaluation of the received information received (statistical and graphical) was the scope of the final phase of the survey.

Table 17 - Facts on survey on perception of Mochovce NPP by inhabitants of the I and II Protective zone

Number of municipalities/villages	*Number of inhabitants*	*Area in km²*	*Number of respondents*
32	74,800	450.6	1770

Figure 16 shows the positive opinion of respondents concerning the completion of Mochovce NPP.

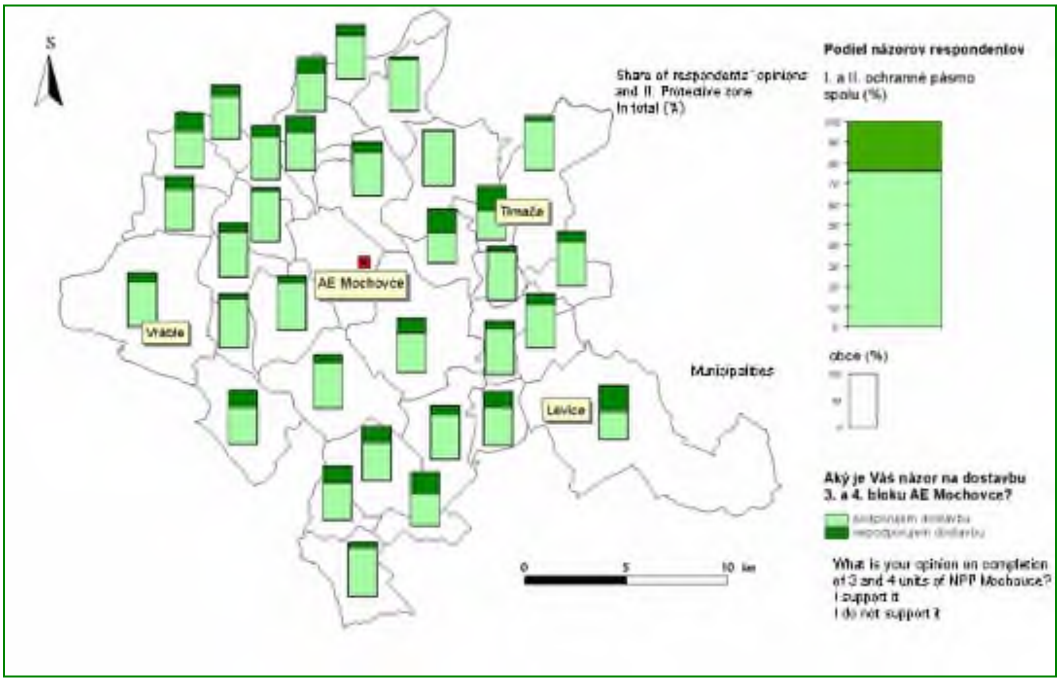


Figure 16 - Results of the survey on the opinion on completion of Mochovce NPP

Attitudes to and perception of the company SE, a.s. by inhabitants of the Slovak Republic

In 2004, GfK Agency group, specialized in market and consumer research, carried out a survey on attitudes and perception concerning the company of SE, a.s. by inhabitants of the SR.

The poll focused on:

- implications of nuclear energy;
- opinions on pros and cons of nuclear energy;
- opinion on the extent of a threat from the NPPs in the SR;
- perception of nuclear energy as a source of electricity generation energy production;
- opinions on the share amount of the electricity energy generated in produced by means of NPPs;
- respondents' opinions on the protests against nuclear energy;
- opinions of the respondents on the safety of the Mochovce NPP safety;
- information about completion of the remaining parts of Mochovce NPP; and
- opinions about completion of the remaining parts of Mochovce NPP.

The sample was made up of 1,000 persons in with the age intervals of 19÷69 (adults) and 14÷19 (students).

Figures 17 and 18 illustrate some responses to specific issues in the polls.

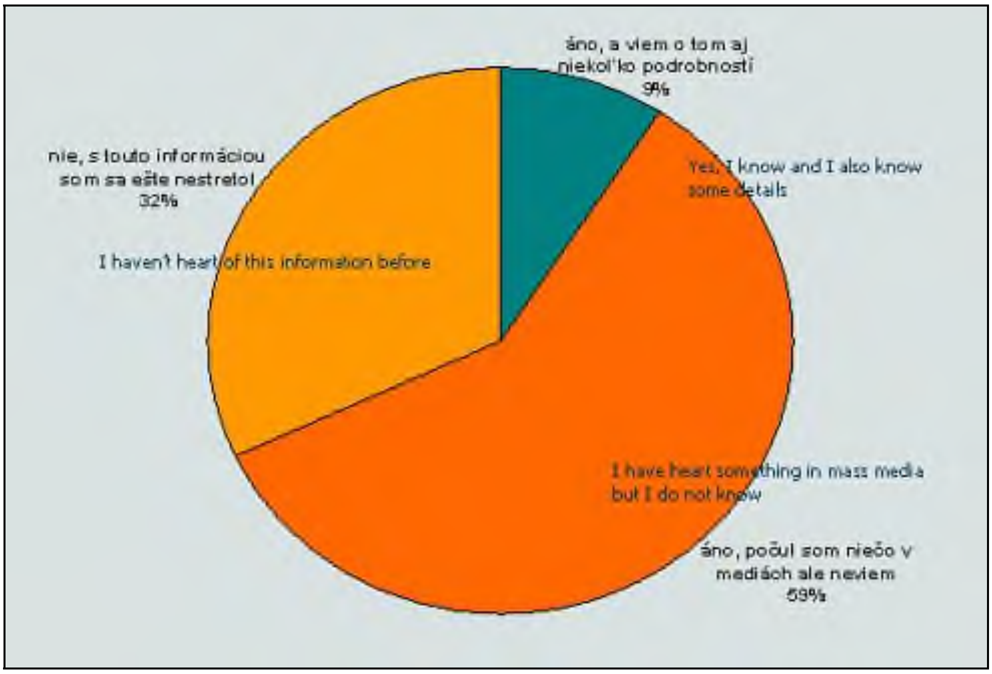


Figure 17- Information about completion of the remaining parts of Mochovce NPP

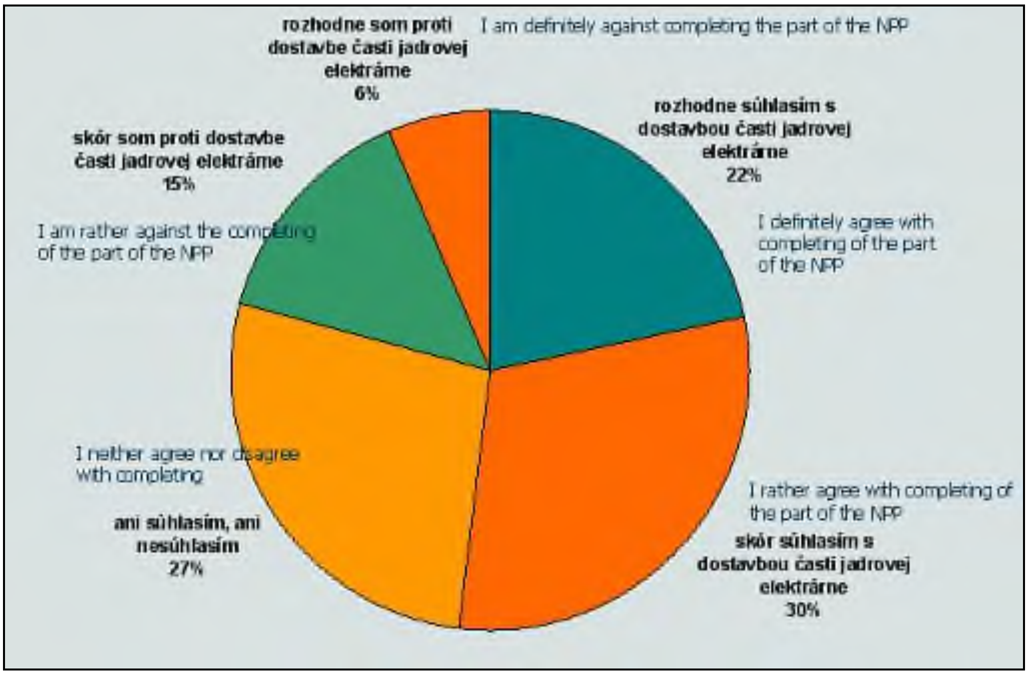


Figure 18 - Opinions about completion of the remaining parts of Mochovce NPP

Another further survey on “Acceptability of Nuclear Power by the Public of the Slovak Republic and Brand Awareness of Slovenské Elektrárne” was carried out by GfK Agency group ion the spring of April 2007. The main survey objective was to find out about opinions and attitudes of the Slovak population about nuclear energy and nuclear power plants in Slovakia, and compare the selected findings with the results of the 2004 survey.

Compared with the year 2004, the 2007 survey shows that:

- associations connected with a specific accident and disaster decreased by more than a half, mainly among the adult population, however, the feeling of potential threat and danger has considerably increased;
- the rational aspects of nuclear power production have increased slightly;
- environmental fears have decreased;
- general awareness of completion of the remaining units of the Mochovce Nuclear Power Plant has increased slightly; despite the fact, that general awareness of the population near Mochovce NPP regarding the completion of MO34 is almost 100%, almost two thirds do not know any other details, in 2007; and
- completion of MO34 has generally strong support of the public – almost 90% in the plant's 10-km area, almost 70% in Slovakia.

Figure 19 shows population opinions on MO34 completion (GFK, 2007 survey).

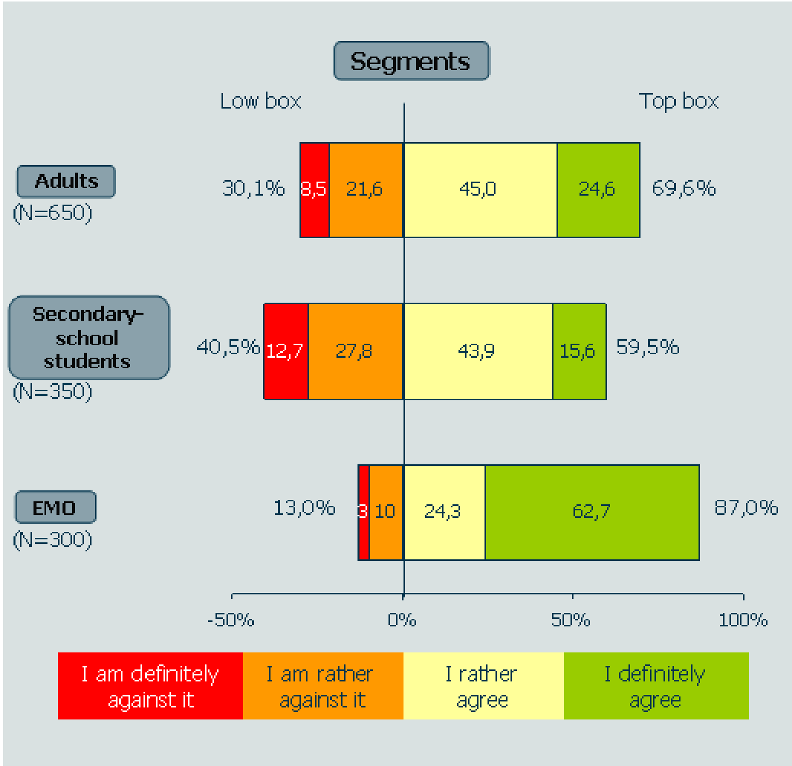


Figure 19 - Opinions on Completion of the Remaining Parts of the Mochovce Nuclear Power Plant (2007 survey)

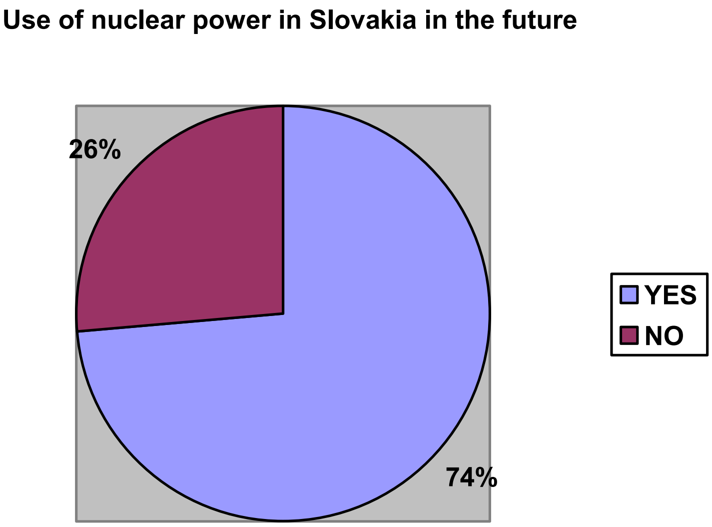


Figure 20 - Opinion on the future use of nuclear power in Slovakia (survey by Markant, 2008)

3.7 Monitoring of Radioactivity in the Environment

In accordance with the Radiation Monitoring Plan in the vicinity of Mochovce site EMO/2/NA-052.01-02, the NPP controls its radiological impacts on the environment and on inhabitants. Monitoring activities are aimed at documenting that radiological impacts, for example exposure of inhabitants and concentration of isotopes from emissions are below the limits presented in the Annex No. 3 to the Decree of the Government No 345/2006 on Basic Safety Requirements for Health Protection of Workers and population from Ionizing Radiation (and L&P laid down by ÚJD) and that the impacts are as low as reasonably achievable – ALARA.

Samples of air, soil, water, and food chain (feed, milk, agricultural products, etc.) in the area with the radius of 20 km around the plant are regularly measured and assessed by the SE ERML (Environmental Radiation Monitoring Laboratory, in Levice). All radioactive potential impact of emissions and effluents to the atmosphere as well as to all hydrosphere components (surface water, potable water, continuous bottom sediments, etc.) on the power plant vicinity are monitored.

SE, a.s. presents annually complete reports on Monitoring of Radioactivity in the SE– EMO Environment. In the reports, analysis of data is based on the pre-operation (the section related to the statistic processing of results) and operation period from the past years. In fact, the measurements of samples were done even prior to commissioning of power plant so that to acquire referential values to be compared with values measured during operation and after the end of the plant's life-time.

Detailed results from the monitoring program of the radioactivity in the environment are provided in Annex IV "Report of monitoring of radioactivity in the SE-EMO environment (years 2005 till 2008)".

Monitoring results demonstrate that impacts of EMO12 during standard operation are close to zero in spite of a high sensitivity of the equipment applied and it can be supposed that the contribute from MO34 will follows this trend. The way of operating the systems of gaseous and liquid emissions treatment and their permitting ensure the emissions maintained ALARA principle and demonstrate that the radiological impacts of the plant operation on the environment and on exposure of inhabitants were not only below the limits specified, but they were practically undetectable.

Tritium and ^{90}Sr values measured in surface waters (river Hron) comply with the Mochovce NPP project values and with the legal requirements (the Decree of the government of SR No. 296/2005, by which the indicators of permissible pollution level of surface waters – tritium - are set forth) too. Results from monitoring of the air, soils, agricultural products, from thermoluminiscent dosimeters or ionization chambers did not reveal impacts of Mochovce NPP operation on the background values of radionuclides in the Mochovce NPP environment (consisting of terrestrial radionuclides - ^{238}U, ^{232}Th, ^{40}K, ^{7}Be and anthropogenic radionuclides - ^{137}Cs, ^{134}Cs, ^{90}Sr produced during nuclear tests in the air and during the Chernobyl disaster) either.

The assessment of primary effects of radiation on non human biota is screened from consideration for two reasons:

1) monitoring shows very low or non detectable radioactivity level in non human biota (see Annex IV);

2) Slovak law does not require forced standard for the exposure of non human biota.

Around Mochovce NPP 15 SDS are located and a station is present in the locality of RR RAW (Republic Radioactive Waste Repository in Mochovce – Managed by JAVYS). The stations take off aerosol particles permanently by their absorption in the filter. Moreover, they contain a polyethylene tank for fallout collection (wet and dry together) and there are located cartridges equipped with TLD (Thermoluminescent Dosimeters) at arms installed at the stations. The environmental radiation monitoring covers an area of about 15 km from the power plant.

There are 24 monitoring stations of TDS located in the vicinity of Mochovce NPP which monitor a dose rate of gamma radiation, volume activity of aerosols and radioactive iodine.

The Environmental Radiation Monitoring Laboratory (ERML) determines volume activity of individual radionuclides by gamma-spectrometry in surface and drinking waters, ERML determines also ^{3}H and ^{90}Sr activity as well as total alpha activity and total beta activity.

ERML takes off sedimentary deposits from the river Hron quarterly from three locations situated in Tlmače (upstream the dam V. Kozmálovce), the discharge tube downstream the dams N. Tekov and at Kalná nad Hronom.

3.8 Impacts on population and potential transboundary impacts

3.8.1 Radiation doses to members of the public

In the following it will be estimated the radiological impact on surrounding population (in terms of doses) in normal operational states and in anticipated operational occurrences taking into account the simultaneous operation of the four units. In the simulation, discharge values and meteorological data from 2006, 2007 and 2008 have been used.

The assessment of the radiological impact was done by the deterministic code RDEMO©.

To estimate the emissions of radionuclides into the atmosphere and hydrosphere in the full configuration (EMO12 and MO34), as well as the radiological situation in the environment around the power plant and the expected effects on inhabitants, an evaluation based on observations at the two reference units (EMO12) was used.

The assessment is reported in the "Assessment of the Radiological Impact of the Radioactive Discharges from Operation of 4 Reactors NPP Mochovce – 1st revision" (SE Report B0120/Spec/2007/6-1; Annex III).

Simulation was performed, much conservatively, for an area with a 60 km radius around Mochovce NPP, in the Slovak Republic territory, in which there are approximately 1.2 million inhabitants.

3.8.2 Radiation doses deriving from normal operation

The analysis of doses to the surrounding population was made on the basis of the radioactive discharges into the atmosphere and hydrosphere during 2006, 2007 and 2008 from operation of EMO12. These discharge data are of the same order of magnitude of data from the last operational years with regard to discharged activity and radio nuclide composition.

RAS discharges from operation of units 3 and 4 are assumed to be on the same level. Balance data of discharged activity for individual radio nuclides were extrapolated by doubling the value of current discharges from operation of NPP Mochovce units 1 and 2 (due to increased amount of reactors from two to four) and then used in the calculation. For example, the list of radio nuclides and their activities, has been obtained doubling the RAS discharges of EMO12 in 2008.

Evaluation of radiological impact of RAS discharges during normal operation of four reactors installed in NPP Mochovce is based on assumption that limits for RAS discharges from operation of four reactors will be twice as high as limits for RAS discharges from the two already operating units 1 and 2 of NPP Mochovce. All other input data for the code RDEMO© are identical for two and four reactors.

Calculations by code RDEMO© show that regions with the highest annual IED (Individual Effective Dose), and 50 (70)-year commitments CED (Collective Effective Dose), are located in ESE direction and NW from the NPP area along the flow direction of the river Hron and in direction of predominating winds.

Moreover results show that annual IED and CED commitments are highest in sectors along the river Hron (significant impact of liquid radioactive discharges). Critical zone with permanent residence with the highest annual IED is in ESE direction in 3-5 km distance – zone No. 64 where it is located the village of Nový Tekov.

The maximum annual effective dose for inhabitants calculated by the model during normal operation of 4 reactors is 0.215 µSv/year for 2006. The result of this calculation is 0.259 µSv/year for 2007 and 0.295 µSv/year for 2008.

The CED commitment (for 50/70 years) for the whole region (1,200,000 inhabitants) is 10.7 man×mSv for 2006, 16.7 man×mSv for 2007 and 18.7 man×mSv for 2008.

3.8.3 Radiation doses deriving from anticipated operational occurrences

Annual balance limit values for RAS discharges for four reactors installed in the nuclear power plant Mochovce were assumed as double values compared with currently valid limit values for operation of NPP Mochovce units 1 and 2.

Calculations performed by the code RDEMO© show that regions with the highest values of individual effective doses (IED) and 50(70)-year commitments of CED are found in SE and NW direction from the NPP area in direction of predominating winds and of the river Hron.

Zone with calculated maximal IED in the whole region is a permanently uninhabitated zone located in WNW direction at 0 – 1 km distance.

Permanently habitated (critical) zone with the highest value of annual IED is in ESE direction at 3 – 5 km distance – zone No. 64 with the village Nový Tekov.

Results show that annual IED is predominantly contributed to by atmosphere (93.0%) rather than hydrosphere (7.0%). The highest annual IED reaches 4.47 µSv for year. As for normal operation, the calculated value is negligible compared with legislative requirements (Decree of the Government of SR No. 345/2006 Coll.) for maximum annual effective dose to inhabitants from critical group (250 µSv/year).

The CED commitment (for 50/70 years) for the whole region (1,200,000 inhabitants) is 465.3 man×mSv.

3.8.4 Conclusions

In conclusion, the calculated results show that the radiological impact of radioactive discharges during normal operation and under anticipated operational occurrences of 4 reactors is negligible, much below the siting design limit for nuclear installations.

It is expected that, when the new units will be in operation, the annual discharges of MO34 will be comparable with EMO12 discharges. The same is valid for the inhabitant doses (there is linear dependency between released activity and inhabitant doses).

It is clear that in 2006, 95% (98% for years 2007 and 2008) of the (negligible) dose from the NPP releases will be due to Tritium discharge into the river Hron. For this reason, the model RDEMO© conservatively overestimates real dose situation because it predicts that all water which was drunk by inhabitants during the year is taken from river Hron.

It can be useful to remark that the Tritium calculated dose itself is much less than normal variations of the natural background. For example, the calculated Tritium dose is lower than the variations (decrease) of natural dose rate from terrestrial natural sources (at 1 m above ground) after 10 mm of rain. In other words, these variations have an effect on individual dose greater than Tritium contribution dose (NUREG Report 1501/August 1994 on parts regarding the variability of background radioactivity).

Conservative estimation of the transboundary impact due to released Tritium (for four units operation) trough the river Hron, can be perfomed. This can be estimated taking into account an additional dilution in river Danube at the confluence of river Hron with Danube river. Average flow rate of Danube in Bratislava is 2000 m^3/s. For the evaluation, it has been assumed the same flow rate in Štúrovo, while the average Hron flow rate (during Tritium release) in year 2008 was 28 m^3/s. So the additional dilution factor for Tritium concentration in Danube is 0,014. The corresponding very conservatively calculated doses for inhabitants of a critical group living in Hungary, close to the confluence of rivers Hron and Danube, from Tritium releases into river Hron in 2006 was 3.0 nanoSv, in 2007 was 3.6 nanoSv and in 2008 it was 4.0 nanoSv.

Dose to an individual from the critical group obtained from discharges of other radionuclides are order of magnitude lower in comparision to Tritium dose. A similar conclusion can be assumed about the transboundary radiological impact of radionuclides other than Tritium, discharged into river Hron. In fact, these radionuclides are predominantly attached to sediment particles and as there are no dams (obstacle for sediments downstream) constructed on river Danube, no catchment of these sediments is assumed. Similarly, dose from these sediments is orders of magnitude lower for the inhabitants of a critical group living in Hungary, close to the confluence of rivers Hron and Danube.

Transboundary impact from airborne releases in Hungary (the same place as in previous paragraph) has been calculated by the code RDEMO as 2,9E-10 Sv/y, which gives really a negligible contribution to dose rate during everyday’s life (compared to natural background, etc.).

Thus, assuming the most conservative results of calculation (year 2008), the total dose rate for an inhabitant in Hungary living at the confluence of rivers

Hron and Danube is calculated as 4.3 nanoSv/y, These values, not measureable by instruments, are, in comparison with dose limits or doses from natural background, very low, and practically equal to zero from a radiation protection point of view.

As far as concerns the transboundary impact of discharges in Austria, there is no impact to inhabitants from NPP EMO water discharges into river Hron. Concerning the impact from airborne discharges in Austria, the dose evaluation at a distance between the source of release and the country border (100 km), is at the limit of validity of any radiological assessment models. In fact, the evaluated dose is in the order of tens of pico Sv due to the modest releases and to the huge dilution of pollutants (at that distance), From the results of RDEMO, an approximation of calculated individual dose from NPP EMO discharges gives dose about 1.E-11 Sv/y for an inhabitant living at the Austrian border close to Bratislava. Again, the value is practically equal to zero from a radiation protection point of view.

Anyway, on the basis of the constant SE care about the environment, Mochovce NPP could focus its environmental sampling programme on levels of Tritium in the groundwater and in river Hron. The much conservatively model for Tritium dose calculation should be refined too. Then, there would be the need to perform a dedicated assessment to the dose calculation model in order to gain a more precise confirmation that the increased contribution due to Tritium discharge in surface water does not contribute significantly to the increase of annual radiation dose for the critical group of exposed population.

Moreover, due to the use of new Gadolinium fuel, Tritium production in reactors should be decreased by about 27% in comparison with the current situation. Consequently, this will also result in a decrease of Tritium doses to critical group.

No long term build up of radioactivity in environment is likely because of the small amount of radioactivity routinely released by the power plant. Further, the extensive environmental radiation monitoring program would provide early detection of any unexpected build up. Early detection would allow mitigation measures to be put in place.

It may be noted that the scientific literature on ecological risk from long-term exposure to low-level ionizing radiation suggests that no observable effects have been found, even in the most sensitive species of organisms, at dose rates less than 1 mGy per day. By limiting the exposure of humans to a maximum dose of 0.250 mSv per year (with actual doses incurred being substantially smaller), it is therefore clear that adequate protection will be ensured for local flora and fauna.

Table 18 - Predicted doses to members of the public during operations compared with natural background and regulatory limit

Natural background (UNSCEAR, 2000)	Regulatory Limit (*)	Max annual effective dose for inhabitants				
		Normal operation State			Anticipated operational occurrences	
μSv/year	μSv/year	Year	μSv/year	Regulatory limit (%)	μSv/year	Regulatory limit (%)
2400	250	2006	0.215	0.09	4.47	1.79
		2007	0.259	0.10		
		2008	0,295	0.12		

(*) Slovak Ordinance of the Government No 345/2006

3.8.5 Radiological consequences during design basis accident conditions

Common design and realization of safety measures for NPP EMO12 gave assumptions to elaborate safety analysis for both units and for that reason preoperational safety analyses report (POSAR) was written for NPP EMO12. The chapter "safety analyses" in POSAR include radiological consequences which have been actualized by each change of fuel type. POSAR actualization and radiological consequences during design basis accident conditions is chronology described below.

Preliminary safety analyses report for NPP EMO34 is elaborated in accordance with law No. 541/2004, regulation No. 50/2006 and safety guideline No. BNS I.11.1/2008.

The results of the analyses for DBA are assessed in terms of the fulfilment of safety functions which are derived from the three safety objectives (Safe shutdown and long-term sub-criticality, Residual heat removal, Limitation of radioactive leakages and graded according to the expected frequencies of occurrence of the postulated event sequences. The initial and boundary conditions for the analyses and the grading of the derived safety functions are determined by the risk involved, i.e. the greater the probability of occurrence of an event, the tighter the acceptance criteria; therefore the allowable consequences are more restrictive for the sequences calculated as less frequent. Fulfilment of the safety objectives is assured by the integrity of unharmed barriers to protect the public against the consequences of radioactive substances release.

These barriers are as follows:

1) the chemical and physical structure of nuclear fuel,

2) the fuel cladding,

3) the reactor coolant pressure boundary,

4) the reactor hermetic zone building (hermetic zone).

The mathematical models used in the consequence assessment bear some resemblance to those used to assess the impact of normal operations, since they reflect the same atmospheric phenomena and environmental processes leading to radiological exposure. The main difference is that, for an accidental release, the accident event itself and the resulting dispersion processes are simulated through time, whereas in normal operations environmental concentrations are assumed to achieve steady-state conditions.

Compliance with the dose targets has to be verified at 2 kilometres from the NPP, since an evaluation of dose commitment (within one year) at shorter distances from the plant is not significant. In fact, an "exclusion area" around the Mochovce Nuclear Power Plant (in an area of radius ranging from 2 to 3 kilometres) has been established in 1979 by a Decree of the Regional Health Office No. H-IV-2370/79, in which no permanent residence is allowed.

Following limits had been approved by the District Health State Authority in Levice (representative of the National Health State Authority of the Slovak Republic):

Mandatory limits	Effective dose [mSv]	Dose to thyroid [mSv]
	≤50	≤500

New limits for radiological consequence, shown in the following table, have been defined based on Governmental Decree 345/2006 and on the subsequent standpoint OOZPŽ/8155/2006 issued in 2007 by UVZ for EMO12.

Mandatory limits	Effective dose [mSv]	Dose to thyroid [mSv]
	≤50	≤250

Calculated dose shall be below the limits for postulated accidents and they have to be verified around the Mochovce NPP within a radius ranging from 2 to 3 kilometers ("exclusion area").

<u>MO34 radiological consequences during design basis accident conditions</u>

Dispersion of the released plume is evaluated using a Gaussian plume model, through the code RTARC©.In the elaboration of the MO34 Preliminary Safety Analysis Report, radiological consequences were calculated in 2008 by VÚJE for the typical following DBA scenarios:

- double-ended guillotine Loss-Of-Coolant Accident (LOCA 2 x 500 mm), with the pipe break location in the non-isolable part of the cold leg of one of the main circulation loops, i.e., between the main isolating valve and the reactor-pressure-vessel nozzle (maximum DBA);
- rupture of a steam-generator cold collector primary lid, with a coolant leakage into secondary circuit (bounding scenario for primary-to-secondary leakage scenarios).

In all the scenarios, highly-conservative assumptions have been adopted:

for thermal-hydraulic analyses of the accident (performed with the codes RELAP5 and MELCOR), including:

- selection of the most adverse position of pipe rupture;
- adoption of the single-failure criterion for the system with the worst consequences on the evolution of the accident;
- no credit to hermetic zone spray to wash-down fission products;
- use of a hermetic zone leak-rate about three times larger than the value measured for EMO12 and expected for MO34;

- assumption of direct releases from the hermetic zone to the environment without consideration of retention of radioactive material in structures surrounding the hermetic zone.
- for the second scenario, 100% of the primary coolant released to environment before the leak is isolated.

for radiological analyses calculating the off-site consequences of the accident (performed with the RTARC© code), including:

- highest admissible specific radioactivity of primary coolant;
- radioactive inventory of fuel gap at the end of fuel cycle;
- worst meteorological conditions;
- no sheltering taken into account in dose calculations.

The fuel radioactive source term has been taken from the analyses performed for EMO12, i.e., Gd fuel of II generation (specific data will be used for the analyses to be included in the Final Safety Analysis Report).

On the basis of the assumptions discussed above, it can be clearly expected that the radiological consequences presented hereinafter are significantly higher than the actual consequences of a DBA.

Table 19 shows the comparison of maximal calculated doses for LOCAs, on the border of protection zone (2 kilometers), with acceptance criteria.

Table 19 - Spectrum of postulated piping break – Comparison of calculated doses and acceptance criteria

MO34	*Effective dose [mSv]*		*Dose to thyroid [mSv]*	
	2 km	*3 km*	*2 km*	*3 km*
Large break LOCAs	0.39	0.25	0.46	0.29
Mandatory limits	≤50		≤250	

The significant reduction of the radiological consequences of a LOCA with respect to the analyses performed for EMO12, is based on a more realistic estimate of the fuel damage occurring during a LOCA accident. In fact, instead of assuming a damage of 100% of fuel assemblies and release of 100% of fuel gap inventory (as done in previous analyses) of more precise evaluation of the extent of the fuel damage has been possible by using the code TRANSURANUS. The TRANSURANUS code (developed at the EC Joint Research Center, Institute for Transuranium Elements, Karlsruhe, Germany) has been successfully employed in several international programs (e.g., EU PHARE, EXTRA) involving also other countries of Eastern Europe (e.g. Czech Republic, Hungary).

Through statistical thermo-mechanical calculations, by using the TRANSURANUS code, it is possible to achieve a conservative but more realistic estimation of the number of fuel elements for which failure cladding can be expected, thus, reducing the excessive margin of conservativeness adopted previously for the radioactive source term.

Table 20 shows the comparison of maximal calculated doses for the second DBA Scenario, on the border of protection zone, with acceptance criteria.

Table 20 - Leaks from primary to the secondary side of the steam generator – Comparison of calculated doses and acceptance criteria

MO34	*Effective dose [mSv]*		*Dose to thyroid [mSv]*	
	2 km	*3 km*	*2 km*	*3 km*
Leaks from primary to secondary side of SG	2.92	2.10	18.5	13.3
Mandatory limits	≤50		≤250	

Conclusions

Considered accidents have been chosen as the most representative scenarios and performed calculations have been carried out with very conservative assumptions.

All the analyses confirm that, even with these conservative assumptions, a large margin exists with respect to the dose targets; indeed, the calculated values are more than one order or magnitude lower than the dose target defined for MO34 project.

3.9 Impacts on air - Radiological parameters

Human health (including members of the public and workers) has been selected as the VEC for radiological parameters of Atmospheric Environment.

The effects of interactions on VECs occur in the Local Study area.

Regarding radioactive aerosol, considering that Units 3 and 4 will have approximately the same level of emission of EMO12 and also on the basis of air monitoring program measures, the anticipated impacts can be considered negligible.

The extent of the effects of these interactions on VECs is detected through the radio-ecological detailed monitoring plan.

Considering that exposure for workers of MO34 will be similar to exposure measured for workers of EMO12, the figures of occupational exposure reported in the Design Framework, show that the expiated collective dose and the maximal individual dose for workers contractors is low compared with WANO Performance Indicator.

The extent of the effects of these interactions on VECs is detected through the radio-ecological detailed monitoring plan and through the organizational and operational measures for prevention, elimination, minimization and compensation of environmental and health impacts.

Likely environmental effects

For radiological parameters, a minor adverse effect is identified for radiological parameters for human health workers.

Table 21- Atmospheric Environment - Significance of likely adverse effects

Likely Adverse Effect							
Valued ecosystem component	**Adverse effect**	**Magnitude** (of effect)	**Geographic Extent** (of effect)	**Timing and Duration** (of effect)	**Frequency** (of conditions causing effect)	**Degree of Reversibility** (of effect)	**Significance of adverse effect**
Non radiological parameters							
Local atmosphere / Human health	Effects on air quality due to predicted ambient concentration of conventional emission	*low*	*moderate*	*moderate*	*moderate*	*low*	*no adverse effect*
Radiological parameters							
Human health workers	*Doses to workers* On average, workers doses are much below the regulatory limits of 20 mSv/year and 100 mSv over a five year period	*moderate*	*low*	*moderate*	*high*	*moderate*	*minor adverse effect*

3.10 Impacts on water conditions – radiological parameters

Project-environment interactions with Radioactivity in surface water and in the aquatic environment, included groundwater, were identified for projects activities during operation phase.

The extent of the effects of radioactivity in surface water and in the aquatic environment, included groundwater is detected through the radio-ecological detailed monitoring plan.

The effects of interactions with VECs (Human health and member of the public) occur in the Regional Study area.

The extent of the effects of these interactions on VECs is detected through the radio-ecological detailed monitoring plan.

As rightly estimated, it is expected that when the new units will be in operation, the annual discharges of MO34 will be comparable with EMO12 discharge.

It is clear that 95% of the (negligible) dose from releases from the NPP will be due to tritium discharge to river Hron.

It can be useful to remark that the tritium calculated dose itself is much less than normal variations of the natural background. For example, the calculated tritium dose is lower than the variations (decrease) of natural dose rate (at 1 m above ground) after 10 mm of rain. In other words, these variations have an effect on individual dose greater than tritium contribution dose (NUREG Report 1501/August 1994 on parts regarding the variability of background radioactivity).

Anyway, on the basis of the constant SE care about the environment, Mochovce NPP could focus its environmental sampling programme on levels of tritium in the groundwater and in river Hron. Since the model RDEMO© conservatively overestimates real dose situation, the much conservatively model for tritium dose calculation should be refined too.

Moreover, due to the use of new gadolinium fuel, tritium production in reactors should be decreased by about 27% in comparison with the current situation. This will also result in decrease of tritium doses to critical group.

<u>Likely Environmental Effects</u>

For non radiological parameters, no long-term build up of pollutants in the environment is likely because of the limited amount of water based releases.

For radiological parameters, a minor advers effect has been identified for *Human health and member of the public.*

The significance of the likely effects is evaluated in Table 22.

Table 22 - Hydrology and groundwater- Significance of likely adverse effects

Likely Adverse Effect							
Valued ecosystem component	**Adverse effect**	**Magnitude** (of effect)	**Geographic Extent** (of effect)	**Timing and Duration** (of effect)	**Frequency** (of conditions causing effect)	**Degree of Reversibility** (of effect)	**Significance of adverse effect**
Non radiological parameters							
Hydrology, Hydrogeology and Aquatic biota	*Chemical and physical effect*	*low*	*moderate*	*moderate*	*high*	*low*	*no adverse effect*
Radiological parameters							
Human health and member of the public	*Doses to member of the public* maximum annual effective dose for inhabitants calculated by model for normal operation of 4 reactors (0.215 μSv/year) is negligible compared with maximum annual effective dose to inhabitants from critical group (250 μSv/year).	*low*	*low*	*moderate*	*high*	*moderate*	*minor adverse effect*

3.11 Other Impacts

No long-term build up of pollutants in the soil is likely because of the absence of measurable effects coming from the contribution of the proposed activity on the terrestrial environment up to 10 km from the Mochovce NPP.

In consideration that civil parts of NPP are completed up to 70%, the commission and operation of units 3 and 4 of Mochovce NPP have no likely effects on the landscape.

The likely effects deriving from the commission and operation of Units 3 and 4 of Mochovce NPP are reasonable compared with likely impact coming from operation of Units 1 and 2.The results of the environment impact assessment have highlighted that the significance of the identified likely adverse effects is minor.

The present Report highlights that positive effects to economic conditions are likely as a result of the project. The positive effects and their significance are summarized below:

- creation of new employment opportunities and maintenance of existing jobs within the study areas, resulting in improved employment stability;
- increase of the population associated with, or directly dependent on, MO34 related employment.

Increased employment associated with MO34 will serve to maintain income levels, which are a major determinant of an individual’s or family’s quality of life. Mochovce NPP will remain one of the single largest employers in the region. These effects will contribute to economic activity growth trough process expenditure and pay rolls.

- Creation of new business activity and increased number of industrial, commercial and institutional business/operations associated with, or directly dependent on, Mochovce NPP related expenditures.

Increased business activity associated with MO34 will contribute to growth and development in the local and regional economic base.

- Increased community stability trough existent of a long term power plant with employment opportunities.

Increased population associated with MO34 will contribute to the maintenance of the social structure and stability of communities across the region.

3.12 Likely impacts on environment and health - Conclusions

Mochovce is an operating NPP with two units in operation since 1998 and 2000 and two units in a partially completed state. The project involves the commission and operation of units 3 and 4 and the operations of all 4 units to generate electricity for distribution to the Slovak Republic grid.

This Report provides the results of an assessment of the likely effects on the environment due to the commission and operation of units 3 and 4 and the continued operations of all 4 units for approximately 40 years.

It is noted that Mochovce is an existing facility on a well established site with an existing Protection Zone (approximately 3 km). As a result of more than 9 years of operations, extensive measures have been incorporated to ensure that the effects of the project are monitored and mitigated using practical technology. In carrying out the environmental assessment existing safety and environmental protection systems and programs were taken into account along with planned enhancement and environmental programs.

For non radiological parameters, no residual adverse effects were identified in the operations phase for Atmospheric Environment, Geology and Seismicity, Hydrology, Hydrogeology and Aquatic Environment.

For non radiological parameters, a minor adverse effect was identified in the operations phase for the radiation exposure to workers and members of the public. The predicted doses are well below regulatory limits. For example the predicted dose to members of the public as a result of the project is less than 0.1% of Slovak and international standards (a summary of these results is provided in Table 23).

The EIA Report also considered the effects of accidental conditions that might be expected and found that existing and planned safety measures are sufficient to mitigate any adverse effect.

Taking into account the findings of the present EIA Report, including the identified mitigation measures, the project is not likely to have any significant adverse effect on the environment. Indeed, the project will result in a number of positive effects through reducing greenhouse gases emissions (if compared to conventional power plants) and providing a safe supply of electricity and economic benefits to the immediate and surrounding communities.

Table 23 Summary of residual adverse/beneficial effects of the Project and their significance

Residual adverse effect	Significance
Atmospheric Environment	
Non radiological parameters	
Change in local climate due to predict increased of the amount of heat discharged to atmosphere	No adverse effect
Radiological parameters	
Increase in the average individual radiation doses to workers and to members of the public as a result of the Completion of MO34	Minor adverse effect (not significant)
Hydrology and Groundwater including Aquatic Environment	
Non radiological parameters	
Chemical and physical effect	No adverse effect
Radiological parameters	
Increase in the average individual radiation doses to workers and to members of the public as a result of the Completion of MO34 Increase of background tritium concentration in surface water and groundwater	Minor adverse effect (not significant)
Socio-economic Condition	
Beneficial effect: increase economic activity trough process expenditures and pay-roll. Beneficial effect: increase community stability through existence of a long term power plant with employment opportunities	Beneficial effect

4.0 PROPOSED MEASURES FOR PREVENTION, ELIMINATION, MINIMIZATION AND COMPENSATION OF ENVIRONMENTAL AND HEALTH IMPACTS

4.1 Physical-planning measures

The radiation dose targets for an individual of the population due to radioactive releases from the NPP during normal/abnormal operation for siting of the nuclear facility, shall not exceed the maximum dose allowed by Slovakian regulatory body (Ordinance of the Government No 345/2006), which is 0.25 mSv/year.

The exclusion area (Protection Zone) for Mochovce NPP was determined by Decree of Region Health Officer No. H-IV-2370/79 from 15.10.1979; it is a zone in which permanent residence is prohibited. The average distance of exclusion area boundary to Mochovce NPP is about 3 km (Figure 21).

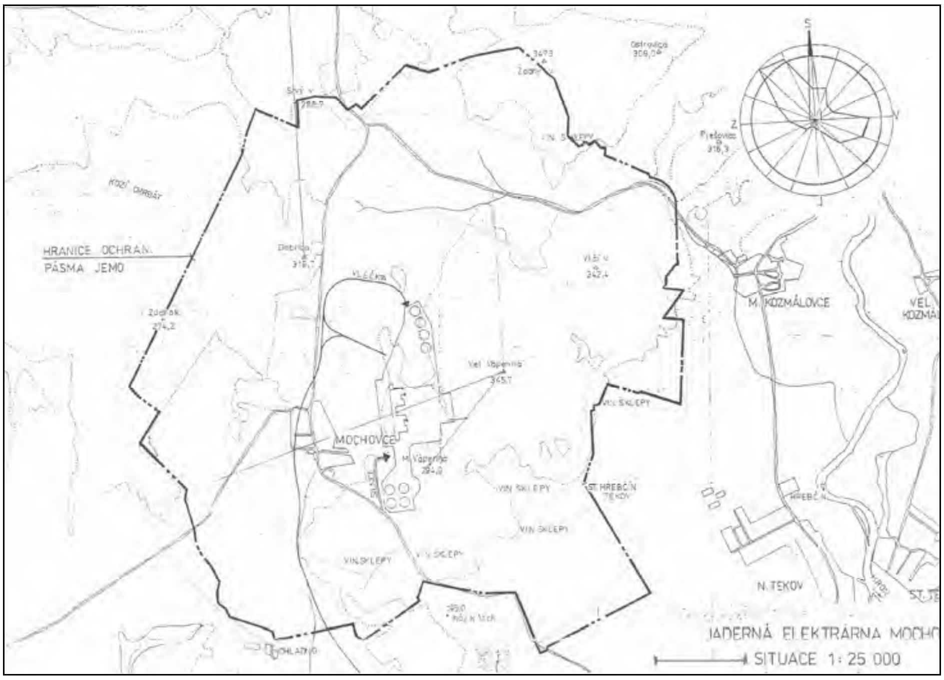


Figure 21 - Exclusion Area Border (Protection Zone) of Mochovce NPP

This radiation dose target is stated in compliance with Decree of the Slovak Government No 345/2006 on Basic Requirements for Radiation Protection of Public and Workers against Ionization Radiation and on the decision of the Slovak regulatory body valid for Mochovce NPP site. The use of dose constraint (250 µSv/year) is fully according with ICRP recommendations and the objectives of European Community Directive 96/29.

4.2 Measures in case of accidents – Emergency Plan

The design, project execution and operation of nuclear power plants ensures that the likelihood of an accident resulting in significant radiation exposures to workers and members of the public is very small. Nevertheless, it is still necessary to prepare suitable emergency procedures, means and equipment – an integral part of emergency response for all levels of accidents. The existence of a proper emergency plan is a standard practice – it is a prerequisite for licensing process resulting in granting a licence for operation of the nuclear installation.

The legal requirements on emergency preparedness come from Act No.541/2004 Coll. on Peaceful Utilization of Nuclear Energy, Act No. 355/2007 Coll., Act No. 444/2006 Coll. on Civil Protection of Population and Ministerial Order No. 345/2006 Coll.

The UJD Decree No. 55/2006 on Details in Emergency Planning in Case of Accident describes the main principles and details for emergency planning and preparedness of operators, as well as of state and municipal authorities located outside the plant (off-site authorities).

In accordance with the above acts, the operating organization, regulatory bodies and public authorities shall cooperate to prepare emergency plans.

The major tasks of emergency planning and preparedness are as follow:

- to decrease the risk of accident or emergency, or to reduce their consequences;
- to prevent serious direct health damage (death, etc.); and
- to decrease the probability of possible later health damage (e.g. cancer) as far as it is reasonably achievable.

Emergency preparedness is a complex of activities aimed at fulfilling all measures necessary to protect employees and other persons, if risk of accident or release of radioactive materials is possible. It includes establishment of emergency plans, training system, correct procedures and exercises for individuals, authorities and organizations to perform activities which have to be fulfilled according to On-site Emergency Plan (OEP) and Off-site Emergency plans – Plans for Population Protection in the threatened area. Accordingly, preparation and precise activities of EMO personnel shall be ensured if it comes to significant emissions of radioactive materials into the working environment and surroundings and it is necessary to take measures to protect human health in the area of the nuclear facility, as well as health of inhabitants in the surroundings of the nuclear facility.

Plant Manager is responsible for maintaining emergency preparedness in accordance with the requirements stated in legislation.

4.2.1 Off-Site Emergency Plan

The National Emergency Plan in case of Nuclear or Radiation Accident describes activities, links of individual units of national emergency response organization. It provides a balance of forces, sources and means necessary for an effective response.

It specifies the links to IAEA and cooperation with neighbouring countries in accordance with bilateral and international agreements.

The "Plan of Population Protection in case of Radiation Accident in Nuclear Power Facilities" (JEZ) is the document based on which the off-site emergency response is managed. The plans were prepared by Emergency Control Departments of County Councils in Nitra and Banská Bystrica in accordance with the Act No. 541/2004 Coll. on Peaceful Utilization of Nuclear Energy, UJD Decree No. 55/2006 on Details in Emergency Planning in Case of Accident, Act No. 444/2006 Coll. on Civil Protection of Population and Ministerial Order No. 345/2006 Coll.

It defines the organizations involved in regional emergency preparedness and defines duties of the individual subjects.

The Government of the Slovak Republic is responsible for the national emergency planning and preparedness. The relevant ministries are responsible for coordination of preparedness and potential activation of the Integrated Emergency System of the Slovak Republic.

Off-site Emergency Response Organization is provided at two levels:

- National level - the Safety Committee of SR and the Central Emergency Headquarters of SR are the control and coordination bodies for events during which population and environment are in a danger. They provide uniform preparedness and efficient realization of measures for protection as well as actions during a radiation event considering both the public and economy in the territory of the Slovak Republic. The Safety Committee is established by the Government of the Slovak Republic.

- Regional level - emergency commissions are established at district and municipal councils. They are coordinated by the emergency commissions of county councils in Nitra and Banská Bystrica. The commissions are responsible for "planning measures according to the relevant region". Plans of Public Protection are approved by the Ministry of the Interior of the Slovak Republic and assessed by the Nuclear Regulatory Authority (UJD).

4.2.2 Protective Measures

Priorities of protection during an emergency are defined as follows:

1) Protection of the plant personnel and persons legally moving on NPP territory;

2) Protection of reactor unit, avert core melting and mitigation of the consequences;

3) Protection of population living in the plant surroundings;

4) Protection of environment.

The following measures are implemented to protect the priorities in case of an emergency:

- monitoring of personnel and other persons´ movements at the site;
- notification of ERO members and officials of public service, self-government and regulatory bodies;
- warning of personnel and other persons at site;
- gathering and sheltering of personnel and persons that are at site, including use of protective aids;
- iodine profylaxation;
- evacuation of persons from the plant;
- warning and notification of population in 5, 10, 20 km Planned Protective Zones;
- recommendations of protective measures for population prepared by ERO at NPP that are subsequently reviewed by the relevant emergency commissions.

5.0 PROPOSED MONITORING AND POST-DESIGN ANALYSIS

5.1 Proposed monitoring from the beginning of construction, during the construction, during operation and after termination of operation of proposed activity

Monitoring is controlled by the regulation *"Programme of radiation monitoring in the vicinity of Mochovce NPP (QA-07-01)"* that describes the radiation monitoring around NPP Mochovce in a radius of 20 km from the plant.

A teledosimetry system (TDS), equipped with 40 monitoring stations, monitors the dose rate of gamma radiation, the volume activity of aerosol, the volume activity of radioactive Iodine and supplementary data on the state of the environment.

The monitoring system has been set up for the whole site of Mochovce, hence, once in operation, Units 3 and 4 will be covered as well.

5.2 Proposed checking of compliance with defined conditions

In order to assist in determining if the environmental and cumulative effects of the Project are as predicted in the EIA Report and to confirm whether the impact mitigation measures are effective and thus determine if new mitigation strategies are required, a follow-up and monitoring program is proposed.

Purpose of the follow-up and monitoring Program

The follow-up program would incorporate current Mochovce monitoring programs and other environmental studies, as appropriate.

Accordingly, the follow-up program should achieve the following three goals:

- *Confirm assumptions in the analysis of the EIA Report;*
- *Verify the predictions and assessment of the environmental effects; and*
- *Verify the effectiveness of implemented mitigation measures.*

New mitigation measures would be justified if either the implemented mitigation measures were found to be ineffective, or if the actual environmental effects were greater than predicted in the EIA Report. This process would help ensure continual improvement in the environmental performance of Mochovce NPP.

The plan for the follow-up program was developed in two steps. First, each of the likely effects of the Project identified in this Report was reviewed to determine how the predicted effect could be confirmed. The focus of the review was to identify which components of the environment might be incorporated into the follow-up and monitoring program. Secondly, each of the mitigation measures was reviewed to determine how its effectiveness could be monitored.

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XII LIST OF ADDITIONAL ANALYTICAL REPORTS AND STUDIES AVAILABLE AT PROPONENT USED AS SUPPORT DOCUMENTS FOR PREPARATION OF ASSESSMENT REPORT

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