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SUBCONTRACTOR:

PROJECT B6.7
ENVIRONMENTAL IMPACT ASSESSMENT REPORT OF 2nd STAGE OF V1 NPP DECOMMISSIONING

NON TECHNICAL EXECUTIVE SUMMARY

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1 BACKGROUND AND CONTEXT

The V1 Nuclear Power Plant (NPP), located at Jaslovské Bohunice, consists of two pressurized water reactors of VVER type 440/230 design. These reactors were commissioned in 1978 in 1980 respectively. V1 NPP decommissioning, on the basis of the Resolution No. 801/99 of the Slovak Government (September 14th, 1999), was a precondition for Slovakia accession into the European Union, in compliance with Slovak Energy Policy, and annexed as Protocol No 9 to the Act of Accession signed in Athens in April 2003. The V1 NPP Unit 1 was permanently shut down on December 31th, 2006, and unit 2 on December 31th, 2008.

The environmental impact assessment (EIA) of the planned decommissioning of V1 NPP was launched in July 2002, when Slovenské Elektrárne (SE), as an owner (in those days) of the plant, submitted to the Ministry of Environment of the Slovak Republic (MoE SR) a "*Complex study on the V1 NPP decommissioning"* for assessment. The purpose of the assessment, developed in the years 2006-2007, was to choose the optimum alternative for V1 NPP decommissioning. This process of concept assessment was completed according to in that time valid Act No. 127/1994 Coll. (currently, Act No. 24/2006) on EIA, as amended, by the Final Statement with the title *"Decommissioning of the Nuclear Power Plant V1"*, issued by the MoE SR on March 7th, 2007 under the Number: 8935/06 - 3.5/hp. The validity of that Final Statement was extended by the Resolution of the MoE SR No. 2332/2010 - 3.4/hp to the period from November 29th, 2010 until November 30th, 2012.

From the point of view of EIA, decommissioning of nuclear facilities is subject to the following legal provisions:

- On the national level:
  - Act No. 24/2006 Coll. on Environmental Impact Assessment and on Alternations and Amendments to some Acts, as amended ("EIA Act")
- On the international level:
  - Directive 2011/92/EU on the Assessment of the Effects of Certain Public and Private Projects on the Environment, as amended, (EIA Directive - Consolidated version).
  - Convention on the Environmental Impact Assessment in a Transboundary Context (Espoo Convention)

As a result of the aforementioned EIA process, the alternative *"Immediate Decommissioning of V1 NPP"* was recommended as the most appropriate one among the different alternatives under assessment. The selected alternative represents the "fastest" option that allows achieving the condition of the site in which any radioactivity is removed from technological installations and constructions in the shortest time among all assessed alternatives. It means that dismantling commences immediately after the end of operation.

The immediate decommissioning of the V1 NPP has been planned in two stages (known as "1st stage" and "2nd stage"), in addition to the pre-decommissioning activities, with the deadline in 2025. On July 19th, 2011, the Nuclear Regulatory Authority of the Slovak Republic (ÚJD SR) issued, upon request of JAVYS and the approval of European Commission in compliance with the European Atomic Energy Community Treaty (EURATOM), the resolution Nr. 400/2011, which permits the 1st Stage of V1 NPP decommissioning. In connection with the resolution, JAVYS also received resolutions from the Public Health Authority of the Slovak Republic (ÚVZ SR):

- Resolution Nr. OOZPŽ/3761: Approval of activities leading to irradiation during the 1st Stage of V1 NPP decommissioning.
- Resolution Nr. OOZPŽ/3760/2011: Approval for releasing radioactive substances from administrative control by ventilating gas discharges through chimneys and in waste waters of the V1 NPP.

As mentioned before, the EIA carried out in the years 2006-2007 had as main aim to select the optimum alternative of V1 NPP decommissioning. When the EIA documents was compiled, detailed information on technical issues in respect to the individual activities were lacking and in view of some changes in the progress of certain activities, JAVYS, as a responsible of the NPP to be decommissioned decided, upon consultation with the MoE SR, to subject the 2nd stage of V1 NPP decommissioning to a new EIA process. The Final Statement of the MoE SR resulting from this process will serve as a basis for the UJD SR decision on permit of the 2nd stage of V1 NPP decommissioning.

JAVYS submitted to the MoE SR, on June 17th, 2013, a Preliminary Environmental Study on the "*2nd Stage of decommissioning of the NPP V1 in Jaslovské Bohunice*" for assessment according to the Act on EIA. The proposed activity was submitted for assessment in a sole alternative since the MoE SR, by writing No. 5602/2013-3.4/hp of May 17th, 2013, consented to the requirement of the proponent to abstain from an optional solution. In August 23th, 2013, the Department of Environmental Assessment of the MoE SR submitted to JAVYS the scope of assessment in respect to the proposed activity, according to §30 of the Act on EIA.

2 PROPOSED ACTIVITY

2nd Stage of V1 NPP decommissioning in Jaslovské Bohunice.

3 PURPOSE OF THE PROPOSED ACTIVITY

The basic objective of the 2nd stage of V1 NPP decommissioning project is to continue the already running decommissioning process by proceeding its second and final stage to achieve *Brownfield* site final status.

The overall 2nd Stage target is to achieve license termination under following restrictive conditions:

a) Further reductions in residual radioactivity are necessary to comply with Slovak Regulations as the residual levels associated with restricted conditions shall be “As Low As Reasonably Achievable” (ALARA).

b) Institutional controls shall provide reasonable assurance that the effective dose from residual radioactivity, distinguishable from background, to the average member of the critical group does not exceed 0,3 mSv per year.

c) Residual radioactivity at the site shall be reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the effective dose from residual radioactivity, distinguishable from background to the average member of the critical group, is as low as reasonably achievable and would not exceed 1 mSv per year.

d) If further reductions in residual radioactivity necessary to comply with 1 mSv/y are not technically achievable, it shall be properly justified (e.g. it would be prohibitively expensive, or it would result in net public or environmental harm).

The completion of various decommissioning activities of the 1st stage shall be assured in order to proceed with the implementation of those projects that are part of the decommissioning 2nd stage.

4 LOCATION OF THE PROPOSED ACTIVITY

The location of the activity is defined by the area of the nuclear energy complex (NEC) Bohunice in which several nuclear facilities are located. They are as follows:

- JAVYS facilities: V1 NPP, A1 NPP, Interim Spent Fuel Storage (ISFS) Radioactive Waste Processing and Treatment Technology (RWPTT).
- JEES facility:V2 NPP (SE, EBO)

The site is located 2.5 km from the village of the same name, in the Trnava District, roughly 60 km northeast of the Slovak capital, Bratislava.

The affected area, from the environmental impact point of view, has been defined as the territory within a radius of approximately 5 km from Bohunice V1 NPP.

5 PROPONENT

The owner and responsible for the V1 NPP decommissioning is the state owned company "*Jadrová a vyraďovacia spoločnosť a.s.*" (JAVYS).

6 COMMENCEMENT AND DURATION OF THE PROPOSED ACTIVITY

The 2nd stage of V1 NPP decommissioning is currently planned for 11 years (from January 2015 to December 2025).

7 ALTERNATIVES

7.1 Zero Alternative

The Zero Alternative represents the status that would arise if the 2nd stage of Bohunice V1 NPP Decommissioning will not be implemented. The Zero Alternative means the operation of the radioactive objects where radioactive process equipment (including reactor), requiring necessary and continual monitoring of radiation, maintenance and monitoring the barrier impenetrability, is housed as well as ensuring energy resources and operational media in order to maintain the safe condition of these civil structures and process equipment.

With respect to the above, it is necessary to operate also some non-active civil structures that serve as technical support to operate the active structures concerned and the non-active structures that serve for the employee's social purposes, as well as some of auxiliary systems shall be in service, like ventilation systems, special drainage, radiation monitoring of process equipment and areas by stationary system and portable instruments, etc. Concurrently surveillance and maintenance of the above systems as well as for buildings shall be provided.

7.2 Alternative 1

Alternative 1 suppose the implementation of 2nd stage of Bohunice V1 NPP decommissioning.The activities of the 2nd stage decommissioning comprise removal of the primary circuit (PC) and of any remaining contaminated and non-contaminated systems, decontamination of any contaminated buildings, demolition, RAW processing and disposal, site restoration, final survey and site release for further use. The 2nd stage will also include works that have not been finished in the 1st stage V1 NPP decommissioning yet.

The 2nd stage decommissioning shall hence comprise the following activities:

a) Groups of main activities in the 2nd stage of V1 NPP decommissioning

- Preparation and dismantling (of reactors, primary circuit (PC) equipment and other equipment in and out of the controlled zone (CZ)).
- RAW management:
  - Fragmentation
  - Decontamination
  - Conditioning and treatment
  - Storage
  - Transport
  - Final disposal in the repository

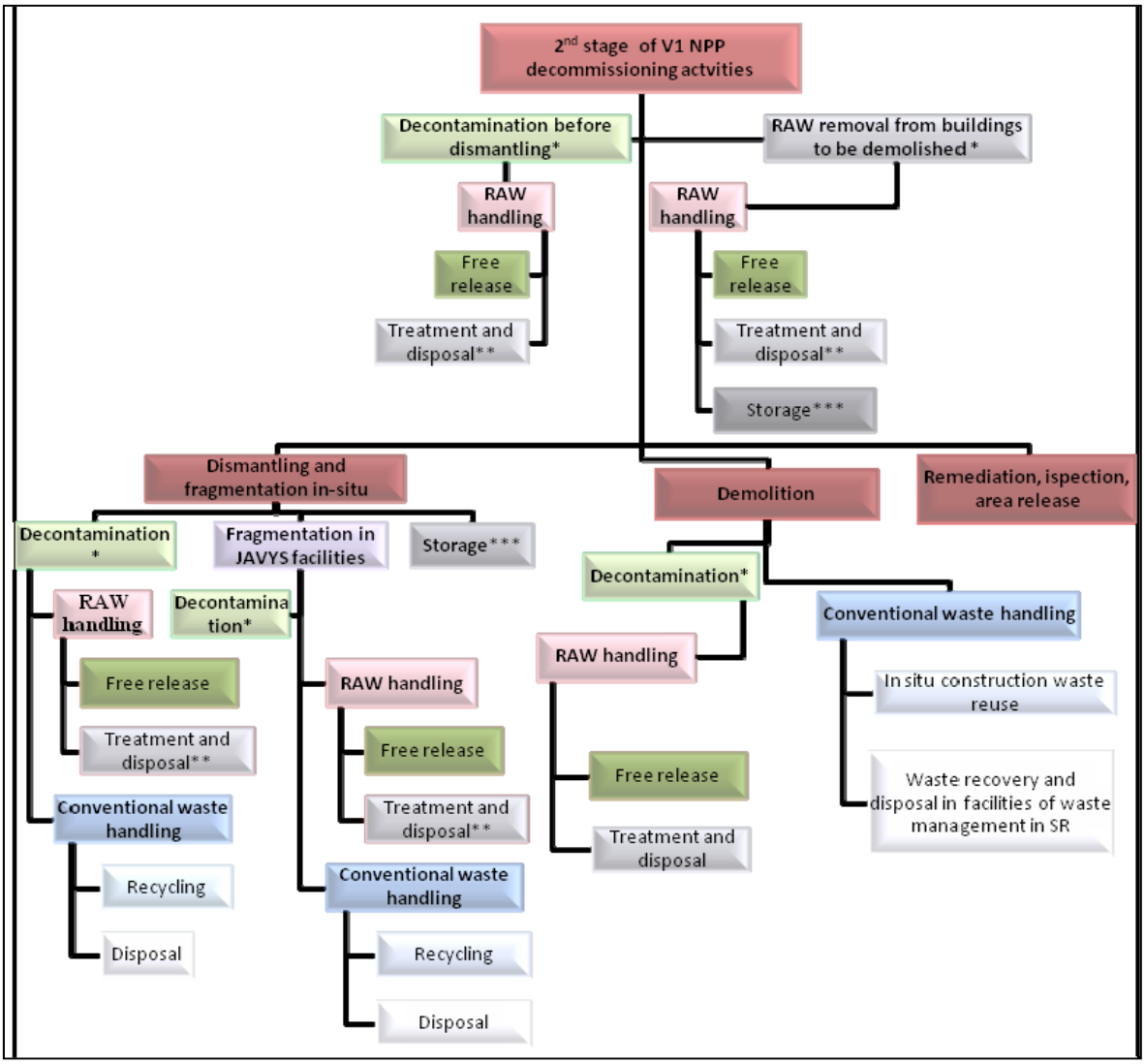
- Decontamination of structures
- Demolition of structures
- Free release of materials into the environment
- Remediation, final inspection and release of the site for further use.

b) Groups of auxiliary activities

- Management of conventional waste.
- Licensing activities
- Modification of systems and installation for decommissioning purposes
- Operation, control and maintenance of auxiliary systems
- Safety (occupational safety and health protection (OSH), fire protection (FP), nuclear, physical security)
- Radiation protection.

The basic sequence of the main activities of 2nd stage V1 NPP decommissioning is shown on the following picture.

Graph No. 1. Pictorial expression of the 2nd Stage of V1 NPP decommissioning activities



The most important activities belonging to the above mentioned groups are as follows:

- Disposal of "RH" waste from the "Mogilnik"
- Decontamination of spent fuel pools and other contaminated tanks
- Modification of technological systems and objects and installation of new equipments
- Dismantling of large-scale components of the cooling system
- Dismantling of systems in the controlled zone
- Dismantling of systems out of the controlled zone
- Fragmentation of materials and equipments.
- Melting of metallic RAW
- Decontamination of objects.
- Demolition of objects and filling up of construction pits.
- Restoration of the site into the original condition.
- Final review and release of the site for further use.
- Operation, control and maintenance of auxiliary systems, control of inactive systems to be decommissioned, the building structures and the V1 NPP site.
- Supervision of nuclear safety.
- Safety - SHPW and FP.
- Physical security.
- Processing, treatment, storage of RAW.
- Release of materials into the environment.
- Management of inactive waste.
- Storage of RAW in the Interim Waste Storage.
- Operation, control and maintenance of security systems.
- Implementing of project amendments and modifications in the CZ.
- Operation of decontamination lines.
- Provisional arrangement, manipulation and securing of equipments within as part of project amendments and modifications in the CZ.
- Activities connected to securing of radiation protection and provision of personal dosimetry services.
- Usage, control, maintenance, overhaul and storage of manipulators, facilities and technological equipments and parts of technological equipments of the nuclear power plant contaminated with radionuclides originating from the operation of nuclear reactors.
- Collection, processing and analysis of samples of material and media contaminated with radionuclides for purposes of assessment of technological processes, assessment of the condition of barriers, monitoring of radiation levels in the premises of the power plant, monitoring of the nuclear facilities' impact on their environment, monitoring of the environment contamination in case of radiation accidents and monitoring of internal irradiation of workers.
- Decontamination of superficially contaminated workers.
- Cleaning of work clothes and garments and protection devices contaminated by radionuclides.

- Providing of permanently reduced pressure in order to prevent spreading out of contamination in the premises of the CZ in course of any activities.
- Adjustment of air technical systems.
- Updating of radiological classification of equipments and constructions of the reactor buildings.
- Material transport.
- Handling and transport of RAW.
- Registration of material flows.

From environmental point of view the most significant activities are activities of dismantling and fragmentation of reactors and PC installations and other systems in CZ, because there is a need to handle activated and contaminated components/materials.

Tab. No. 1. Equipment dismantling, decontamination and RAW handling

EQ. TYPES	DISMANTLING AND WASTE MANAGEMENT STAGES (from left to right)					
	Equipment Dismantling & Handling				On-site Transport and Storage	Final Conditioning, Transport, Disposal
	Preparation	Dismantling	Size reduction	Treatment by decontamination		
Main Circulation Pumps	Dismantling of motor deck equipment	In-situ cutting into small fragments using thermal (main) and mechanical (further) cutting methods	In-situ	Ultrasonic or electrochemical decontamination in C7- A3 or C7-A2	RH->C7-A3 by crane RH-> C7-A2 by truck	to FR-box pallet, truck to NRR-FCC, truck
Main Gate Valves	Dismantling of motor deck equipment	In-situ cutting into small fragments using thermal (main) and mechanical (further) cutting methods	In-situ	Ultrasonic or electrochemical decontamination in C7- A3 or C7-A2	RH->C7-A3 by crane RH-> C7-A2 by truck	to FR-box pallet, truck to NRR-FCC, truck
Main Circulation Pipelines	-	In-situ cutting into small fragments using orbital cutters and other mechanical methods	In-situ	Ultrasonic or electrochemical decontamination in C7- A3 or C7-A2	RH->C7-A3 by crane RH-> C7-A2 by truck	to FR-box pallet, truck to NRR-FCC, truck

FR-free release, RH- Reactor Hall , NRR – National RAW Repository in Mochovce, FCC – fibre concrete container, C7-A3 – new Fragmentation & decontamination facility, C7-A2 – existing modified Fragmentation & decontamination facility , C7-A3 – new metal melting facility

Tab. No. 2. Sequence of PC dismantling activities and techniques to be used

Step	Description	Cutting technique
1	Fragmentation of the lower grate	CAMC; Plasma cutting
2	Cutting of pipes to the lower grate	Plasma cutting
3	Circular cutting of the cylindrical part of the lower shell	Band saw
4	Cutting of the lower shell pipes	Plasma cutting
5	Cutting of guide pipes under the upper grate	Plasma cutting
6	Fragmentation of the upper grate	CAMC; Plasma cutting
7	Cutting of guide pipes above the upper grate	Plasma cutting
8	Cutting and fragmentation of the upper shell	Band saw
9	Cutting of the temperature control pipes	Plasma cutting

Handling of activated and contaminated components is summarizes in the following tables.

Tab. No. 3. Activated components handling

EQUIPMENT	DISMANTLING PROCESS	CLASSIFICATION	CONTAINER	STOCKPILING/BUFFER AREA	ON-SITE TRANSPORT	CONDITIONING	STORAGE	OUT-SITE TRANSPORT	DISPOSAL
Reactor Pressure Vessel	Size reduction by dry fragmentation / radiological separation	LA RAW	FCC	Reactor Hall level +10,5m	RH to RWTC by truck	Cementation into FCC	Buffer storage at IS-RAW prior to disposal	IS-RAW to Mochovce by truck	NRR Mochovce (LA RAW repository)
		MLW	CFM	Reactor Hall level +10,5m	RH to IS-RAW by truck	—	Safe long-term storage at IS-RAW	—	—
Reactor Internal Structures	Size reduction by wet fragmentation / radiological separation	LA RAW	Collection basket into FCC	Reactor Hall level +10,5m	RH to RWTC by truck	Cementation into FCC	Buffer storage at IS-RAW prior to disposal	IS-RAW to Mochovce by truck	NRR Mochovce (LA RAW repository)
		MLW	Collection basket into CFM	Reactor Hall level +10,5m	RH to IS-RAW by truck	—	Safe long-term storage at IS-RAW	—	—
Reactor Shielding Assemblies	Size reduction by wet fragmentation	MLW	Collection basket into CFM	Reactor Hall level +10,5m	RH to IS-RAW by truck	—	Safe long-term storage at IS-RAW	—	—
Annular Water Tank	Size reduction by dry fragmentation / radiological separation	LA RAW	FCC	Reactor Hall level +10,5m	RH to RWTC by truck	Cementation into FCC	Buffer storage at IS-RAW prior to disposal	IS-RAW to Mochovce by truck	NRR Mochovce (LA RAW repository)
		VLA RAW	ISO containers 20'	Reactor Hall level +10,5m	RH to IS-RAW by truck	—	Buffer storage at IS-RAW prior to disposal	IS-RAW to Mochovce by truck	NRR Mochovce (VLA RAW repository)

Abbreviation: FR- free release, RAW – radioactive waste, FCC- fibre concrete container, CFM - Container for Medium RAW, NRR – national RAW repository, LA RAW- law active RAW, VLA RAW- very low active RAW, RH- Reactor hall, IS – interim storage, RWTC – RAW Treatment Centre in Bohunice

Tab. No. 4. Handling of contaminated components

EQUIPMENT	DISMANTLING PROCESS	CLASSIFICATION	FIELD CONTAINER	TREATMENT	CLASSIFICATION AFTER TREATMENT	CONTAINER AFTER TREATMENT	STOCKPILING / BUFFER AREA	ON-SITE TRANSPORT	CONDITIONING	STORAGE	OUT-SITE TRANSPORT	DISPOSAL
SGs Unit2 tubes	Size reduction by dry fragmentation	LA RAW	200l drums	—	LA RAW	200l drums	Reactor Hall level +10,5m	RH to RWTC by truck	Compaction at RWTC and drum pellets Cementation into FCC	Buffer storage at IS-RAW prior to disposal	IS-RAW to Mochove by truck	NRR Mochovce (LA RAW repository)
Metallic	Size reduction by dry fragmentation / radiological separation	VLA RAW (decontaminable)	Box pallets 1,2x0,8x0,8	Decontamination in C7-A3	Clearable for FR (RT1&RT2)	Box pallets 1,2x0,8x0,8	Reactor Hall level +10,5m	RH to FR facility	—	—	—	—
					VLA RAW (not decontaminated)	ISO Container 20'	Reactor Hall level +10,5m	RH to VLA RAW storage	—	VLA RAW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLA RAW repository)
		VLA RAW (not decontaminable)	ISO Container 20'	Wrapped in polymer film	VLA RAW	ISO Container 20'	Reactor Hall level +10,5m	RH to VLA RAW storage	—	VLA RAW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLA RAW repository)
		Clearable for FR (RT1&RT2)	Box pallets 1,2x0,8x0,8	Free release (FRM02C)	Cleared waste	Box pallets 1,2x0,8x0,8	Reactor Hall level +10,5m	TH to conventional storage	—	Conventional storage areas	By truck to final destination	Conventional dumps/Recycling
					VLA RAW (not cleared)	ISO Container 20'	Reactor Hall level +10,5m	RH to VLA RAW storage	—	VLA RAW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLA RAW repository)
Insulation	Equipment removal	Clearable for FR (RT1&RT2)	Large capacity bags	Free release (FRM06C)	Cleared waste	Box pallets 1,2x0,8x0,8	Reactor Hall level +10,5m	TH to conventional storage	—	Conventional storage areas	By truck to final destination	Conventional Disposal/Recycling
		VLA RAW (decontaminable)	Box pallets 1,2x0,8x0,8	Decontamination in C7-A3	Clearable for FR (RT1&RT2)	Box pallets 1,2x0,8x0,8	Reactor Hall level +10,5m	RH to FR facility	—	—	—	—
					VLA RAW (not decontaminated)	Box pallets 1,2x0,8x0,8	Reactor Hall level +10,5m	RH to RWTC by truck	Treatment at RWTC	VLA RAW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLA RAW repository)
		VLA RAW (not decontaminable rock wool)VLA RAW	200l drums	—	VLA RAW	200l drums	Reactor Hall level +10,5m	RH to RWTC by truck	In-drum Compaction at RWTC and drum pellets loading into ISO container Cementation into FCC	VLA RAW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLA RAW repository)

Abbreviation: SG –steam generator, FR- free release, RAW – radioactive waste, NRR – national RAW repository, LA RAW- law active RAW, VLA RAW- very low active RAW, RH- Reactor hall, TH-turbine hall , IS – interim storage, RWTC – RAW Treatment Centre, FCC – fibre concrete container

7.2.1 Fragmentation

Dismantling and fragmentation activity uses the following partitioning methods:

- Hydraulic cutting - for materials for which there is no assumption of further processing
- High shear segmentation - in places where it is not possible to use other mechanical methods
- Low shear segmentation - for materials with relatively higher contamination
- Thermal segmentation - in places where it is not possible to use other mechanical methods

7.2.2 Decontamination

Decontamination of activated equipment will not be carried out . Contaminated equipment will be decontaminated as follows:

7.2.2.1 Decontamination of equipment in situ

Decontamination is the removal of surface contamination of equipment and facilities by washing, heating, chemical or electrochemical means, mechanical cleaning, or by other techniques.

7.2.2.2 Post-fragmentation decontamination

Post- fragmentation decontamination methods proposed are:

- Electrochemical decontamination in the decontamination bath - the removal of fixed contamination on surfaces of dismantled and fragmented pieces of contaminated equipment parts.
- Ultrasonic decontamination in the decontamination bath - for finishing cleaning of materials from lightly fixed contamination using ultrasound after previous electrochemical decontamination.
- High- sprayed in the decontamination bath - rinse and remove residual material free of contamination and the less accessible surfaces after previous electrochemical and ultrasonic decontamination.
- Abrasive blasting in a basket - the blasting of fragmented metal surface of contaminated components, which are freely inserted into the basket, the movement of which rotate them and are blasted.
- Manual abrasive blasting - for manual blasting of large objects with large thickness, which are surface contaminated.

7.2.2.3 Decontamination of civil structures

Decontamination of fragmented facilities will be carried out as electro-chemical decontamination, applying standard methods.

After dismantling of the systems deployed in the individual objects the respective dosimetric control and verification of safety at work prescriptions will be carried out since the concrete used in buildings where reactor vessels and other systems are situated, is expected to be contaminated to a significant extent.

7.2.2.4 Decontamination of civil structure surfaces

Structure's surfaces will be decontaminated only after the equipments have been dismantled. The following decontamination methods have been proposed:

- Surfaces covered by coating out of stainless steel will be decontaminated by semi-dry electrolytic decontamination or, in limited scope, mechanically with subsequent rinsing.
- Surfaces covered by a carbon steel coating with epoxide varnish will be to a limited extent decontaminated by mechanical means.
- Surfaces with epoxide varnish will be decontaminated by means of a detergent-water solution (1:1 ratio) applied on the surface as foam. Mechanical decontamination will be applied in limited scope if it is necessary.
- Surfaces without coating and epoxide varnish will be decontaminated mechanically by abrading to a depth of approximately 5 to 10 mm.

Decontamination will be carried on until the activity measured in the concrete and other masonry walls will reach release levels valid for building structures in Slovakia. Several decontamination cycles will be applied if necessary.

Examples of typical technologies are:

- Hot high pressure water jet
- Semi-dry electrolytic decontamination
- Decontamination by foam
- Decontamination by gel
- Decontamination by adhesive coatings
- Decontamination by detachable paint (film) and electrolytic decontamination
- Washing cloth
- Decontamination by abrasion/scarification.

7.2.3 Demolition of objects and filling up of construction pits

Emptied buildings will be demolished down to the foundations.

Demolition of structures including cooling towers can be carried out only applying mechanical methods, such as:

- Jaw crushing machines - during demolition, small pieces of concrete with diameters of max. 20 cm will fall on the ground, while other structural parts remain unaffected.
- Gradually cutting the upper part down to the height of 50 m. Subsequently, the individual parts will be transported to the ground by crane, where they will be fragmented to smaller parts. After demolition down to 50 m, the demolition method described in the previous alternative will be applied from 50 to 0 m, by means of jaw crushers.

Concrete generated in course of the demolition of cooling towers and the other objects will be subsequently separated from iron reinforcements and after used for backfilling the construction pits remaining after demolition of objects.

7.2.4 Free release of materials from decommissioning

Radioactive and non-active materials from the NPP, forming part of the V1 NPP site release process, will pertain to these two streams:

- Waste released from administrative control is generally referred to as "free release" or "clearance", meaning that no further material control from the point of view of radiation protection is required. Such waste can be recycled / disposed of in accordance with waste management laws (Waste Act).
- Material with radioactive contamination exceeding the clearance values will be transported to facilities for further RAW processing.

Release of material generated during the V1 NPP decommissioning is subject to authorisation by the Public Health Authority of SR (UVZ SR) according to the Act No. 355/2007 Coll. on Protection, Support and Development of Public Health, as amended.

Free release materials will be various, in particular, it will consist of concrete and aerated concrete, metals, thermo-insulations, bulky materials and parts of civil constructions.

7.2.5 RAW processing

At present the various facilities for radioactive waste processing are in place and within the 2nd stage of decommissioning the use of these technologies will continue. These are:

- Cementation facility (Bohunice RAW Treatment Centre, BRWTC).
- Incineration facility (Bohunice RAW Treatment Centre, BRWTC).
- Pressing facility / Compactor unit (BRWTC).
- Separation facility (BRWTC).
- Concentration facility/ Evaporator (BRWTC).
- Bituminization plants PS 44, PS 100 and a plant for bituminization of radioactive sorbents PS 44/II Stage.

7.2.5.1 RAW processing general procedures

Basic procedures are focused on volume reduction, removal of radionuclides and reformulation, storage and disposal. The individual methods are often combined to obtain max. decontamination effect. RAW processing RAW in JAVYS is currently implemented in nuclear facilities TSU RAW V1 or A1 depending on type of RAW.

RAW processing is focused on reaching the following objectives:

- To reduce the volume of waste,
- To create a safe forms suitable for storing by their fixation,
- To ensure sufficient barrier against leakage of radioactivity into the environment during the time of deposit.

In the controlled zone wastes are separated in two basic groups for radioactive and non-radioactive (releasable to the environment) already during their generation and then sorted by radioactivity and possibilities of further handling (type catalogue of RAW).

All radioactive wastes are carefully collected and monitored throughout their handling process, recorded and inspected. Liquid and solid wastes are treated by appropriate technologies into a form that is suitable for long-term safe storage or final disposal. Gaseous effluents are cleaned on special filters and released under the control as the gaseous discharges.

Radioactive waste treatment represents activities leading to changes of their physico - chemical properties and the creation of a form suitable for safe handling, storage and disposal.

For RAW conditioning and treatment the following technologies are used in JAVYS:

- Bitumination
- Vitrification
- Cementation
- Sialization

New treatment of wastes is planned in JAVYS – melting of metal radioactive waste, which will be subject to a separate EIA assessment.

7.2.6 Transport, storage and final disposal of RAW

Any conveyor and transporting facilities applied for transport of RAW must meet the requirements established by the Act No. 541/2004 Coll. and the European Agreement concerning the International Carriage of Dangerous Goods by Road - ADR Agreement. They are subject to authorisation as conveyor facility and a transport licence and must meet the criteria of technical safety, radiation protection, nuclear safety and fire protection.

Under storage of radioactive waste or spent nuclear fuel it is understood the temporary placement of these materials in spaces, objects or facilities that allow for their isolation, monitoring and at the same time environment protection.

In contrast, disposal of RAW represents their permanent placement in the repository. According to its definition, a RAW depository is a surface or underground space, object or facility that serves the purpose of RAW disposal, allowing for their isolation, monitoring and environment protection.

Fragments of RPV, the internal reactor components, parts of the control rod assembly and the shielding cartridges from the active zone of the reactor that belong to the category medium-activity RAW will be placed for temporary storage in the interim storage facility (project C8) in shielded containers. Fragments of the annular water tank obtained from its dismantling at the site, as well as the reactor pressure vessel fragments (flange zone, pipe bottom zone and base zone) and temperature control channels (upper part of the control rods unit) are assigned for final disposal. Small fragments that belong to the category low-active RAW (that is to say, parts of the reactor vessel and the control rods unit) will be transported in fibre-concrete containers for interim storage in 200 l barrels. Large fragments (parts of the annular water tank and the reactor pressure vessel) that belong to the category low-activity RAW will be transported in fibre-concrete containers covered by concrete mixture. Annular water tank fragments belonging to the category of very low-activity RAW will be transported in

ISO containers to the repository of very low-activity RAW in Mochovce. Transport will be carried out according to the current legislation by road.

Small fragments belonging to the category low-activity RAW will be disposed, being placed in fibre-concrete containers. Very low-activity RAW (annular water tank fragments) will be placed in the RAW repository in Mochovce without containers.

At present, a repository for low-activity RAW is available at the Mochovce site and construction of a repository for very low-activity RAW is currently in preparation in the nuclear facilities of NRR Mochovce. Activities associated with the repository and the extension of its storage capacity has been subject to a separate EIA process. Placement of RAW is subject to strict keeping of limits and conditions applicable to the repository, approved by the ÚJD SR (Nuclear Regulatory Authority of SR) and the ÚVZ SR (Public Health Authority of SR). Transport package units in which RAW may be transported to the repository are subject to permission as well.

7.2.7 Conventional waste management

In handling with conventional waste JAVYS shall apply all the basic principles of WMS arising from the strategy of the EU and Slovak WMP SR, in particular the principle of hierarchy, proximity and self-sufficiency, BAT and security.

A substantial part of conventional wastes are recoverable construction waste and metal waste of category "other waste". Construction waste consisting of uncontaminated concrete and aerated concrete will be treated by crushing in shredders and all resulting material will be used to fill depressions after removal of buildings, especially cooling towers. Metal waste and other recoverable waste will be used as secondary raw material, resp. alternative fuel. A very small proportion of conventional waste will be handed over to the waste recovery and disposal operators who are authorized to handle the respective type of conventional waste.

7.2.8 Restoration of the site into the final condition

The main objective of this activity is the remediation of the territory before the beginning of the final survey, with the objective to release the territory from the control regime.

Contaminated superficial and substratum (non-saturated) soil and rock on the outside areas will be decontaminated or processed as necessary at the Bohunice Processing Centre of RAW, until the contamination level is lower than the values for the determined locality usage. Finally, the superficies of the site will be conditioned so as to match with the surrounding field.

7.2.9 Final examination and site release

Radiological control of non-contaminated and decontaminated outer spaces will be carried out in order to prove that levels for release of the site for restricted use, set by the competent authorities, have been kept. If it is not possible to show that these values have been kept the failing spaces or soils will be remediate again.

8 INPUTS AND OUTPUTS OF PROPOSED ACTIVITY

The following tables summarize the requirements for inputs and outputs relevant to EIA.

Tab. No. 5. Inputs identification

Kind of inputs	Specified inputs	Note
Energy	Electricity	Needed for electric equiopment and tools supply
	Gas	Needed for gas equipment supply
	Petrol, diesel, oil	Needed for mashines, vehicles, tools operation and maintenance
Human resources	Internal and external resourses	Needed for continious maintenance and for specific expert works
Natural resources	Water	Needed as drinking, demineralized water, steam, water for sprinkling
Material	Special equipment, tools	Needed for dismantlig, fragmentation, waste treatment and variuos monitoring
	Packaging for RAW	Needed for RAW treatment and transport as 200 liter barrels, containers
	Cement, bitumen, SIAL, additives	Needed for RAW treatment
	Oxygen, acetylene, compressed air	Needed for dimantling, fragmentation, RAW treatment and demolition
	Chemical compounds	For decontamination

Tab. No. 6. Outputs identification

Kind of outputs	Specified outputs	Note
Waste water	Radioactive discharges	From special drainage system for technological waste water
	Non-active	From rain and sewage drainage system
RAW	Primary RAW	From activated and contaminated components dismantling and fragmentation
	Secondary RAW	From used tools, used PPE, from decontamination
	Historical	Sediments and sludge from pools and tanks
Conventional waste	Hazardous waste	From dismantling, demolition and used machines and vehicles.
	Other waste	From dismantling and demolition.
Emission to air	Radioactive discharges	Emissions from dismantling and fragmentation of activated and contaminated materials including the secondary contamination of materials, emissions from decontamination, emissions from RAW treatment.
	Non - radioactive	Emissions from all machines using fuel, from the existing air static, mobile and surface area pollution sources in place. Primary dust and secondary dust during demolition, fragmentation and mechanical waste treatment (operation of shredder)

9 IDENTIFICATION AND EVALUATION OF ENVIRONMENTAL IMPACTS

9.1 Zero Alternative

The Zero Alternative implying that the licensee would simply abandon or leave a facility after ceasing ongoing operations. The Zero Alternative implementation extends its duration to an indefinite period of time, determined by a spontaneous decay of radioisotopes in the shutdown power plant. According to this, Zero Alternative means the persistence of the status which will be reached after the shutdown without time limitation, in practical terms, where the radioactivity of radioactive substances present will decrease only due to the natural decay of radionuclides. It should last for so long

until the possibility of releasing the equipment to environment due to natural radioactive decay is reached. With respect to the current values of the radioactivity inventory in V1 NPP and its character (presence of radionuclides with a long half-time, especially of alpha radionuclides), the time horizon of Zero Alternative can be estimated to be 10^4 – 10^5 years.

This option does not require investments for decommissioning however it is not time limited and puts off the horizon of the new site utilization to a very far future. In addition it extends hazards of possible radioactive substances leakages into the environment.

Radiological investigation confirmed that contamination of equipment located in V1 NPP buildings has potential of negative human impact for on-site workers (direct exposure). For off-site residents the negative health impact resulting from contaminants release is very low. The impact on the geological environment in a long term perspective is minimal, but only on condition that long-term continual inspections, water tightness of the civil structures and hermetic tightness of the technological equipment is ensured. In general, Zero Alternative presents lower risks in short term period compared to other alternatives involving dismantling of V1 NPP equipment. However in a long term perspective, aggregated risk is much higher due to the very long period needed for release of the existing equipment to the environment.

9.2 Alternative 1

As previously detailed, the Alternative 1 includes the immediate and continuous dismantling of the equipment and facilities, the demolition of buildings back to the bottom of the foundation and the preparation of the site for other restricted (industrial) use.

With regard to the character of the Alternative 1, the impacts caused by the decontamination of dismantled equipments and building structures, and the treatment of RAW arising from the decontamination, dismantling and demolition can be in general defined as the most important assessment criteria. The importance of the proposed activity for the safety and complexity of the disposal of RAW is also a significant assessment criterion. The following matrix provides summary of information on environmental impact identification and evaluation of adverse impacts caused by the Alternative 1.

Tab. No. 7. Identification and evaluation of project impacts

Impact	Impact identification yes/no	Impact evaluation scale 1-5*	Comment/explanation
Impact on population – health risks	yes	-1	Radiological impact from RAC discharges into atmoshpere and hydrosphere during the 2nd Stage fd decommissioning will be significantly lower than limit values. On cumulative radiological impact the proposed project may participate by portion of 24% in maximum. According to calculation the impact of RAW transport to Mochovce will be negligible. Free release of low radioactive materails is not source of significant impact on population, because only ca. 5% portion of total FR RAW requires distibution to waste recovery and disposal facilities, 81% portion will be reused in-situ for backfilling of depressions after building demolition and ca. 4% portion will be iron and steal used a secondary raw material.

Tab. No. 7. Identification and evaluation of project impacts

Impact	Impact identification yes/no	Impact evaluation scale 1-5*	Comment/explanation
Socio – econimic context and consequences – employment	yes	+3	During coming 10 yers period the employment will be partially kept in V1 NPP and new opportunities for labour will arise for external work forces. From long-term point of view conditions for new industrial utilization of area with a potential of new employment will be created.
Safety and quality of life, project acceptance for affected municipalities	yes	+2	Nuclear installation will be removed and RAW will be safely stored, V1 NPP decommissioning is, in global percept by affected municipalities as acceptable.
Impact on rock environment	no		New disturbance/intervention in rock environment is not planned.
Impact on rock environment pollution	yes	+1	Partially contamination of rock environment (as well as ground water) by tritium will be reduced by removal of object No 800 (partial source of contamination) and remediation of this area.
Impact on climate	no		Project is not relevant to significant changes of green house gases production.
Impact on air	yes	-1	In short-term period and in local scale the dust – emission of particulate matters will increase during demolition of buildings and in-situ mechanical treatment of construction waste
Impact on water	yes	-1	During the decommissioning the discharges of RAL into surface water recipients will continue with decreasing trend in since of permits from CA
Impact on soil	no		The use of surrounding soils as well as the current soil erosion will not be affected.
Impact on soil contamination	yes	+1	In local scale state of soil inside the V1 NPP area will be improved by removal of buildings, contaminated places/soil and total remediation of area
Impact on fauna and flora and biotops	no		Project is planned inside of existing industrial territory, inputs and outputs from this project cannot change the current status surrounding fauna, flora and biotopes.
Impact on landscape – use of landscae	no		Also after the area release for next use still it will be an industrial use of landscape with the same landscape structure.
Impact on landscape - scenery	yes	+1	In short term period, until a new industrial complex will be developed, the scenery will improve by removal of some dominant structure.
Impact on protected areas, Natura 2000	no		Territory of NEC dont touch any protected area, there is the degree 1 of landscape and nature protection (according to Slovak Act on Landscape and nature protection). Although NATURA 2000 -Protected bird aea is located in vicinity of NEC (CHVÚ Špačinsko – nižnanské polia), the project will not influence the conditions on securing a favorable state of habitat of the migratory bird and bird of European importance, the Saker falcon (*Falco cherrug*) living here also during the operation of V1 NPP.

Tab. No. 7. Identification and evaluation of project impacts

Impact		Impact identification yes/no	Impact evaluation scale 1-5*	Comment/explanation
Impact on the territorial system of ecological stability		no		Project will not involve significant changes.
Impacts on urban complex and land use		no		Project will not involve significant changes.
Impacts on urban complex and land use		no		Project will not involve significant changes.
Impacts on cultural and historical landmarks		no		Not present in the area.
Impacts on archaeological paleontological localities and significant geological sites localities		no		Not present in the area.
Impacts on intangible cultural values		no		Project will not cause significant changes.
Other impacts	Impact on traffic	yes	-1	Part of RAW will be transported to National repository in Mochovce (RÚRAO), but the total max. number of shipments about 1500 during the whole decommissioning period (8-10 years) will not be significant regarding the frequency of traffic (max. 16 shipments a month).
	Impact on WMS	yes	-2	Big amount of conventional waste will be generated, but 85% portion of total amount will be reused in-situ for backfilling of wholes after buildings demolition (mainly concrete), about 15% portion will be recycled as a raw material (mainly metals). The existing WM facilities in SR will not be overloaded – 3% from total amount of conventional waste and 2% portion of free release RAW will have to be processed during the whole decommissioning period – together it will be about 20 thousand tons during 8 -10 years.

+ (plus) sign expresses a positive impact; - (minus) indicates a negative impact

10 SELECTION OF THE MOST SUITABLE ALTERNATIVE

The comparison of alternatives for the proposed activity shows alternative 1 as the more optimal solution because it takes into account the anticipated development of the site from the point of view of creating the conditions for the utilizations of equipment, systems of buildings of V1 NPP for these purposes. This alternative is also the most suitable from the technical point of view, because it is linked to the current status of the site and to the provisions for decommissioning. An important aspect from the current perspective, based on existing experience of decommissioning, is the preservation of experience and knowledge of the actually involved technicians, whose could be

effectively used for the successfully development of specific working procedures to achieve the final objective of the activity, minimizing environmental impacts and social annoyances.

Based on the following reasons, to implement the assessed Alternative 1 of the proposed activity is also recommending:

- The proposed activity represents at the Bohunice V1 site a continuation of the decommissioning process within the framework of its 2nd Stage in the period of 2015 – 2025. In course of the negotiations on the accession of SR to EU, SR committed itself to decommission V1 NPP. Interrupting the decommissioning process would represent a breach of international commitments of SR and, moreover, SR would lose the financial means granted from Bohunice International Decommissioning Support Fund.
- The proposed alternative 1 is in accordance with the accepted energy strategic and conceptual documents of SR and JAVYS.
- Interrupting the decommissioning process after the 1st stage of decommissioning would mean ineffective/ unreasonable utilization of financial means spent on the activities of the 1st stage and preparatory works for the 2nd stage of V1 NPP decommissioning.
- The proposed alternative does not constitute an intolerable/unbearable load on the environment of the affected area under the environmental perspective.
- The proposed alternative will in no way affect areas of nature and landscape protection according to the Act No. 543/2002 Coll. on protection of nature and landscape, as amended, or the area belonging to the European network of protected areas NATURA 2000 – SKCHVU054, special area of conservation Špačinsko-nižnianske polia protected pursuant to the Regulation of MžP SR No. 27/2011.
- Identified adverse impacts on the individual environmental parts are insignificant and of short-term character.
- Model calculations, based on the worst case scenario, have not shown a risk of adverse impacts on the affected population.
- An asset of the proposed alternative constitutes also the fact that, in long run, the present radiation load risk originating from the V1 NPP site will be eliminated.
- In the socio-economic sphere, positive short-term and a long-term potential impact of the proposed alternative, as opposed to the zero alternative, are expected, in particular in connection to workforce demand and employment and the release of the territory for further industrial use, offering the possibility to use the existing supply networks (infrastructure) and some existing facilities.

11 MITIGATION MEASURES TO PREVENT AND REDUCE THE ADVERSE ENVIRONMENTAL IMPACTS

The following matrix provides summary of information on mitigation measures to prevent or reduce the adverse environmental impacts.

Tab. No. 8. Identification of mitigation measures

Impact	Receptor	Mitigation measures	
		Kind	**Description**
Exposition to radiation	Employees	Preventive	Design/engineering and ensuring radiation protection to desire limit value Education and training of personnel Restrict of employees presence during some activities Control of employees movement Personal protection equipment (PPE) personal dosimetric control Medical examination, preventive healthcare
		Technical	Exchange of air in rooms Air filtration Shielding (protection barriers) Blocking system to enter certain rooms for certain activities Definition of the controlled zone
		Organisational	definition of the controlled zone proper disposal of all state of matter RAW subordination of other fields of activity of the Department of Radiation Protection RAW detention system Operational procedures and emergency schedules Monitoring plan approved by the regulatory body
Exposition to radiation	Employees	Technological	Use remote control technology Use the best technologies and technological processes tested in other cases
		Controlling	Monitoring levels of ionizing radiation according to the approved monitoring plan Personal dosimetry
	Population	Preventive	Designing radiation protection for the lower limit as indicated by the legislation Defined and subject to a limit radiation exposure of the population inform the public about the level of radiation exposure in the vicinity of Communication with affected municipalities
		Technical	Absorption of IT in the passive protection shield several times filtration air before municipal discharges into the atmosphere Treatment of liquid effluents to the desired limit before discharge to receiving Vah and Dudváh and traffic RAW in accordance with the requirements of legislation
		Controlling	Monitoring the activities of all outputs into the environment Monitoring activities V1 NPP according to the monitoring plan approved by the regulatory body Providing information to the public of the results of monitoring
	Air, Soil Ground water	Technical	air filtration in ventilation systems passive protection-shielding special sewerage secure storage of RAW
		Organizational	RAW detention system until the release of achieving levels of activity Control system of leak

Tab. No. 8. Identification of mitigation measures

Impact	Receptor	Mitigation measures	
		Kind	**Description**
		Controlling	Activity monitoring all media prior to release into the environment monitor relevant parameters in air, soil and groundwater, according to the approved monitoring plan
Dust	Employees Population Air	Preventive	Design of work processes, cleaning inside areas and roads, cleaning of transport mechanisms, sprinkling water
		Technical/ Technological	Implementation of BAT - modern shredders with safeguards technology "water jet"
		Organizational	Timing of the works and the organization of demolition
Pollution	Soil Rock environment	Organizational Preventive	Preventive maintenance of building and transport mechanisms to Prevent oil and technical liquids leakage Waste management under the law Bounded existing soil contamination near the construction site and prevent the spread of contamination, proper disposal of contaminated soils
		Corrective	In case of oil leakage and technical liquids used immediately remediation methods
Noise and vibration	Employees	Organizational	Timing of work, so that the least discomfort to workers in the area use mechanisms with low noise emissions and in good condition

12 PROPOSED MONITORING AND POST-PROJECT ANALYSIS

Monitoring of discharges in course of decommissioning will be carried out by a control measurement system of gaseous and liquid discharges. Monitoring of activities which are significant under the perspective of radiation protection has been already in place in accordance with the applicable regulations.

The most relevant monitoring systems to be carried out are as follows:

- Monitoring of discharges through the ventilation stack, including the measure of the following specific types of radioactive emissions:
    - Radioactive noble gases (Ar, Kr a Xe).
    - Radioactive aerosols with a longer decay period (> 24 h).
    - Radioactive ^{131}I, monitored separately by catching on selective sorbents.
    - Radionuclides in waste gases which play an important role in the assessment of impacts on the population, e.g. ^{3}H, ^{14}C, ^{90}Sr, ^{239}Pu.
- Monitoring of liquid discharges, including continuous measurements into the pipe collector Socoman.
- Monitoring of the environment in the surroundings of JAVYS. The most important component of the environment monitoring in the surroundings of JAVYS is the so called teledosimetric system which monitors:
    - Aerosols from continuous extraction

- Radioactivity of deposits
- Radioactivity of milk
- Radioactivity of drinking and surface waters
- Radiation control boreholes
- Radioactivity of agricultural products
- Radioactivity of soils
- In situ gamma spectroscopy measurements
- Measurement of dose equivalent rate of gamma radiation in teledosimetric stations
- Measurement of dose rates at all teledosimetric stations.

− Specific monitoring, taking as main aims:

- To provide control of impacts of NEC Bohunice operation on the groundwater as one of the environmental units
- To provide documentation for regular reports on the radiation situation of groundwater to control and supervisory authorities
- Continuous acquisition of data on radioactivity and hydro-geological situation of groundwater at the site and its surroundings in order to create a set of data for historical analysis and specification of reference levels
- Purposeful usage of the monitoring system, technical equipments and specialist employees in permanent alert for the case of emergency

− Monitoring of discharges of non-radioactive harmful substances presented in wastewater from the CZ into the environment.