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SUB-CONTRACTOR:

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

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PR No.: (operation project)

Revision No.: 1 Copy No.:

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APPROVAL SHEET

<table>
<tr><th></th><th></th><th>NAME</th><th>SIGNATURE</th><th>DATE</th></tr>
<tr><td rowspan="5">CONTRACTOR</td><td rowspan="2">AUTHOR</td><td>Antonio Laguna</td><td></td><td></td></tr>
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REVISION SHEET

Revision of this document will be made by exchange of the complete document including the title page with signatures. Replacement of the individual pages is not permitted.

The revision number is indicated in the header of all pages.

The reasons for the release of a new revision and/or main modifications in the actual revision and the pages concerned are recorded in the below list revision.

Number of Revision	Reason for Revision	Date
00	Initial version	09/09/2013
01	Revised on the basis of comments by the client from 16/09/13	11/10/2013
02	Revised on the basis of comments by the client from 23/10/13	02/11/2013

INTRODUCTION

The proposed activity is a part of a complex process of V1 NPP decommissioning and represents a continuation of planned, approved and partially implemented activities of the 1st Stage of decommissioning. In order to show continuity we provide basic information on the broader context of the proposed activity.

Decommissioning of V1 NPP is a complex project led by the State Nuclear and Decommissioning Company a.s., JAVYS and financed mainly from the Bohunice International Decommissioning Support Fund (BIDSF) and the National Nuclear Fund of SR. BIDSF was established by the European Commission, while the European Bank for Reconstruction and Development (EBRD) was designated administrator of the Fund.

The purpose of the planned V1 NPP decommissioning is to achieve a status that fulfils the criteria established for site release for further use. Accordingly, decommissioning of V1 NPP will be completed upon removal of all unnecessary and not usable buildings and equipments and release of the site for further use.

In line with the adopted Strategy of V1 NPP decommissioning, the process is organized in two subsequent stages:

1st Stage (July 2011 - December 31, 2014)

In 2006 - 2007, prior to the approval of V1 NPP decommissioning, Environmental Impact Assessment according to the Act No. 127/1994 Coll. on Environmental Impact Assessment, as amended (EIA Act) was carried out. This process covered the environmental assessment of three alternatives of decommissioning (Immediate decommissioning alternative; Deferred decommissioning alternative with safe enclosure under surveillance for 30 years; and Deferred decommissioning alternative with reactor safe enclosure for 30 years). These alternatives were compared to the zero alternative, which refers to the situation and consequences that would occur should the proposed activity not take place. The Final Statement issued by the Ministry of Environment of the Slovak Republic on 7th March 2007 selected Immediate Decommissioning of V1 NPP as the best suited option. This option represents immediate and continuous dismantling of equipment, demolition of buildings and preparation of the site for future use. The Final Statement served as basis for the decision of UJD SR (Nuclear Regulatory Authority of the Slovak Republic) No. 400/2011 (issued in July 2011) by which the 1st stage of V1 NPP decommissioning was authorised. The 1st stage, which shall last until December 31, 2014, will comprise removal of inactive components and demolition of buildings and equipments that will not be needed for future decommissioning activities (mainly demolition of cooling towers and dismantling of turbine hall equipment).

2nd Stage (January 1, 2011 - December 31, 2025)

The 2nd Stage of V1 NPP decommissioning shall focus in particular on dismantling of activated and contaminated components and any remaining structures and performance of some activities not finished in the 1st Stage. In order to assess in more detail the environmental impacts of all planned activities (under the Immediate Decommissioning Alternative) the Environmental Impact Assessment according to the Act No. 24/2006 Coll., as amended, is carried out, which was launched by submitting the Preliminary Environmental Study (PES) to the competent authority - MŽP SR (Ministry of Environment of SR) and going on by submitting this Environmental Impact Assessment Report.

Considering the fact that EBRD applies set rules for public participation the EIA documents will be made available to the public, for a period above the scope of the Act No. 24/2006 Coll., namely 120 days, during which members of public can send their written comments on the proposed activity to the Proponent, or more precisely, its representative, on the address:

Ing. Agáta Staneková

spokesman

Tomášikova 22

Bratislava 821 02

Tel.: + 421/33 531 5291

Mobile: 0910 834 204

E-mail: stanekova.agata@javys.sk.

Abbreviations

A1 NPP	Bohunice A1 Nuclear Power Plant
AKOBOJE	Automated Complex of Security Protection
ALARA	As Low As Reasonably Achievable
ANS	American Nuclear Society
AoC	Assembly of Contributors
ARSOZ	Integrated information system based on relational database ORACLE
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BAS	Backup Alarm Station
BIDSF	Bohunice International Decommissioning Support Fund
BIOCLAR	Biological Clarification Plant
Brownfield site	Abandoned, idled, or under-used industrial and commercial facilities in which expansion or redevelopment is sometimes complicated by real or perceived environmental contaminations.
BSC	Bohunice Radwaste Conditioning Centre
Buffer storage	It refers to an area where materials are temporarily left for logistics reasons
CA	California
D&D	Decontamination and dismantling
DDB	Decommissioning Data Base
DF	Decontamination factor
DFD	Decontamination for decommissioning
DG	Decommissioning group
DPS	Defined part of technological system (in Slovak: “dielčí prevádzkový súbor”)
DS	Decommissioning Strategy
DSIA	Decommissioning Stage I Authorisation
DSIIA	Decommissioning Stage II Authorisation
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIA	Environmental Impact Assessment
EMO NPP	Mochovce Nuclear Power Plant
EOP	Emergency Operational Procedures
EPRI	Electric Power Research Institute
EU	European Union
FCC	Fiber–Concrete Container
FL	Fragmentation line
FP LRAW	Final processing of liquid radioactive waste
FSAR	Final Safety Analysis Report
GA	Grant Agreement

GmbH	Gesellschaft mit beschränkter Haftung (company with limited liability)
GO	Governmental Ordinance
HLW	High level waste
HVAC	Heating, ventilation and air conditioning
I&C	Instrumentation and control
IAEA	International Atomic Energy Agency
IDO	Immediate Decommissioning Option
IERG	International Expert Review Group
ILW	Intermediate level waste
ISDC	International Structure for Decommissioning Costing
ISFS	Interim Spent Fuel Storage
IWP	Indoor areas Work Plans
JAVYS	JAdrová a VYraďovacia Spoločnosť – stands for Nuclear Decommissioning Company
KPI	Key performance indicators
LLW	Low Level Waste
LTP	Licensing Termination Permission
MCP	Main reactor Coolant Pump
MH SR	Ministry of Economy of Slovak Republic
MSVP	Spent Fuel Storage Facility
MW(e)	Megawatt (electrical)
MŽP SR	Ministerstvo Životného Prostredia Slovenskej Republiky – stands for Ministry of Environment of the Slovak Republic
NEA	Nuclear Energy Agency
NJF	Národný Jadrový Fond – stands for National Nuclear Fund
NNF	Nuclear National Fund
NPP	Nuclear Power Plant
NRR	National Radwaste Repository
NSSS	Nuclear Steam Supply System
OECD	Organisation for Economic Co-operation and Development
OWP	Outdoor areas Work Plans
PIS	Project Information Sheet
PMU	Project Management Unit
Pre-decommissioning	Internationally accepted term for the activities performed before decommissioning starts as the word itself means. These activities will be performed in the final stages of operation and during the operation termination period
PO SAR	Pre-operational Safety Analysis Report
PRZ	Pressurizer
Q	Quarter

QA	Quality Assurance
RA	Radioactive
Radioactive waste	The law No. 541/2004 Coll. on peaceful use of nuclear energy (Atomic Act) defines the radioactive waste (RAW) as any materials in gaseous, liquid or solid form for which no further use is foreseen, and that contains or is contaminated by radionuclides at concentration or activities greater than clearance levels into the environment.
RAI	Residual Activity Index
RAW	Radioactive Waste
RCS	Reactor Coolant System
Restricted use	The use of an area or of materials, subject to restrictions imposed for reasons of radiation protection and safety. Restrictions would typically be expressed in the form of prohibition of particular activities (e.g. house building, growing or harvesting particular foods) or prescription of particular procedures (e.g. materials may only be recycled or reused within a facility) (IAEA Glossary). For the restricted use of a site it should be ensured that, with restrictions in place, the effective dose should not exceed the dose constraint of 300 μSv in a year above background and that if the restrictions were to fail in the future the effective dose should not exceed 1 mSv in a year (IAEA Safety guide WS-G-5.1)
RP	Radiation Protection
RPV	Reactor pressure vessel
RWM	Radioactive waste management
SE	Slovenske Elektrarne
SFP	Spent Fuel Pool
SG	Steam generator
SHMU	Slovenský hydrometeorlogický ústav -Slovak Hydrometeorological Institution
SO	Civil Structure
Special waste	Radioactive waste not acceptable at Mochovce NRR
SR	Slovak Republic
SRAW	Solid Radioactive Waste
SSC	Systems, Structures and Components
SWG	Strategy Working Group (a group consisting of PMU Consultant and JAVYS working on V1 NPP Decommissioning Strategy update)
SWP	Special activities Work Plans
TD	Tender Dossier
TEDE	Total effective dose equivalent
TIS	Technological Information System
UJD SR	**Ú**rad **J**adrového **D**ozoru **S**lovenskej **R**epubliky, Nuclear Regulatory Authority of the Slovak Republic

Unrestricted use	The Use of an area or of materials without any radiologically based restrictions (IAEA Glossary). For the unrestricted use of a site, it should be ensured by means of the optimization of protection that the effective dose to a member of a critical group is kept below the dose constraint of 300 μSv in a year (IAEA Safety guide WS-G-5.1)
USA	United States of America
USDOE	United States Department of Energy
UVZ SR	**Ú**rad **V**erejného **Z**dravotníctva **S**lovenskej **R**epubliky, Public Healthcare Institution of the Slovak Republic
V1 NPP	Bohunice V1 NPP
V2 NPP	Bohunice V2 NPP
VARVYR	Public Warning and Notification System
VDL	High-capacity decontamination line
VLLW	Very Low Level Waste
VYZ	Branch of JAVYS, a.s. for Decommissioning of the nuclear facilities, Radioactive Waste and Spent Fuel management
VVER	Vodo-Vodyanoi Energetichesky Reactor; Water-Water Energetic Reactor
WWER	See VVER

CONTENT

A. BASIC DATA

I. Basic data on the Proponent

1. Name

Jadrová a vyraďovacia spoločnosť, a.s. (State Nuclear and Decommissioning Company,)

2. Identification number

Business identification number (IČO): 35 946 024

3. Registered office

Tomášikova 22

821 02 Bratislava

4. First name, surname, address, telephone number and other contact data of the authorized representative of the Proponent

Ing. Peter Čižnár
Chairman of the Board and Head Manager
E-mail: ciznar.peter@javys.sk
Tel.: +421/33 531 5340

Ing. Miroslav Obert
Vicechairman of the Board and Director of the Decommissioning Division V1 and PMU
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Tel.: +421/33 531 5266

Ing. Anton Masár
Member of the Board and Director of the Economy and Dealing Division
E-mail: masar.anton@javys.sk
Tel.: 033/531 5346

Ing. Ján Horváth
Member of the Board and Director of the Safety and Investments Division
E-mail: horvath.jan@javys.sk
Tel.: +421/33 531 5042

5. Name, surname, telephone number and other contact data of the person who can provide relevant information on the proposed activity and consultation possibilities

Ing. Agáta Staneková
spokesman
E-mail:stanekova.agata@javys.sk
Tel.: + 421/33 531 5291
Mob. tel.: 0910 834 207

II. Basic data on the proposed activity

1. Name

"2nd stage of decommissioning of the V1 Bohunice Nuclear Power Plant"

2. Purpose

Project is proposed in order to ensure continuation and completion of V1 NPP decommissioning process in Jaslovské Bohunice.

In April 2007, by issuance of the Final Statement by MžP, the Immediate Decommissioning (IDO) alternative for V1 Bohunice NPP decommissioning was adopted. The IDO alternative for decommissioning establishes two different phases: Stage 1 - dismantling and demolition of no more required equipment, systems and buildings out of controlled zone, and Stage II - dismantling of remaining elements back to the bottom of the foundation until to fully achieve the planned level site for restricted usage ("brown field", such as for a possible reindustrialization) of the site.

3. User

Jadrová a vyraďovacia spoločnosť, a.s. (JAVYS)

Tomášikova 22

821 02 Bratislava

4. Location (cadastral district, parcel index)

Region: Trnava

District: Trnava

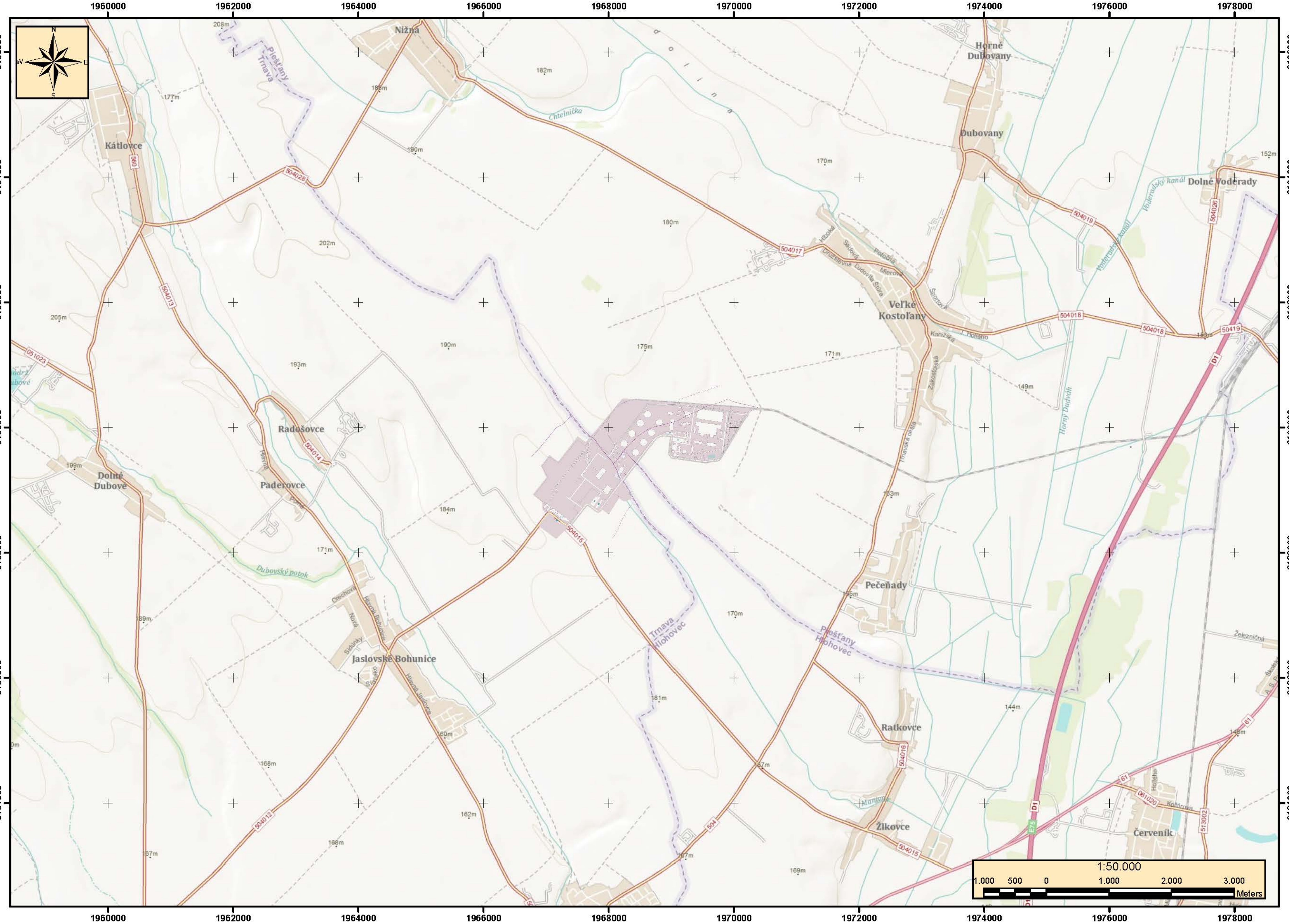
Municipality: Jaslovské Bohunice

Cadastral territories: Jaslovské Bohunice, Veľké Kostolany, Ratkovce and Pečeňady

5. General situation of the location of the proposed activity (scale 1: 50 000)

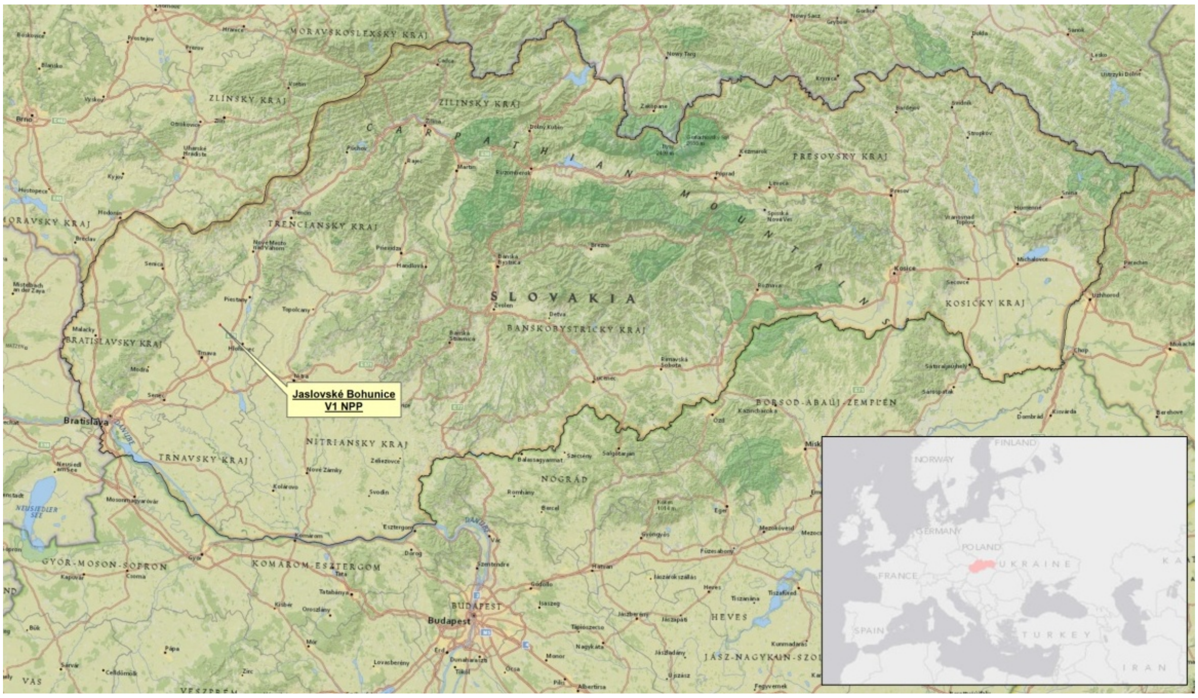
The location of the activity is defined by the area of the nuclear energy complex of Jaslovské Bohunice. Possible impacts arising from the proposed activities on the natural and anthropogenic components of the environment and the population will be evaluated in a broader potentially affected area.

Graph No. 1. Location of the proposed activity (scale 1: 50 000; cartographic base)



Graph No. 2. Location of the proposed activity - ortophotographic map (scale 1: 50 000; ortophotographic base)

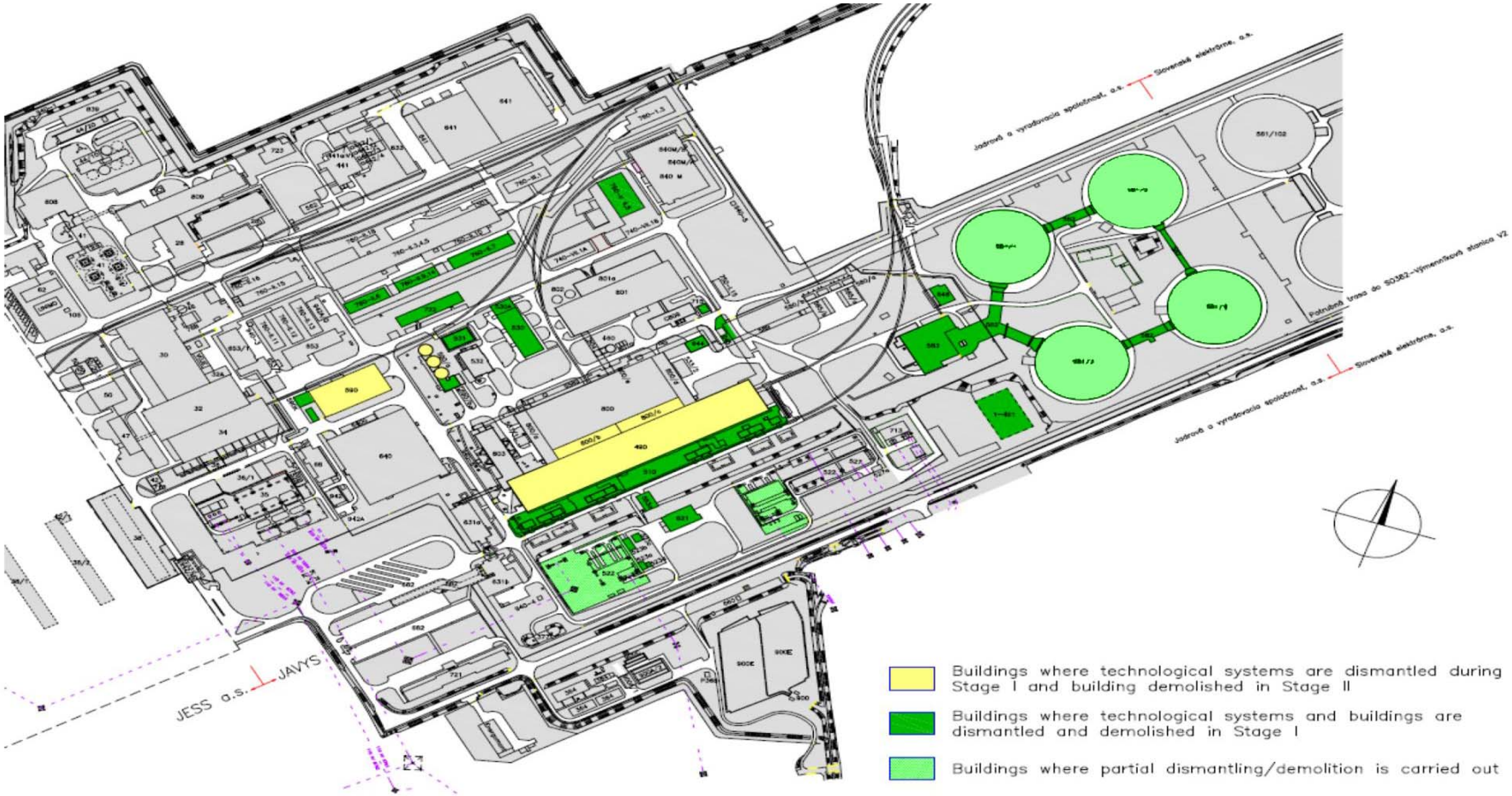
Graph No. 3. Location of the nuclear energy complex of Jaslovské Bohunice in the Slovak Republic



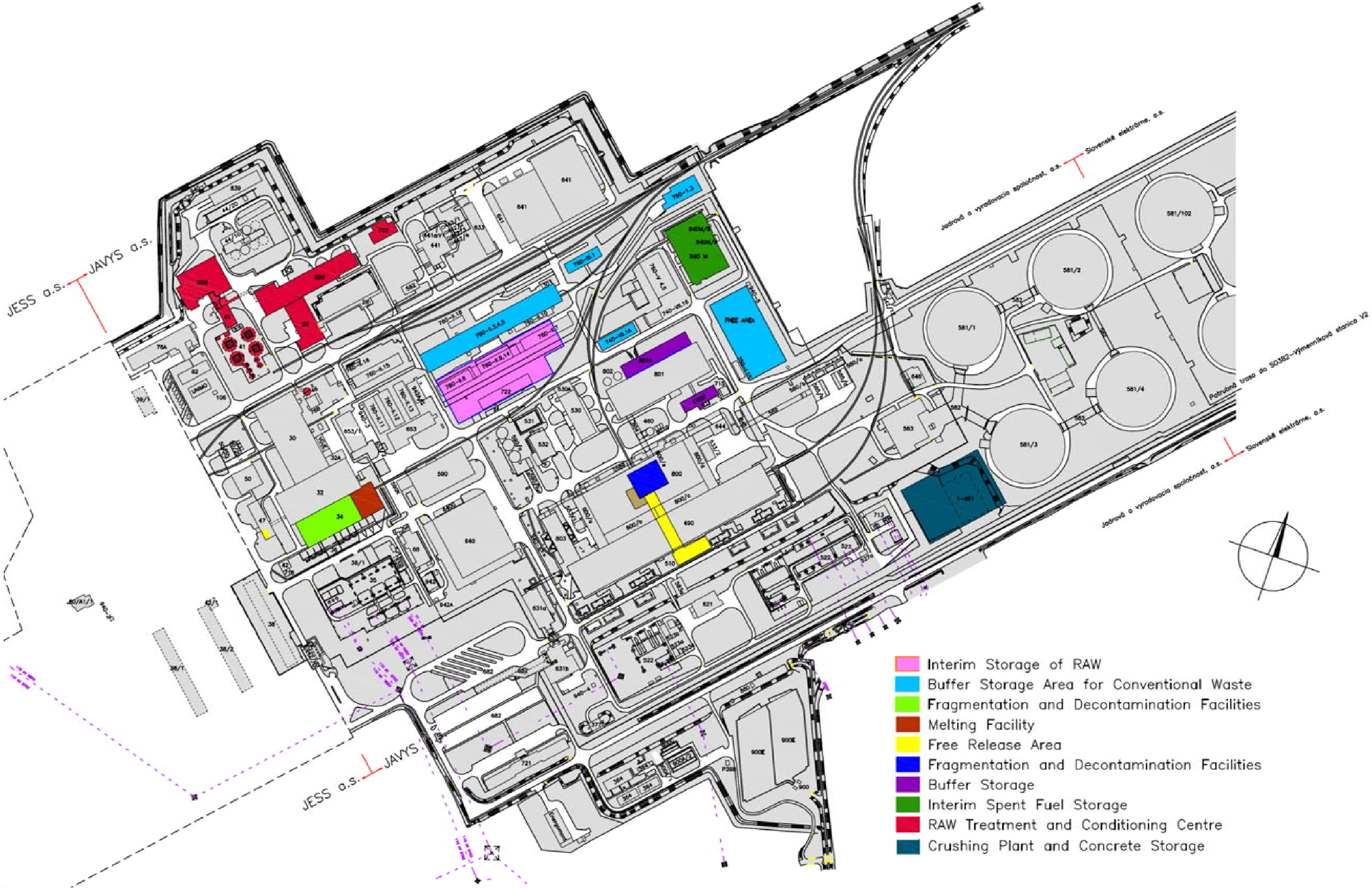
Graph No. 4. Area of V1 NPP within the nuclear energy complex of Jaslovské Bohunice

Graph No. 5. Area within a radius of 5 km around the centre of the proposed activity

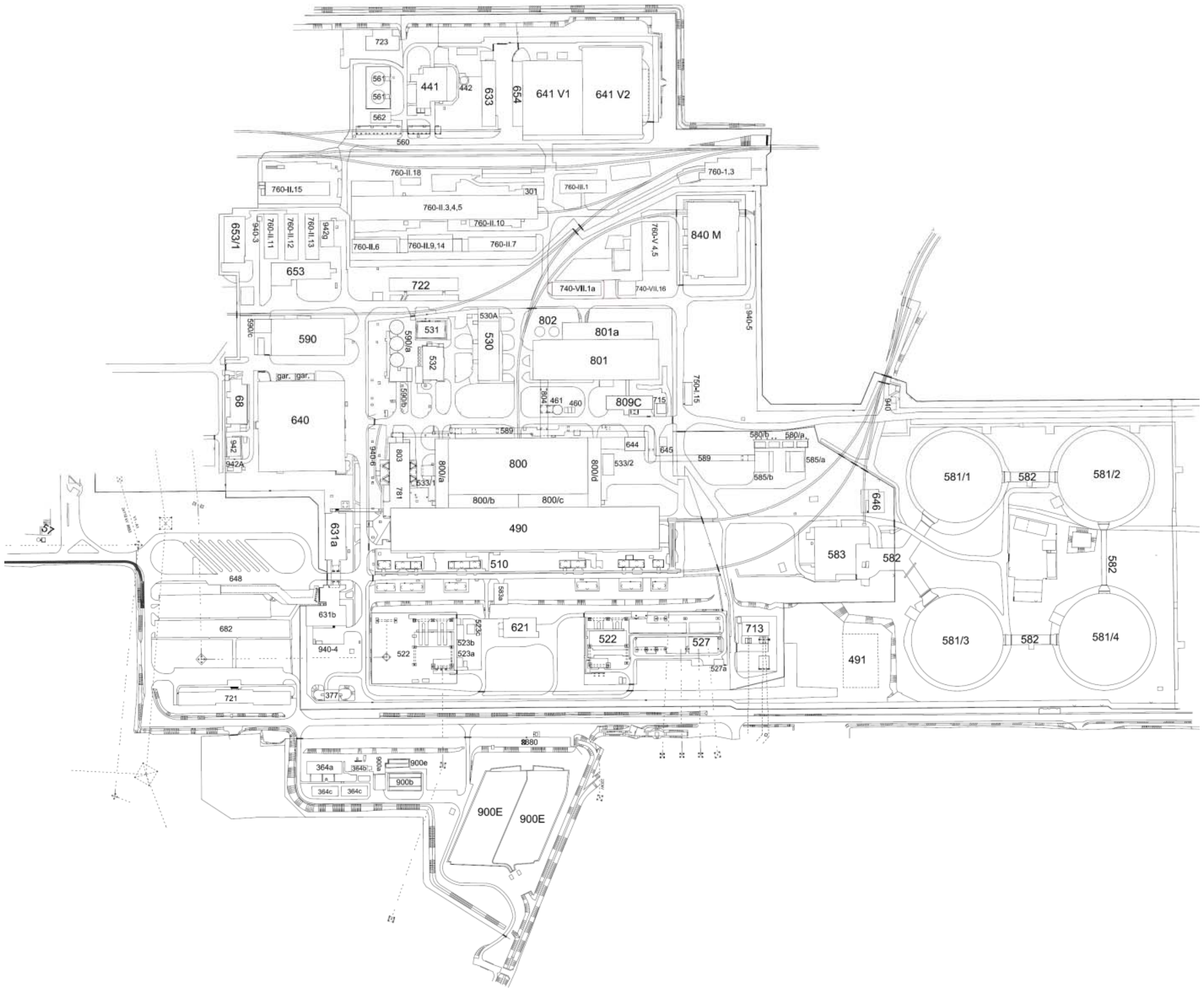
Graph No. 6. .NPP status at the end of the 1st Stage of V1 NPP decommissioning



Graph No. 7. Ground plan of auxiliary facilities for the 2nd stage of V1 NPP decommissioning



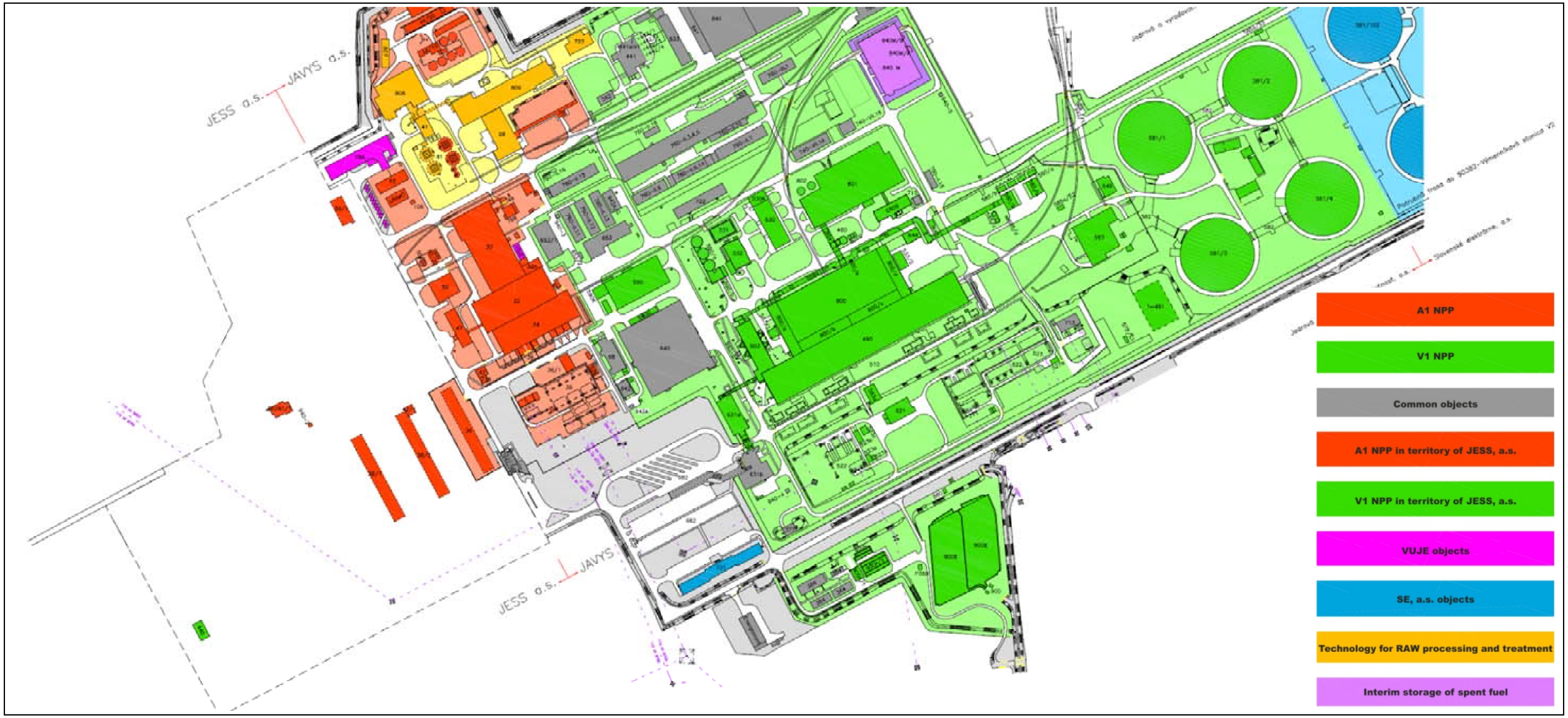
Graph No. 8. Ground plan and V1 NPP buildings



No.CB	NAME
364a	Sump and sewage waters purification plant -BIOCLAR
364b	Sump and sewage waters purification plant
364c	Sump and sewage waters purification plant
377	Drinking water pumping station and water reservoir
441	Reserve boilrer house
442	Boiler house chimney
460	Ventilation stack
490,491	Turbine hall and turbogenerator foundation
522	External switching station
523a	House of relay protection
523b	Compressor plant of switching station- partially
527	External switching station 110kV
527a	House of relay protection 110kV
530	Dieselgenerator station
531	Fuel oil system
532	Compressor station and central cooling station
533/1	Cooling station of emergency ventilation system-unit 1
533/2	Cooling station of emergency ventilation system-unit 2
561	Heating oil tanks
562	Heating oil machine room
581	Coling towers (two)
582	Channels for cooling water piping
583	Cooling water pumping station
583a	Blowdown of circulating circuit
583/1	Pumping station for emptying cooling water piping
589	Aboveground essential service water collector
590	Chemical water treatment
590a	Demineralised water tank
621	Lub-oil system
631a	Administration building
631b	Dining room and gate
633	Civil structures maintenance
640	Workshops and storehouses
641	Storehouses of metallic material,spare parts and valves
644	Hydrogen storages
645	Nitrogen storages
646	Hydrochlorid acid dosing, V1 NPP
653	Fire fighting station
713	Transformer station
723	Store of solidified RAW
781	Defense shelter
800	Reactor building
800a,b,c,d	Reactor building
801,801a	Nuclear auxiliary building
802	Clean condensate tanks
803	Operating building
804,461	Interconnecting bridge between buildings 800 and 801
880	Building of waste waters activity measurement
900a,b,c,e,E	Waste industrial water disposal
940	AKOBOJE

Graph No. 9. Plant status at the end of 2nd Stage of V1 NPP decommissioning

Graph No. 10. Current status of the NEC Bohunice



6. Reasons for location in the given place

According to Government Decree of SR No. 801/1999 and in accordance with the conditions of the Accession Treaty to the European Union, the first unit of V1 NPP was shut down on 31st December, 2006 and the second unit of V1 NPP on 31st December, 2008. Nowadays, there are two additional nuclear units located and operated at the Bohunice site(JE V2 – operated by SE, a.s. – plant EBO V2), which were commissioned in the years 1984 and 1985. JAVYS also operates the following nuclear facilities at this site: ISFS, RWTC and a nuclear power plant (NPP A1) in decommissioning process.

The only possible location for the proposed activities related to dismantling of equipment and demolition of facilities of V1 NPP is the site of the NPP itself.

An effective and first of all secure way of management of generated RAW implies the placement of new facilities for processing and conditioning of waste as closest as possible to the source of their generation, within the controlled area of V1 NPP. After slight adjustments premises for processing and conditioning of generated waste will be also at disposal. Significant advantages of this location of activities related to generated waste follow from its proximity to RAW treatment technologies in operation on place and to existing transport corridors.

7. Date of beginning and termination of the construction and operation of the proposed activity

The 2nd stage of V1 NPP decommissioning is to start, according to schedule, in January 2015 and finish in December 2025. The time schedule of the 2nd stage of decommissioning is shown in Annex 1.

8. Brief description of the technical and technological solution

The main purpose of the 2nd Stage of V1 NPP decommissioning is to achieve in full the planned condition of the site for further restricted use ("Brownfield") through complex dismantling of systems and equipments.

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, 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.

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

a.) Groups of main activities in the Stage II 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.
- Modification and processing.
- Storage.
- Transport.

- Final disposal in the repository.
- Decontamination of structures.
- Demolition of structures.
- Release of decommissioned materials into the environment.
- Adjustments, final review and release of the site for further use.

b.) Groups of auxiliary activities

- Management of other and hazardous waste.
- Licensing activities.
- Modification of systems and equipment for decommissioning purposes.
- Operation, control and maintenance of auxiliary systems.
- Safety (safety and health protection at work (SHPW), fire protection (FP), nuclear, physical security).
- Radiation protection.

The most important activities belonging to the above mentioned groups:

- 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-size components of the cooling system.
- Dismantling of systems in the controlled zone.
- Dismantling of systems outside 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, modification, 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 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 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 the 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.

Activities connected to system dismantling and demolition works comprise in particular the following: provision of the required documentation, necessary technical and technological equipment, classification and separation of waste and metal components as well as handling of materials and waste depending on their character (recycling, reuse or disposal).

8.1 Preparation and dismantling (of reactors, PC equipment and other equipment in and out of the controlled zone (CZ))

8.1.1 Activated equipments

After dismantling, activated equipments constitute usually medium active RAW that due to very high dose rates require remote cutting (either by means of dry or under water cutting equipment) as well as biological protection during transport and storage. Owing to the activation character decontamination is not possible and hence release of such waste into the environment is not possible either, with the only thinkable options being its disposal in the repository or storage.

Activated equipments are:

- Reactor pressure vessel.
- Internal reactor components.
- Annular water tank.
- Shielding cartridges of the active reactor zone.
- Absorbers of control rod assemblies (HRK) and connection rods.
- Racks of the storage pond of spent nuclear fuel.

8.1.2 RPV (Reactor pressure vessel)

Preparatory activities shall include every necessary activity for the correct performance of dismantling activities. This point includes scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

8.1.2.1 *Drainage of reactor vessel water*

Before starting reactor vessel lifting operations, drainage of the reactor vessel water shall be performed according with plant procedures.

8.1.2.2 *Dry cutting area preparation*

Several interferences shall be removed prior to RPV segmentation in the dry cutting area located in level -1.80 m.

First of all, Steam generators and Main coolant pumps, as well as all other equipment (valves, structures, pipes, etc.) shall be removed, so to eliminate any interference and allow enough room for the cutting station installation.

8.1.2.3 *Civil works*

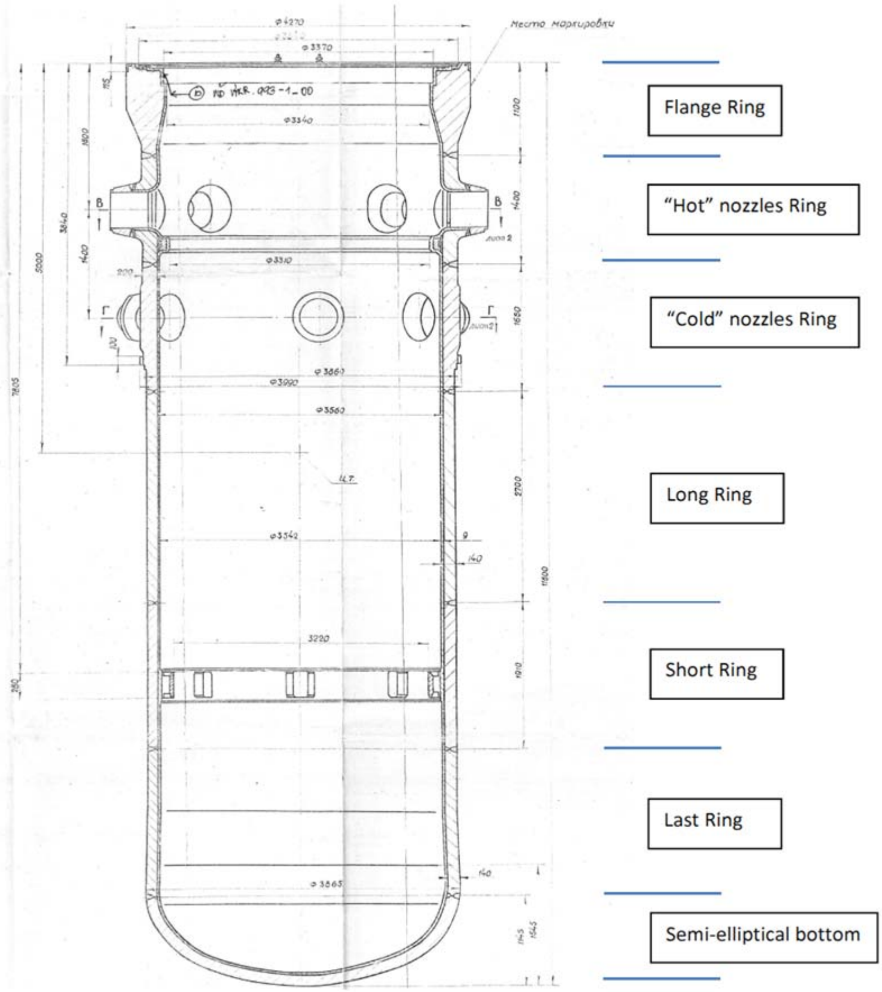
Pressurizer wall shall be removed between elevations -1.80 and +10.50 m., because it interferes with the secondary cutting station and packing station location.

As well, the RPV dry cutting zone implantation shall be verified according loads transmitted to the concrete slabs

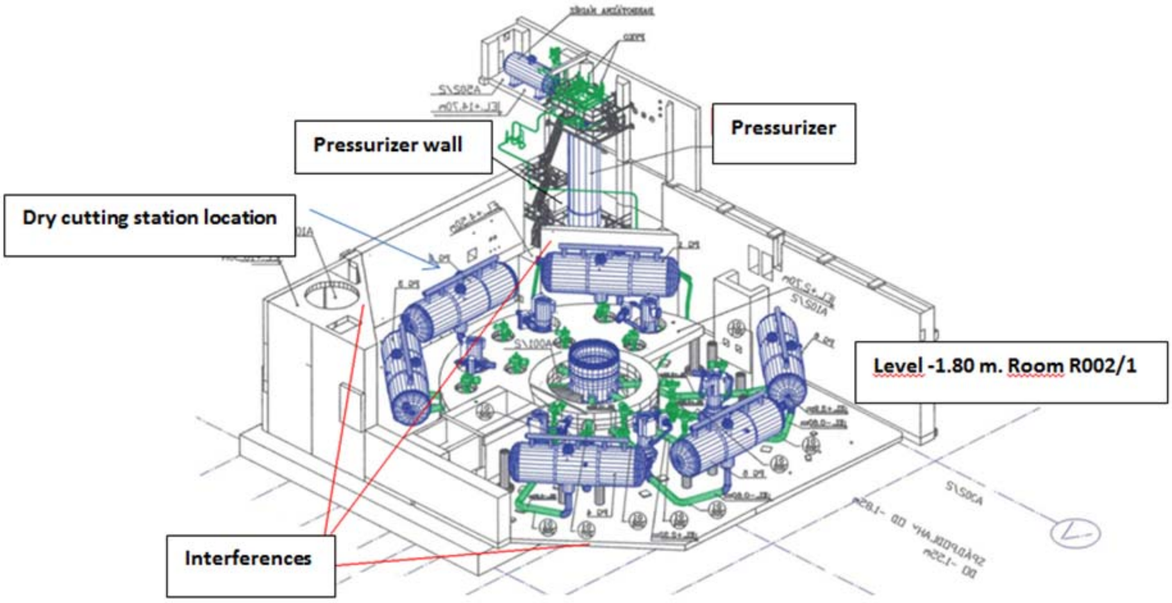
The RPV dismantling sequence contains the following main phases:

- Preparatory works.
- Mock-up and tests.
- Dry cutting zone preparation.
- RPV lifting and transportation to the cutting area situated in the SG-MCP bay (room R002/1).

Graph No. 11. Schematic drawing of reactor type V230 RPV body



Graph No. 12. Level -1.80 m. Equipment to be removed



8.1.2.4 *Preparatory works*

- Reactor internal structures extraction and fragmentation (see section 8.1.1.2).
- Level -1.80 m. clearance of material (see section 8.1.1.5):
  - Steam Generators removal.
  - MCP removal.
  - Valves, piping, structures removal.
  - PZR and bubble tank removal.
- Pressurizer wall removal in elevation -1.80 m.
  - Demolition equipment lowering to level -1.80 m to free area after equipment dismantling in level -1.8m.
  - Wall demolition.
  - Equipment removal.
- RPV separation from hot and cold legs:
  - Area preparation.
  - Automatic pipe cutter installation.
  - Remote control facilities implantation (Local control center).
  - Pipes cutting.
  - Equipment removal.
- RPV separation from other connections to other systems structures.

8.1.2.5 *Mock-up and tests*[1]

- Crane tests (Load test, emergency blocking test).
- Lifting means load tests.
- Structures integrity and structural analysis (structures load tests, civil structures analysis).
- RPV mock-up:
  - Area preparation.
  - RPV Mock-up manufacturing.
  - RPV Mock-up transportation.
  - Cutting station implantation.
  - Cutting process development.
  - Packing process development.

[1] Mocks-ups shall be done to perform the testing of the tools and processes for dismantling works. These tests shall be done in the workshop representing the execution conditions, for that it is required to manufacture large scale models of the applicable equipment. Mock-ups testing shall be detailed designed in further design steps.

- Mock-up test report elaboration.
- Authorized expert's approval.

8.1.2.6 *Dry cutting zone preparation*

- Erection aperture on top of Steam Generator PG15 slab removal (if not done previously).
- Structures installation in level -1.80 m.
- Turntable installation.
- Shielding gates installation.
- Containers lowering to level -1.80 m.
- Manipulators installation.
- Horizontal band saw installation (primary cutting zone).
- Vertical band saw installation (fragmentation).
- Radiation background sensors installation.
- Gas filters and exhausts installation.
- Remote control facilities implantation (Local control center).

8.1.2.7 *RPV lifting and transportation to the cutting area situated in the SG-MCP bay (room R002/1)*

Before proceeding to the RPV transportation, the following activities shall be performed:

- Main lifting devices preparation (traverse beam, slings, hoists, shackles).
- Transportation route clearance. Working areas delimitation and marking.

Vessel transportation shall imply the following main activities:

- Traverse beam connection to the bridge crane hoist.
- Traverse beam connection to the RPV.
- RPV water drainage.
- RPV lifting.
- RPV transportation to the R002/1 area.
- RPV lowering over turntable and structure.
- RPV fixation.

Note: Both RPVs shall be dismantled in the same area.

8.1.2.8 *Testing*

8.1.2.8.1 On-site testing

Manipulation means shall be tested before activities start date. Reactor Hall crane (250 T) shall be load tested, according applicable codes and standards. Regarding commercial lifting means, such as slings, hoists, shackles, etc., this equipment shall present their corresponding certificates, including maximum load and utilization instructions.

8.1.2.8.2 Workshop testing

Prior to dismantling activities, a Mock-up testing shall be performed, in order to obtain operative experiences, such as:

- Elaboration, optimization, and implementation of the dismantling concept.
- Simulation of all cutting steps as a basis of a safe cutting procedure as well as for high availability and performance.
- Simulation to demonstrate collision-free operation and accessibility of all cutting areas as well as implementation of locking and interlocking systems
- Times estimation and performance ratios.
- Short technical examination periods of documentation and equipment for all relevant cutting steps with mock-up testing.
- Development of back-up techniques.

The major aims of the dismantling mock-up are the testing of the tools and working processes to guarantee the adherence to the protection goals for the later cutting of the active components as well as the technical feasibility. By an extensive test programme in the presence of the authorized expert it will be proved that the used tools are suitable and a technical optimization of the individual steps can be achieved.

Mocks-ups shall be done to perform the testing of the tools and processes for dismantling works. These tests shall be done in the workshop representing the execution conditions, for that it is required to manufacture large scale models of the applicable equipment. Mock-ups testing shall be detailed designed in further design steps.

Special emphasis shall be given to the expected radiation exposure of the personnel, the maximum application time of the tools and the minimization of the secondary waste.

After performance of each test, a corresponding test report will be prepared. The test report evaluates the results of the test. The aim of the test report is to give the evidence that the technological processes with personnel participation under active conditions are performed under adherence of the limit and guide values of radiation protection and the facilities and equipment are qualified for the work.

The test report shall include the following information about each test step:

- Description for each test step.
- Information about dose expectation on the basis of the calculated ambient dose rate at the working places of the activated components, taking into account real times taken during mock-up and information on the efforts for the performance of the test steps during model dismantling.

- Summary information on the qualification of the newly installed facilities and equipment.

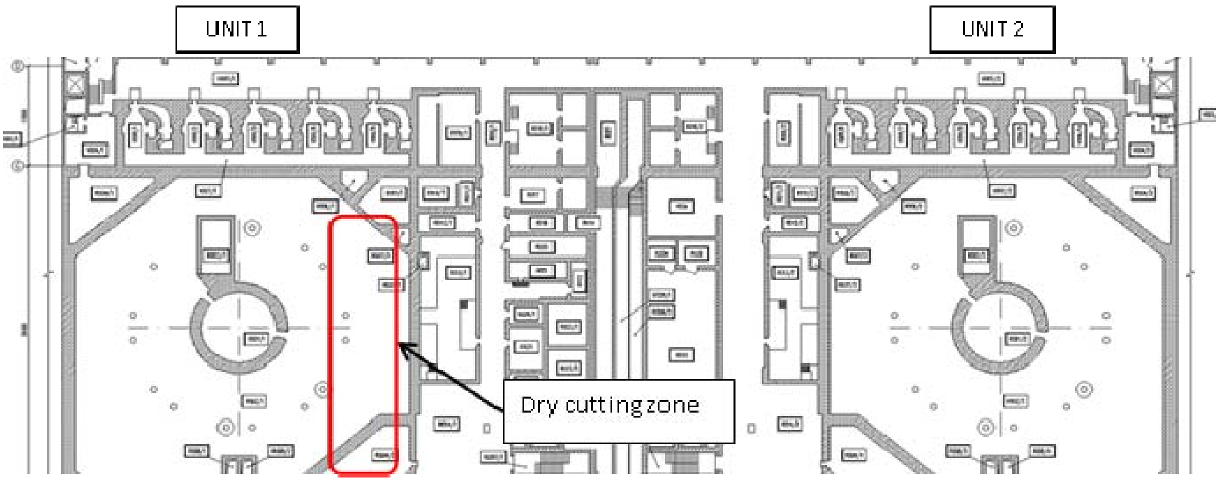
On the basis of the reports for each test process, the final report will be prepared and submitted to the authorized experts for approval.

8.1.2.8.3 Dismantling location

A dry cutting zone is arranged at V1 for the purpose of fragmenting the reactor pressure vessel.

The dry cutting zone is arranged in the Steam Generators & Main Coolant Pumps bay (SG-MCP bay) (room R002/1), level -1.80 m, which shall be free from equipment for the dismantling operations.

Graph No. 13. V1 NPP reactor building. Level -1.80 m. layout

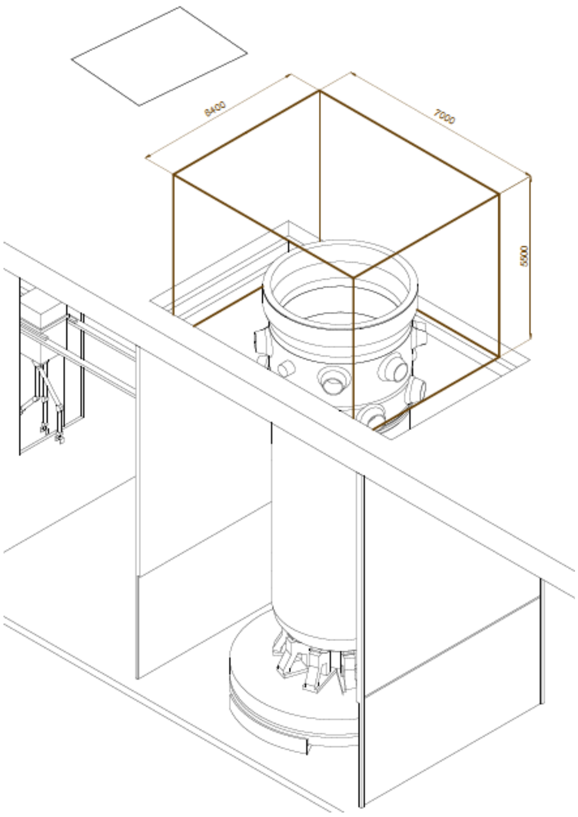


The cutting zone shall be common for both RPVs, and established in reactor nº1. The reactor pressure vessel dismantled from its regular position is lowered through the erection aperture into the SG-MCP bay. A 5 m high 4500 x 4500 mm protective dome is erected over the erection aperture. The dome structure has a “connection” harness which serves as a mediator between the RPV transport traverse and the hook of the 250 t central hall crane. The reactor pressure vessel is slung by the central hall crane through the protective dome.

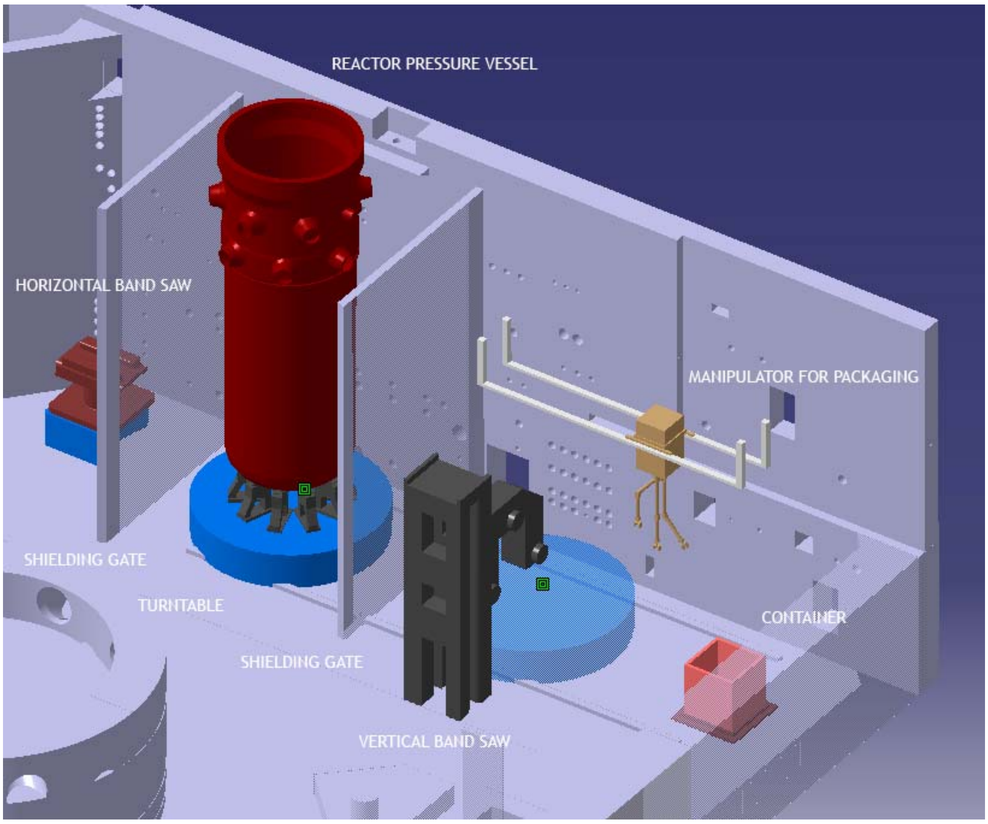
The dry cutting zone is a series of independent work areas separated from one another by protective gates. It is divided into three different areas:

- Primary cutting area;
- Fragmentation area;
- Packaging area.

Graph No. 14. Protective dome



Graph No. 15. Dry cutting area. 3D view



The dry cutting zone consists of a set of the following components:

- Horizontal band saw (primary cutting area).
- Vertical band saw (secondary cutting area).
- Transportable turntable with fixing brackets.
- Gripping manipulators for packaging.
- Radiation background sensors.
- Lifting mechanisms, wire ropes and traverses.
- Gases filters.
- Shielding walls, gates, and manholes.

8.1.3 Reactor internals (RIS)

The reactor pressure vessel (RPV) is a cylindrical vessel with an elliptical bottom head and a removable hemispherical top head called reactor head. The RPV contains the reactor internals structures (RIS) that were designed to arrange and control the coolant flow, and also for supporting fuel assemblies and guiding control rods during the operation of the plant.

The RIS consist of the following associated support and alignment devices:

- Protective Tubes Unit (PTU).
- Core basket.
- Barrel (reactor cavity).
- Barrel Bottom (cavity bottom).

Annex 7 shows the location of the internal parts of the reactor in the RPV and overview of the block protective tubes. Typical configuration of the reactor VVER 440 type V-230 is given in Annex 8.

8.1.3.1 *Protective Tubes Unit (PTU)*

During the operation of the reactor, the PTU served to protect the fuel assemblies and the core basket from moving in the ascending direction of the coolant flow. Additionally, the PTU was used to hold the fuel assemblies according to the triangular lattice, with defined gaps between them to allow the thermal dilation of the assemblies and avoid coolant flow blockage.

8.1.3.2 *Core Basket*

Core basket served mainly for precise positioning of fuel assemblies and control rod elements inside the reactor and to uniform the distribution of coolant into individual elements.

8.1.3.3 *Barrel (reactor cavity)*

The barrel (also known as reactor cavity) is a vertical cylindrical vessel that slides down inside of the RPV. The barrel contains all the RIS and ensures their centering and correct position. Toward the bottom of the core barrel, there is the core basket on which lower support plate the fuel assemblies were inserted during the operation. Below the core basket is located the barrel bottom. The barrel is fixed by eight guide grooves impeding its rotational moment and vibration. The guides are welded tongues located on the internal RPV surface.

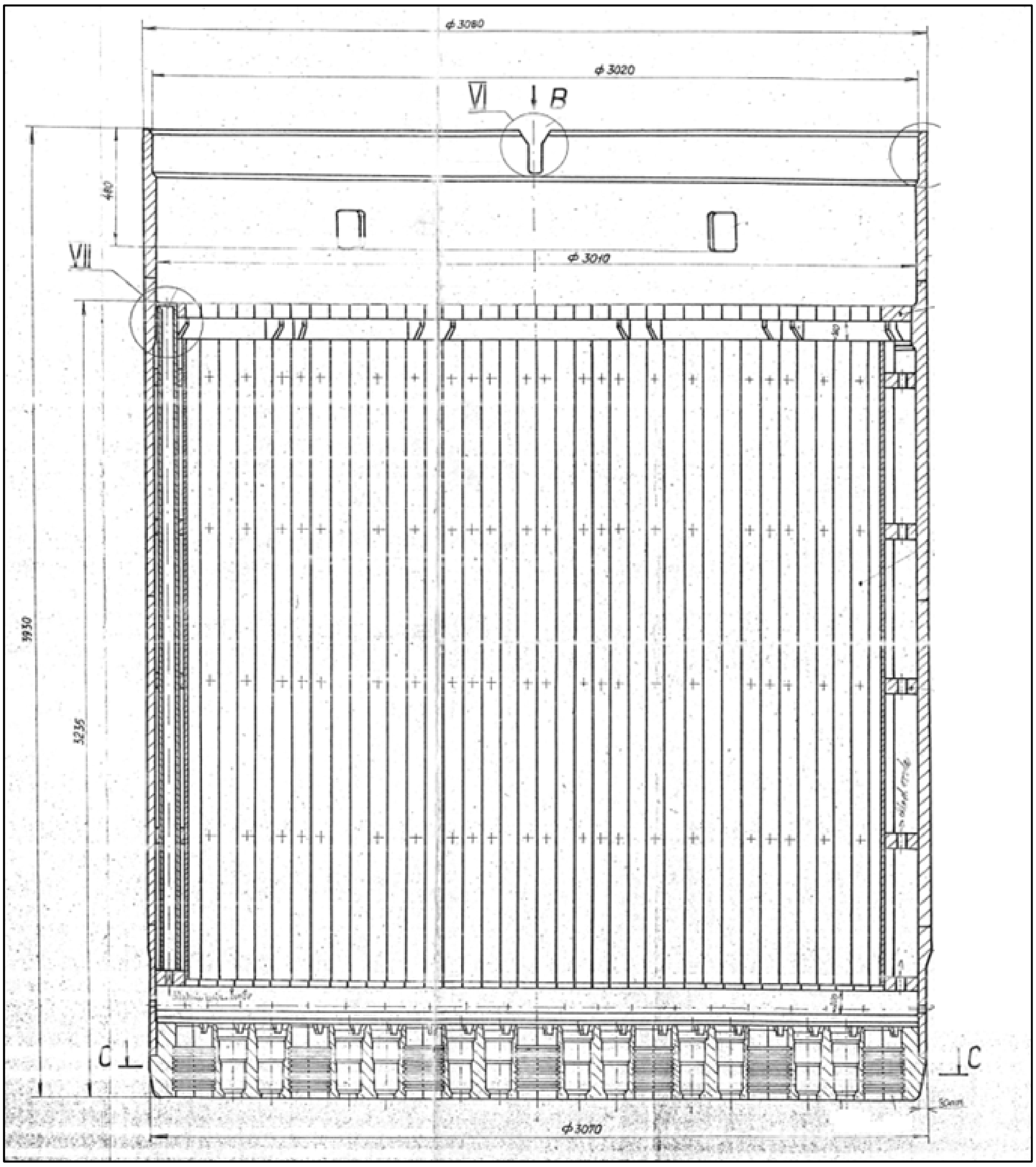
For descriptive purposes the barrel can be divided in four parts:

- Upper part, allows the barrel to be inserted and retrived out of the RPV.
- Mixing chamber region.
- Reactor Core region.
- Lower part – allows the positioning of the barrel bottom, its centering and it also serves to preclude the rotation of the barrel bottom.

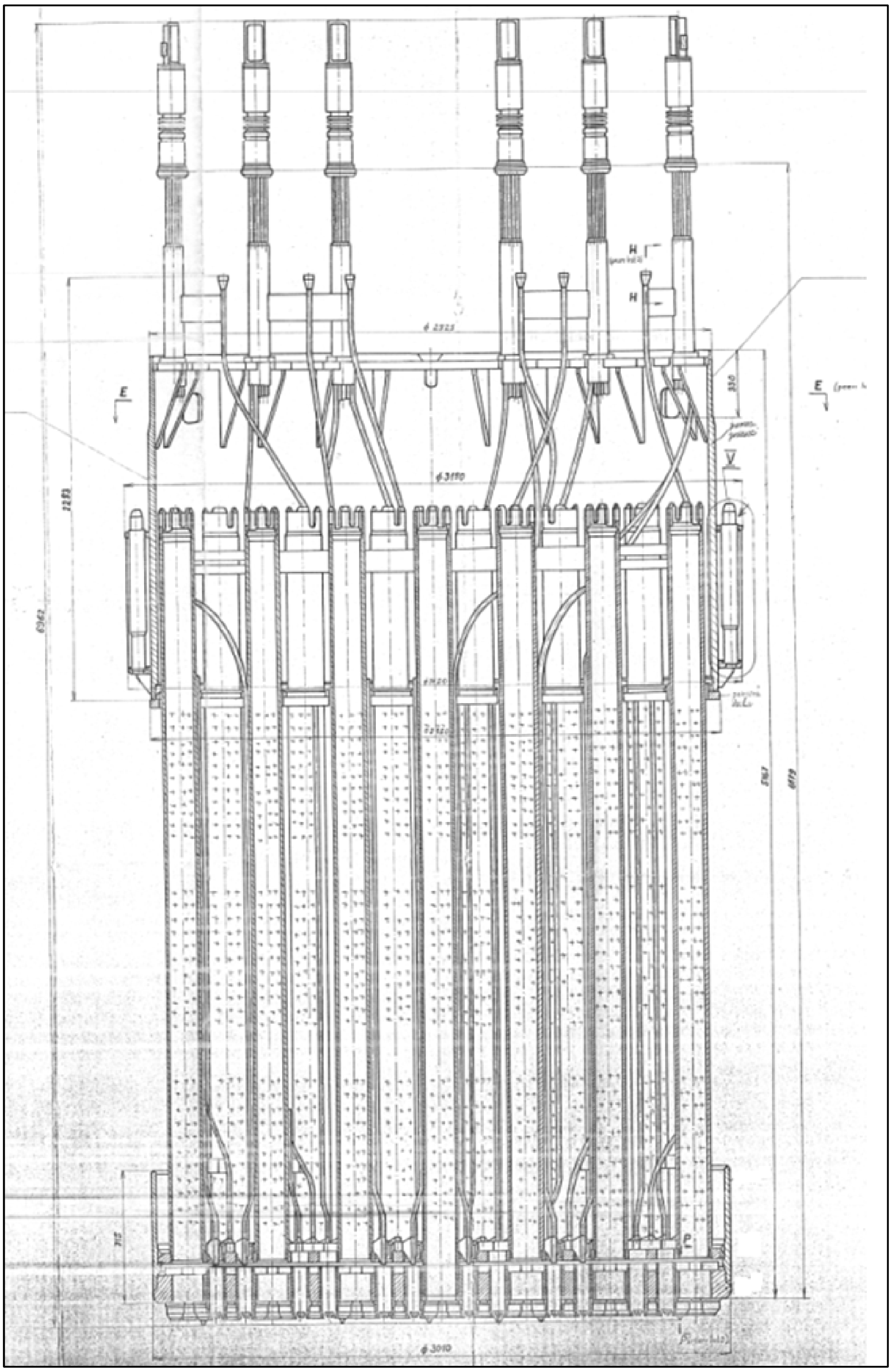
8.1.3.4 *Barrel Bottom*

The bottom part of the barrel (cavity bottom) is hung in the barrel and supports the core basket. Coolant flow rate speeding profile was balanced and attenuated inside the barrel bottom.

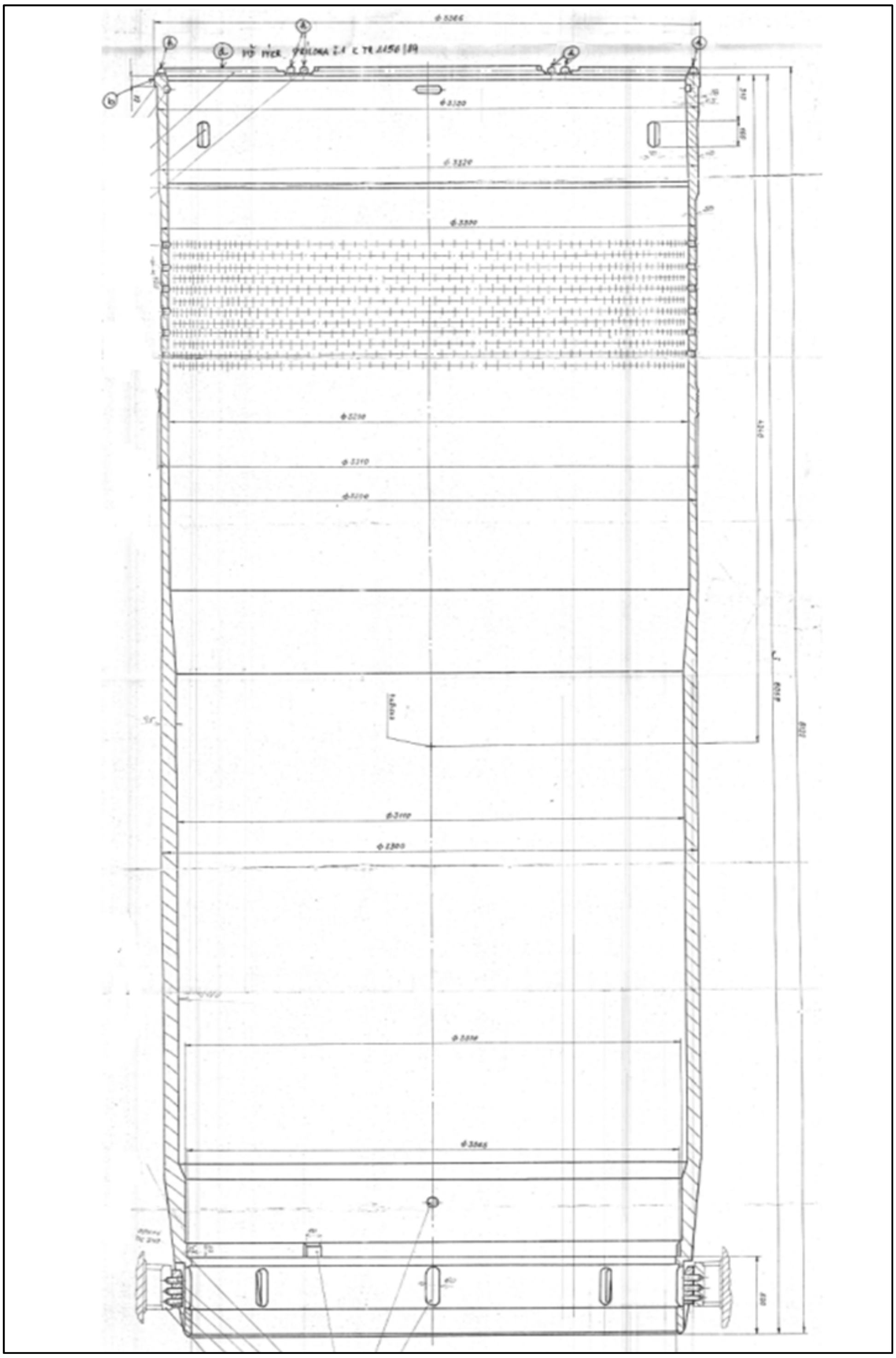
Graph No. 16. Core basket



Graph No. 17. Protective Tube Unit.



Graph No. 18. Reactor Barrel.



8.1.3.5 *Preparatory and dismantling works*

The RIS dismantling sequence includes the following phases:

- Wet cutting zone preparation.
- Mock-up and tests.

- Preparatory works.
- RIS lifting and transportation to the cutting area situated in the SG-MCP bay.

8.1.3.6 *Wet cutting zone preparation*

- Erection aperture slab removal.
- Packaging area implantation.
- Room R002/1 equipment installation: Fixing structures, transportable turntable, manipulators, lifting devices, etc.
- Shielding gates installation.
- Pool installation, assembly, welding and testing.
- Water cleaning system installation into the pool.
- Cutting devices installation.
- Manipulators installation.
- Radiation background sensors installation.
- Pool flooding.
- Remote control facilities installation.

8.1.3.7 *Mock-up and tests*

- Crane tests (Load test, emergency blocking test).
- Lifting means load tests.
- Structures integrity and structural analysis (structures load tests, civil structures analysis).
- Water filtration unit test. Change and filter disposal.
- RIS mock-up:
    - Area preparation.
    - RIS Mock-up manufacturing.
    - RIS Mock-up transportation.
    - Cutting station implantation.
    - Cutting process development.
    - Packing process development.
    - Mock-up test report elaboration.

8.1.3.8 *Preparatory works*

- RV Head removal
    - RVH Rigging and Guides installation.
    - RV Head un-bolting.
    - RVH lifting and transfer to actual or new storage position.

- Verification of water level.
- Removal and storage of RVH guides.

8.1.3.9 *RIS lifting and transportation to the cutting area situated in the SG-MCP bay*

Before proceeding to the RIS transportation, the following activities shall be performed:

- Room R002/1 material clearance: Steam Generators and Main Coolant Pumps removal.
- Main lifting devices preparation (traverse beam, slings, hoists, shackles).
- Transportation route clearance. Working areas delimitation and marking.

RIS transportation by RIS container shall imply the following main activities:

- RIS container lifting and transportation to the RIS location.
- RIS connection to container.
- RIS lifting and transportation to wet cutting station.
- RIS lowering over turntable (container shall assure radiological protection over water level).
- RIS fixation to turntable.
- Container disconnection.

Note: Both RIS shall be dismantled in the same area. The abovementioned sequence shall be the same for PTU, Barrel, Core Basket and Barrel Bottom parts

BOR - KVCR is designed for the following purposes:

- Transport, locations and lifting Block protective tubes (BOR), trash core, reactor cavity, the lower part of the shaft or shafts with its bottom.
- Radiological safety of operating personnel during transport RIS and RIS control functional parts.

The container includes a lifting device and roller cover.

The operation description is as follows:

During the emplacement or lifting operations of RIS, the container KVČR is set down and placed on the RPV flange using the 250/32/2 tons bridge crane. The 250 tons bridge crane hook block is attached to the eye lifting bracket of the lifting device. When removing one of the RIS and after interlocking it to the container cylinder, the corresponding RIS is drawn in the protection container KVČR (axial position is selected depending on the radiological characteristics of the RIS, (i.e. core basket, PTU, Barrel, Barrel Bottom). RIS transport container KVČR actuators are remotely controlled from stationary consoles. Then the 250 tons bridge crane transport the container KVČR containing the RIS is able to transport the RISGeneral view of the RIS container (KVČR) / Similar Lifting device / Remote Sampling Add attached to the RIS Container KVČR during RIS characterization (B6.4 Project).

Graph No. 19. General view of the RIS container (KVČR) / Similar Lifting device / Remote Sampling Add attached to the RIS Container KVČR during RIS characterization

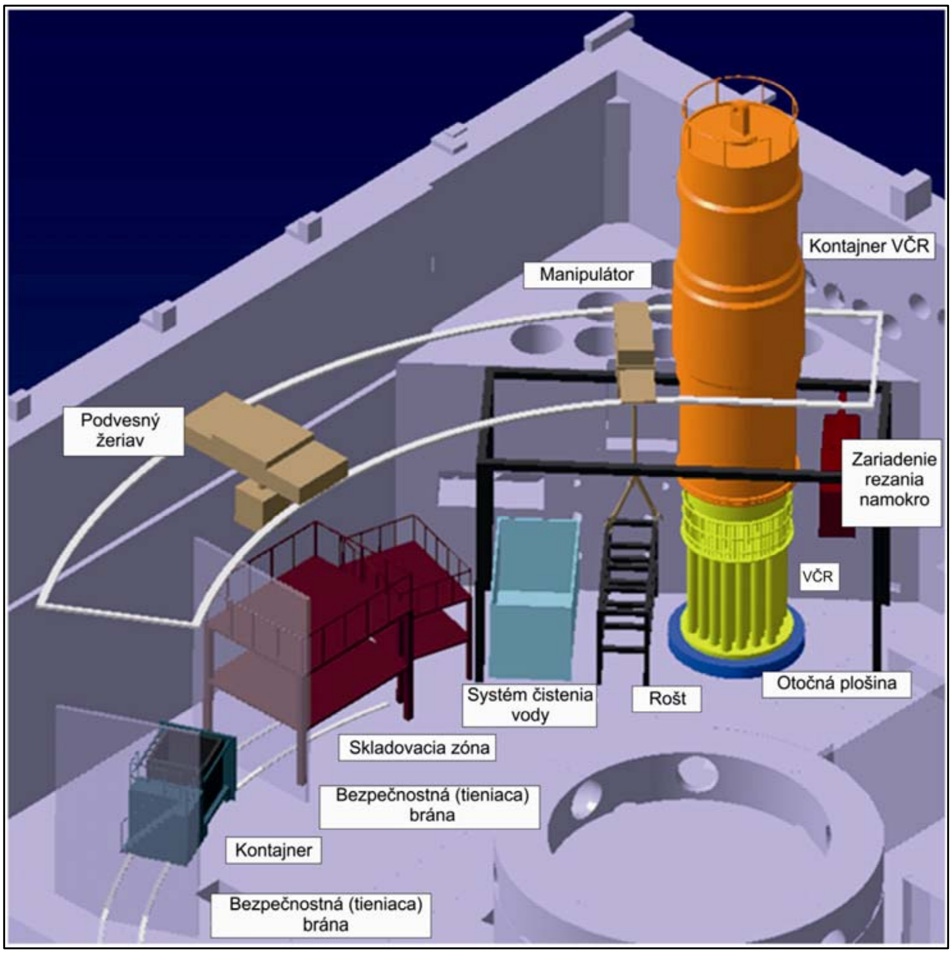
8.1.3.10 *Wet cutting area*

The dismantling area shall be implemented in the SG-MCP bay, between alignment 11 and 12, in the area J as you can see in the sketch below. Wet cutting area lay-out, at the same level where the dry cutting area has been implemented for the RPV cutting (-1.80 m.)

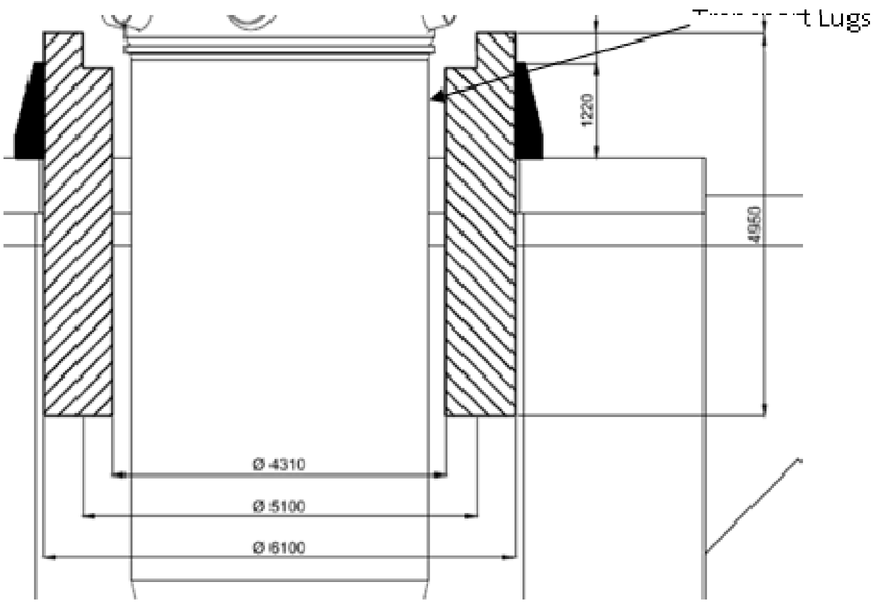
8.1.4 Annular water tank (AWT)

The Annular Water Tank (AWT) surrounds the Reactor Pressure Vessel to provide additional radiological shielding for operators involved in works during refueling activities while the plant was in operation phase.

Graph No. 20. Wet cutting area. 3D view



Graph No. 21. AWT section view.



8.1.4.1 *Preparatory and dismantling works*

Fragmentation will take place on site, not carried out relevant dismantling works

8.1.4.2 *Manipulation means*

For material handling the bridge crane 32 tonnes (reactor hall crane) will be used and, if necessary, the bridge crane 250 tonnes could be used.

8.1.4.3 *Auxiliary systems*

For the dismantling of the annular water tank the following auxiliary systems are required:

- Ventilation system.
- Compressed air system.
- Drainage system.
- Cooling system
- Liquid radwaste system.
- Fire protection.
- Electrical system.

8.1.5 Reactor shielding assemblies (RSA)

Shielding elements are intended to reduce the neutron flux level (neutron fluence) on VVER-440/V-230 type reactor pressure vessel wall. During operation, the shielding elements are located on the periphery of reactor core (see figure below). The total quantity of shielding elements per reactor is 36 pieces. Shielding element itself is an assembly with similar dimensions like a fuel assembly.

These elements have already been dismantled from their original position and are currently stored in the SFSP in unit 2.

The transportation from SFSP unit 2 to the dismantling location shall be conducted in the same way as the internals transportation to the wet cutting zone (same as presented in previous sections), implemented in the SG-MCP bay, at the same level where the dry cutting area has been implemented for the RPV cutting (-1.80 m).

8.1.5.1 *Preparatory and dismantling works*

Preparatory activities shall include every necessary activity for the dismantling activities correct performance. This point includes scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

The necessary means shall be installed once the area is free of obstacles. The pool, cutting devices, turntable, water cleaning systems, shielding gates, etc. shall be implemented.

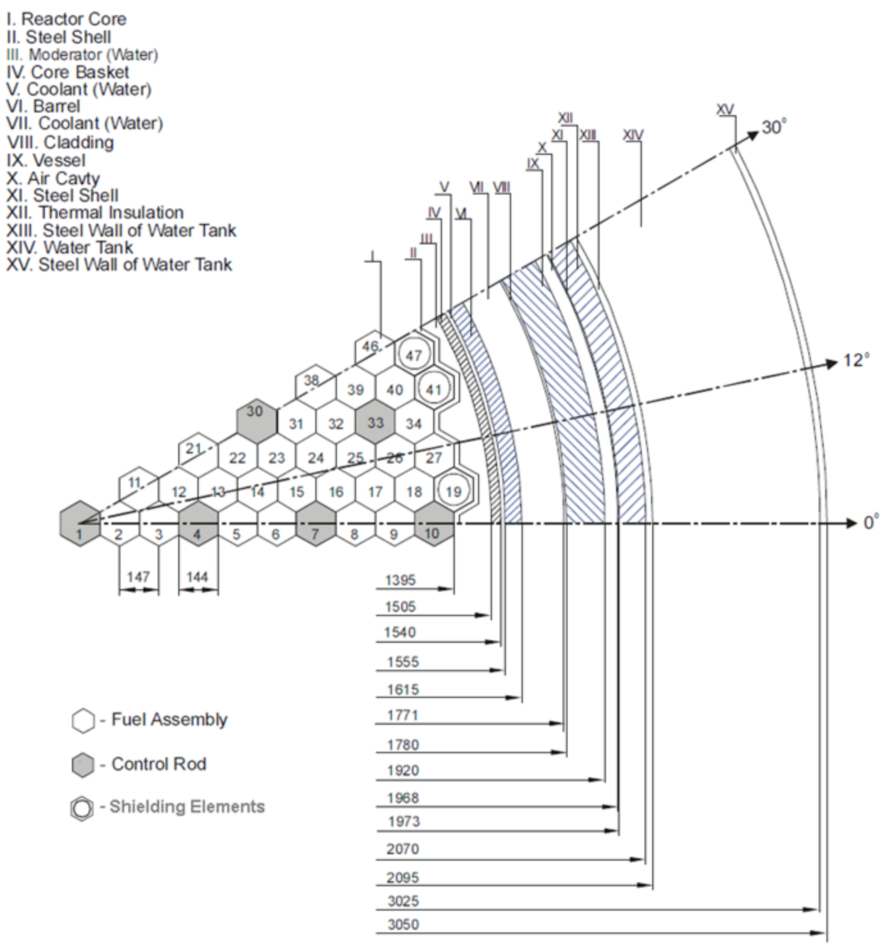
As shielding assemblies have been extracted from the reactor and transported into the SFSP unit 2, no further preparatory activities, such as RPV head removal or cavity flooding should be conducted.

The RSA dismantling sequence includes the following phases:

- Wet cutting zone preparation.
- Mock-up and tests.

- RSA lifting and transportation to the cutting area situated in the SG-MCP bay.
- RSA Cutting.
- Packaging and transportation.

Graph No. 22. Geometry model of VVER-440 showing Shielding Elements' loading in reactor core



8.1.5.2 *Wet cutting zone preparation*

(See 8.1.3.10)

8.1.5.3 *Mock-up and tests*

- Crane tests (Load test, emergency blocking test).
- Lifting means load tests.
- Structures integrity and structural analysis (structures load tests, civil structures analysis).
- RSA mock-up:
  - Area preparation.
  - RSA Mock-up manufacturing.
  - RSA Mock-up transportation.

- Cutting station implantation.
- Cutting process development.
- Packing process development.
- Mock-up test report elaboration.

8.1.5.4 *RSA lifting and transportation to the cutting area situated in the SG-MCP bay*

Before proceeding to the RSA transportation, the following activities shall be performed:

- Room R002/1 material clearance: Steam Generators and Main Coolant Pumps removal.
- Main lifting devices preparation (traverse beam, slings, hoists, shackles).
- Transportation route clearance. Working areas delimitation and marking.

RSA transportation shall imply the following main activities:

- RIS/RSA container lifting and transportation to the RSA location.
- RSA connection to container.
- RSA lifting and transportation to wet cutting station.
- RSA lowering over turntable.
- RSA fixation to turntable.
- Container disconnection.

Note: Both units´ RSA shall be dismantled in the same area. The abovementioned sequence shall be the same for both units.

8.1.6 Contaminated primary circuit equipment

This kind of equipment does not contain activated metal but only surface contamination. All Unit 1 equipment and most of Unit 2 equipment belongs to VLLW class:

Unit 2 steam generators (without heat exchange tubes) belong to LLW while their tubes belong to MLW.

After planned inline decontamination pressurizers and bubble tanks of both units will be suitable for free release, waste class of Unit 2 SGs will decrease from LLW to VLLW, while their tubes will be reclassified as LLW, all other equipment will remain VLLW. After dismantling, additional decontamination may be applied thus further reducing waste class down even to free release levels (except for Unit 2 SG tubes).

Regarding Main Circulation Pumps (MCP), Main gate valves, Mogilnik and circulation pipelines, after decontamination, will be classified as VLLW, therefore, in-situ dismantling shall be preferred to whole dismantling.

Pressurizer and bubble tank dismantling shall consider that, after decontamination, material shall be classified as free release.

Regarding reactor shaft protection lid, it is non-contaminated.

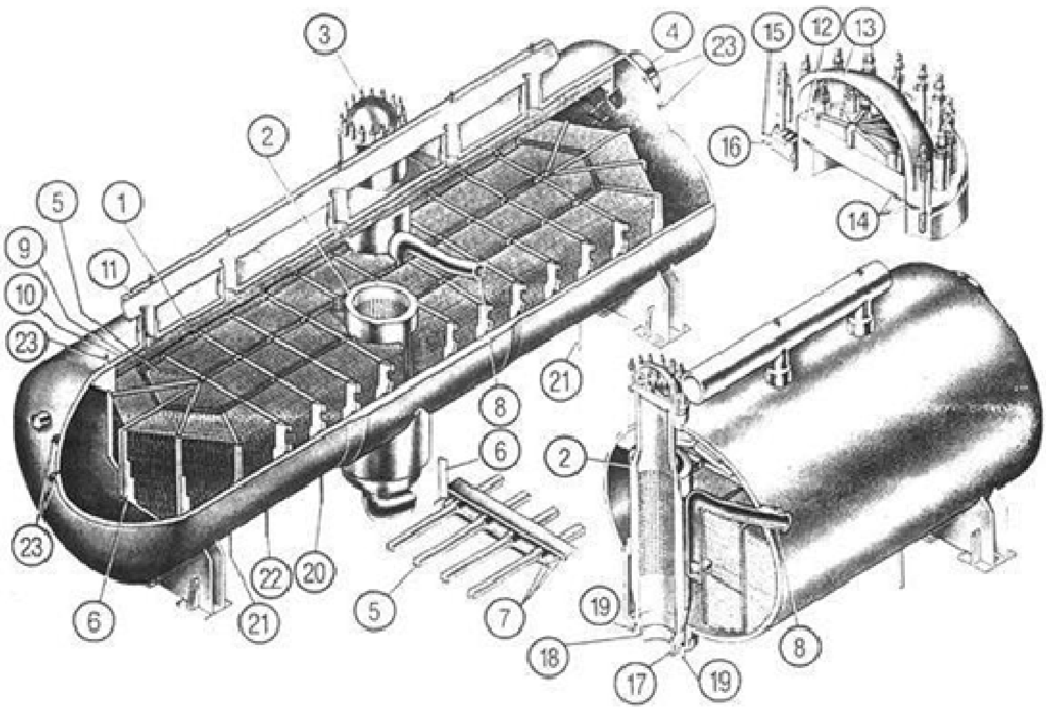
8.1.7 Preparatory and dismantling works

Preparatory activities shall include every necessary activity for the dismantling activities correct performance. This point includes scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

The following sections describe the following devices:

- Steam Generators.
- Main Circulation Pumps.
- Main gate valves.
- Main circulation circuit pipes.
- Pressurizer with Bubble Tank.
- Mogilnik.
- Reactor shaft protection lid.
- Reactor pressure vessel head.
- Reactor pressure vessel head upper block.

Graph No. 23. Steam generator characteristics



1 - Steam generator body; **2** - Primary cold leg collector; **3** - Primary hot leg collector; **4** – Manhole; **5** - Heat exchanger tubes; **6** - Vertical distance grid; **7**- Horizontal distance grid; **8** - Feedwater pipeline; **9** – Separator; **10** - Perforated sheet; **11** - Steam header; **12** - Primary circuit header cover; **13** - Secondary circuit header cover; **14** Cover seals for the primary and secondary circuit; **15** - Secondary circuit seal cover monitoring location; **16** Secondary circuit air vent; **17** - Primary circuit seal cover monitoring location; **18** - Primary circuit air vent; **19** - Header periodic blowdown; **20** - Steam generator periodic blowdown; **21** - Steam generator permanent blowdown; **22** – Nozzle; **23** - Pipe unions for steam generator level checking.

8.1.8 Steam generators

The Steam Generator (SG) is a horizontal heat exchanger consisting of a cylindrical vessel blinded by elliptic fronts

Support structure is installed in the location of the SG and is welded to the anchoring elements, which are encased in concrete in the lower plate of the structure

Horizontal SGs are the large evaporation surface and the ability to circulate coolant water without concentrating impurities.

Main characteristics of the SG are defined in the Graph No. 23.

8.1.8.1 *Cutting area preparation*

Several interferences shall be removed prior to SG fragmentation, such as connection pipes, valves, pumps, etc.

8.1.8.2 *Removal of the insulation shell*

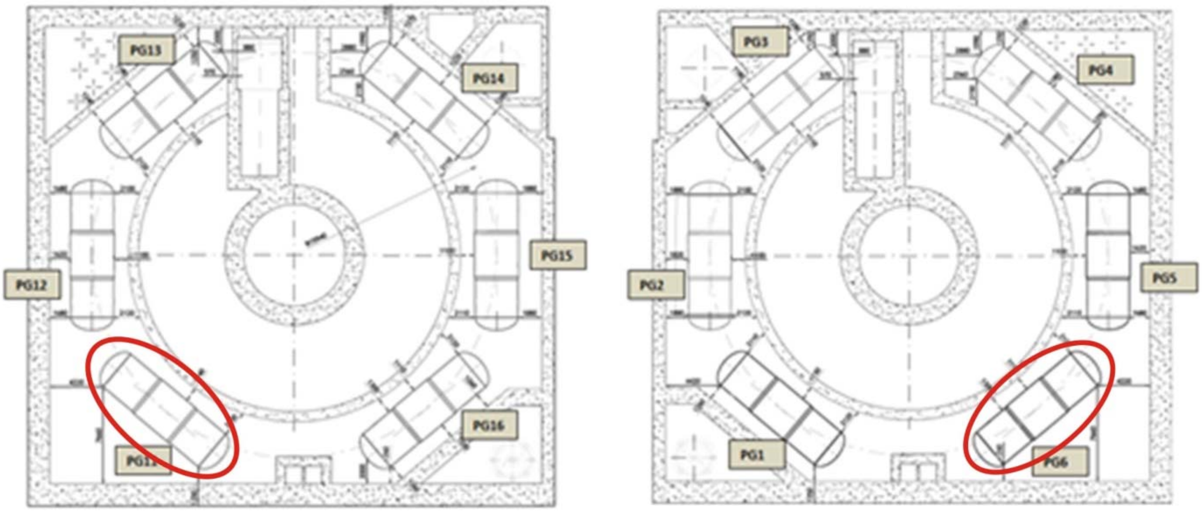
Steam generators insulation shell shall be removed before dismantling operations. The insulation shall be removed by cutting means, obtaining cases which may be hand-manipulated and transported, taking into consideration health and safety measures for its manipulation.

Graph No. 24. SGs Insulation shell

Dismantling of the steam generators shall consist on the initial fragmentation of the equipment in large parts on their regular positioning, for subsequent transportation to the secondary fragmentation area for final fragmentation in small parts which shall be packed into containers.

The dismantling process shall begin with the removal (as a whole) of one of the steam generators in order to free space in the SG-MCP bay for the cutting operations. In Graph No. 25 it is presented the SG to be removed for each reactor (PG11 in reactor 1 and PG6 in reactor 2).

Graph No. 25. Steam generators to be removed first. Reactors 1 & 2



The erection apertures for SG whole dismantling present lids which are embedded in the floor by means of metal bands which are welded to the lids and covered with concrete, so concrete shall be removed in the perimeter of the lid and metal bands welds shall be cut for performing the lid removal.

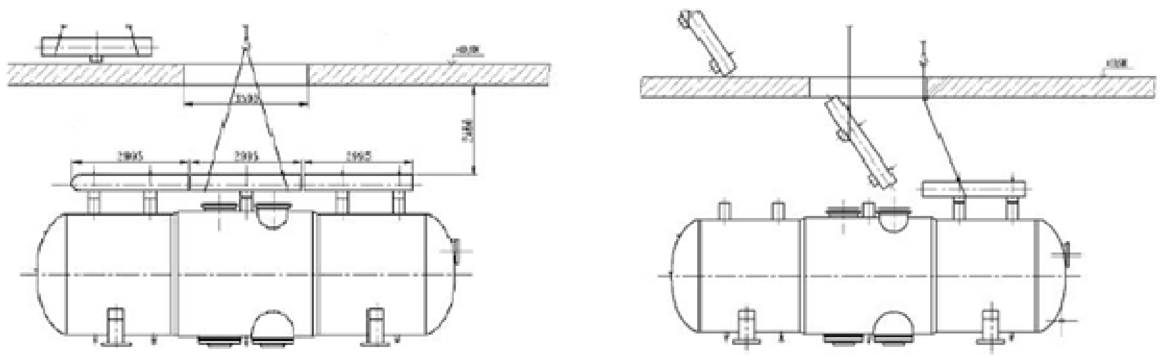
There are six maintenance hatches (one above each SG) which may also be used for material insertion/extraction.

Graph No. 26. Maintenance aperture over SG

Once that erection apertures´ lid is removed, for the Steam Generator whole dismantling, it is necessary to perform the following operations.

8.1.8.3 *Steam header removal above the SG*

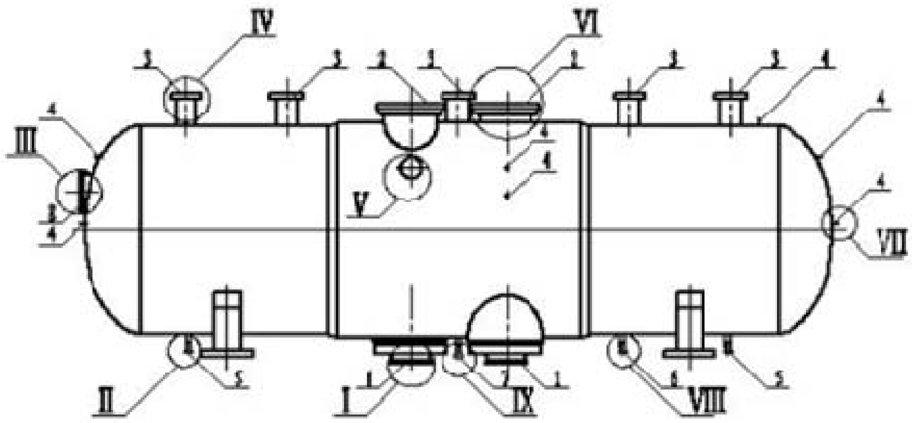
Graph No. 27. Steam header dismantling



8.1.8.4 *Pipework and process communications removal.*

The cut-off pipes shall be closed by means of plugs.

Graph No. 28. Pipes diameters and installation of plugs

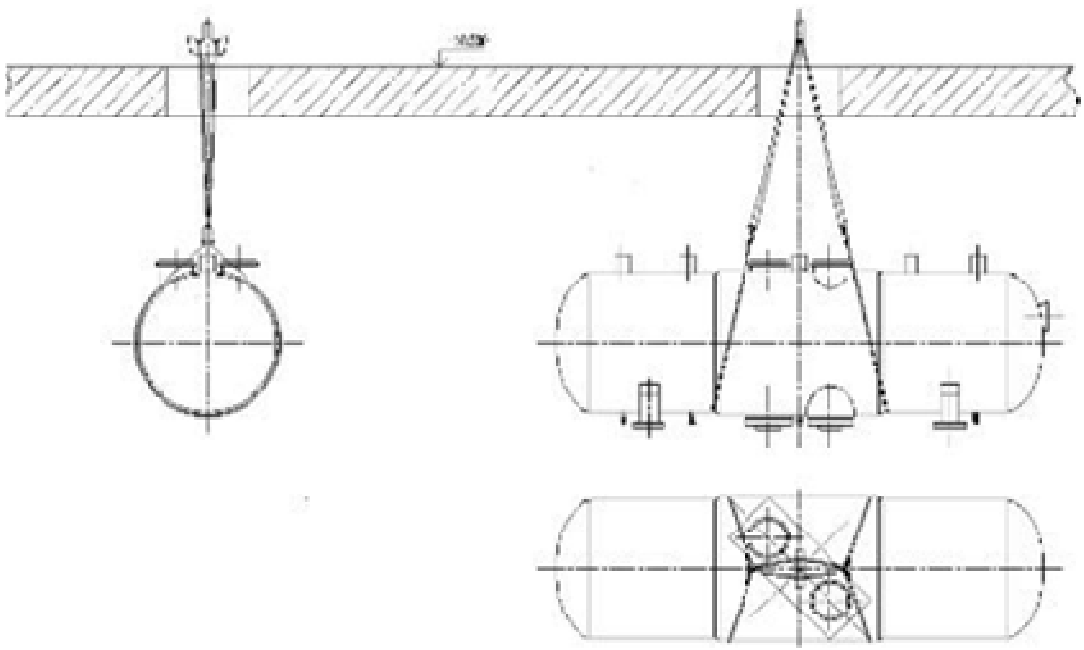


1 – primary circuit header	Ø500	6 – drain	Ø80
2 – secondary circuit header	Ø700	7 – continuous blow down fitting	Ø80
3 – steam pipe stub	Ø250	8 – access manhole	Ø500
4 – level gauge fitting	Ø20	9 – feed water pipe stub	Ø250
5 – intermittent blow down fitting	Ø40		

8.1.8.5 *Release the SG hangers*

Once all pipe connections are cut, the steam generator shall be slung and suspended using the central hall crane, in order to cut the steam generator´s hangers. These hangers shall be cut at the SG supports level in order to allow the SG supporting on the floor in the next steps.

Graph No. 29. SG hanging by central hall crane



8.1.8.6 *SG lifting*

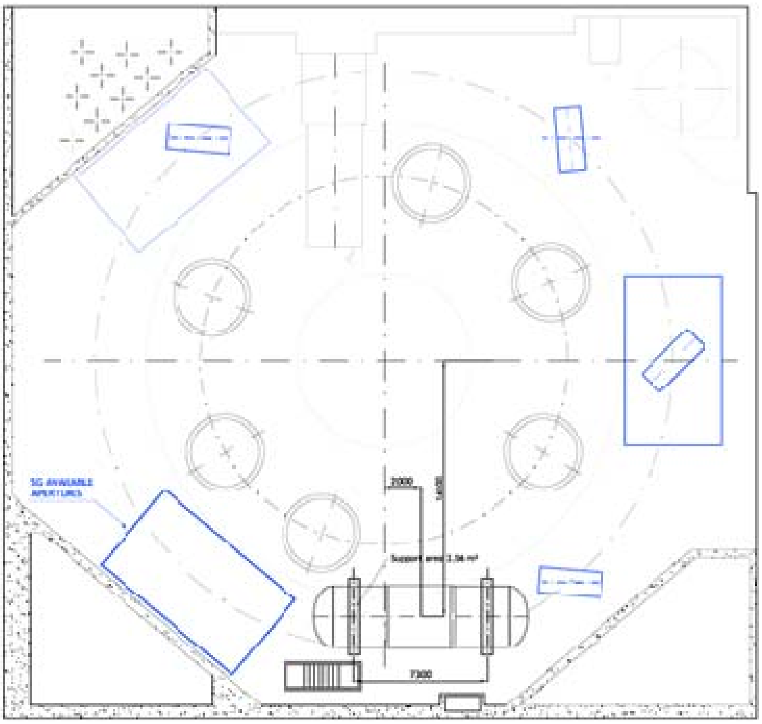
Once the suspensions are removed, the steam generator shall be lifted through the erection aperture. Since erection aperture length is smaller than steam generator length, it shall be necessary the SG tilt in order to extract it to the central hall.

Lifting means shall be designed in order to perform this operation. Adjustable length tackles shall be used (commercial or specially designed) and calculated.

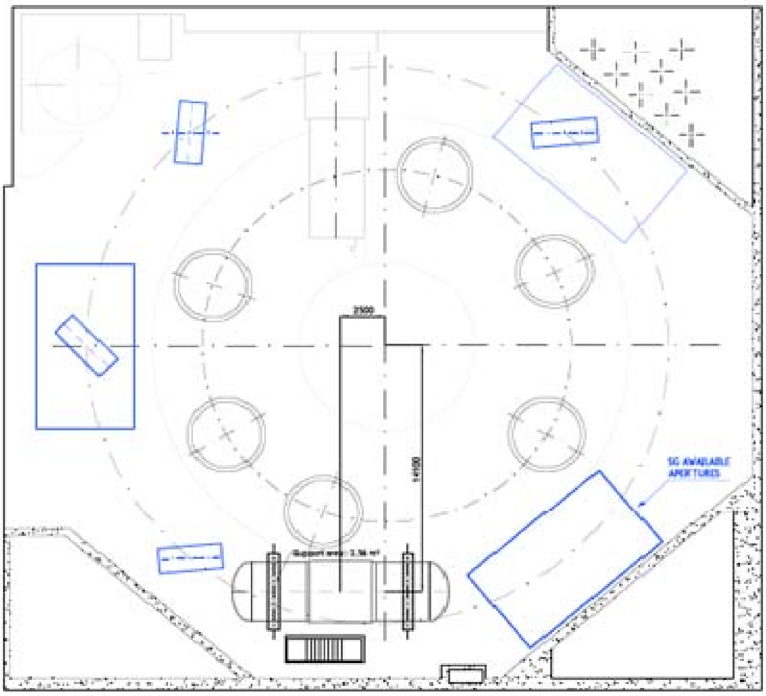
8.1.8.7 *SG storage on level +10.50 m*

Once that SG is lifted through the erection aperture, it shall be transported to a dedicated storage area in the central hall.

Graph No. 30. Reactor 1. Level +10.50 m. SG storage location



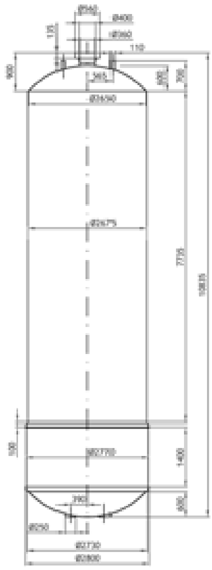
Graph No. 31. Reactor 2. Level +10.50 m. SG storage location.



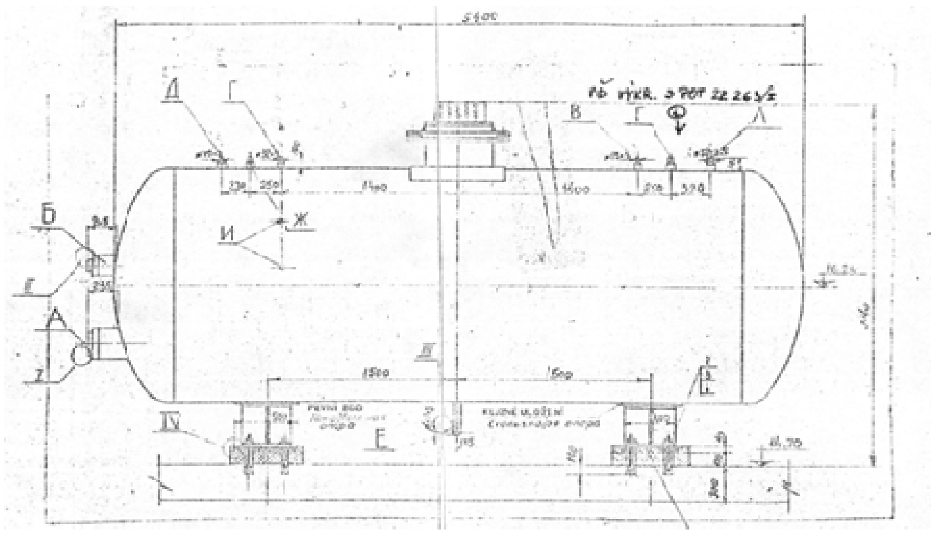
8.1.9 Pressurizer (PZR) with bubble tank

PRZ body itself is formed by a vertical cylindrical vessel welded semi-elliptical ends. Schematic drawing of PRZ body is on figure below.

Graph No. 32. Schematic drawing of pressurizer PRZ body.



Graph No. 33. Schematic drawing of bubble tank body



Preparatory activities shall include every necessary activity for the dismantling activities correct performance. This point includes scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

8.1.9.1 *Most important preparatory work for the PRZ*

- Pipes cutting, removal of pipes, structures, valves, etc.
- Thermal isolation removal.
- Scaffolding installation in level +2.70 m.
- Monorail installation.
- Jib crane installation.
- Transportation gantry installation on level -1.80 m.

- Isolation gates installation.
- Manipulators installation.
- Cutting devices installation (acetylene cutter & wire rope saw).
- Gas filter and exhaust installation.

Apart from the aforementioned preparatory works, the following milestones must be completed before bubble dismantling.

8.1.9.2 *Insulation removal*

PRZ & bubble tank´s insulation shell shall be removed before dismantling operations. The insulation shall be removed by cutting means, obtaining cases which may be hand-manipulated and transported, taking into consideration health and safety measures for its manipulation. Insulation material will be removed as part of BIDSF Project D4.3A to be initiated during Phase I of the Decommissioning.

8.1.9.3 *PRZ & PRZ bubble connections removal*

8.1.9.3.1 Cutting of the associated pipes at the outside of the PRZ & bubble tank

The main concern for this operation is the removal of insulation and cutting of the pipes at the PRZ flange level. This operation is carried out by means of oxyacetylene cutter.

The bubble tank dismantling sequence contains the following main phases:

- Pipes cutting, removal of pipes, structures, valves, etc.
- Thermal isolation removal.
- Scaffolding installation in level +2.70 m.
- Transportation gantry installation on level -1.80 m.
- SAS installation.
- Manipulators installation.
- Cutting devices installation (acetylene cutter & wire rope saw).
- Gas filter and exhaust installation.
- Room A511/1 (unit 1) or A511/1 (unit 2) concrete slabs removal.

8.1.9.3.2 Cutting area preparation

Several interferences shall be removed prior to PRZ / tank segmentation in the dry cutting area.

First of all, mechanical structures, supports and other equipment shall be removed, so to eliminate any interference and allow enough room for the cutting operations.

8.1.10 Main coolant pumps, main valves and primary piping

The coolant is pumped around the primary circuit by the main coolant pumps (MCPs).

Six vertical main circulation pumps are installed in circle closer to the center of the compartment. Each MCP is installed on a tripod support and passes through a circular opening of the deck floor with a diameter that exceeds the pump diameter.

Twelve main gate valves are installed in circle close to the reactor shaft walls. The valves are operated remotely by electrical drives which are installed in the electrical drives compartment R102/1. The valves are connected to the drives via penetrations in the sealed hatches.

Motors of main coolant pumps and isolation valves shall be dismantled as a whole prior to any fragmentation activity of its associated component. These motors, as well as the spare/stand-by motors located in R301, shall be fragmented following standard procedures due to non-significant radiological risk is expected.

Preparatory activities shall include every necessary activity for the dismantling activities correct performance. This point includes scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

Dismantling operations in the box of Steam Generators and Main Circulation Pumps will start cutting the Primary Piping close to the RPV bio-shield. For that, RPV water level shall be established below the level of the main reactor coolant pipes in order to avoid leakages. Once cutting of the primary piping in this location is finished, shielding plugs shall be installed in the primary piping.

The proposed dismantling method assumes maximization of free release and avoiding arrangement of new fragmentation and decontamination facility in the V1 Turbine Hall. All equipment is fragmented in-situ to small fragments suitable for fragmentation and decontamination in F&D facilities.

Primary pumps and valves will be fragmented by thermal (mainly) and mechanical methods. These methods are described in previous sections of this document.

Dismantling of the MCP (Main Coolant Pump) consists in removal of the extractable part in accordance with the maintenance process and cutting of the MCP shell into fragments of up to 800 mm.

The MCP is to be dismantled first of all. Dismantling of the MCP is performed by way of its disassembly in accordance with available maintenance process.

Disassembly of the MCP is done in accordance with the following pattern (extended):

- Dismantle the electric motor;
- Disconnect the MCP from process communications (cut the pipework);
- Dismantle the cooler;
- Dismantle the auxiliary circulation pump;
- Remove the upper and lower spacers;
- Remove the bioprotection from the main socket;
- Extract the removable part of the MCP using a maintenance traverse;
- Remove the journal-and-thrust bearing;
- Remove the shaft sealing unit;
- Dismantle the guiding device and place it in the central hall.

The internal part of the MCP is emplaced into an ISO container.

Upon removal of the extractable part of the pump it is necessary to remove the bolts anchoring the flange and biological protection (steel slab). All of the above mentioned operations are done in accordance with regular process using tools available at the NPP.

When dismantling primary circuit equipment it is necessary to dismantle all pipelines of auxiliary systems and GERBs. Erection of supports is required to immobilize pipelines and equipment of the MCC. When cutting MCC pipelines they have to be additionally fixed.

Dismantling sequence of primary circuit is detailed in the following table:

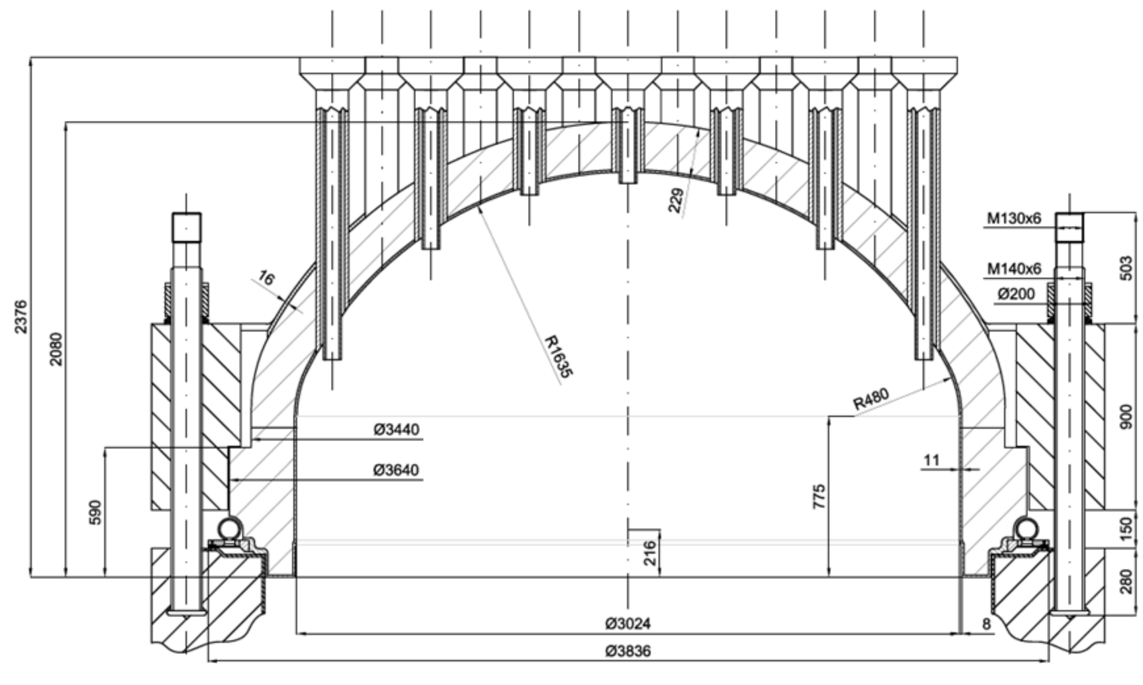
Tab. No. 1. Cost Dismantling sequence of primary circuit

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**	**Conditioning**		
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 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 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 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

8.1.11 Reactor vessel head

Reactor pressure vessel is closed by an elliptical component called RPV head. The reactor pressure vessel head is bolted on to complete the vessel pressure boundary and to support and locate the control rod drives.

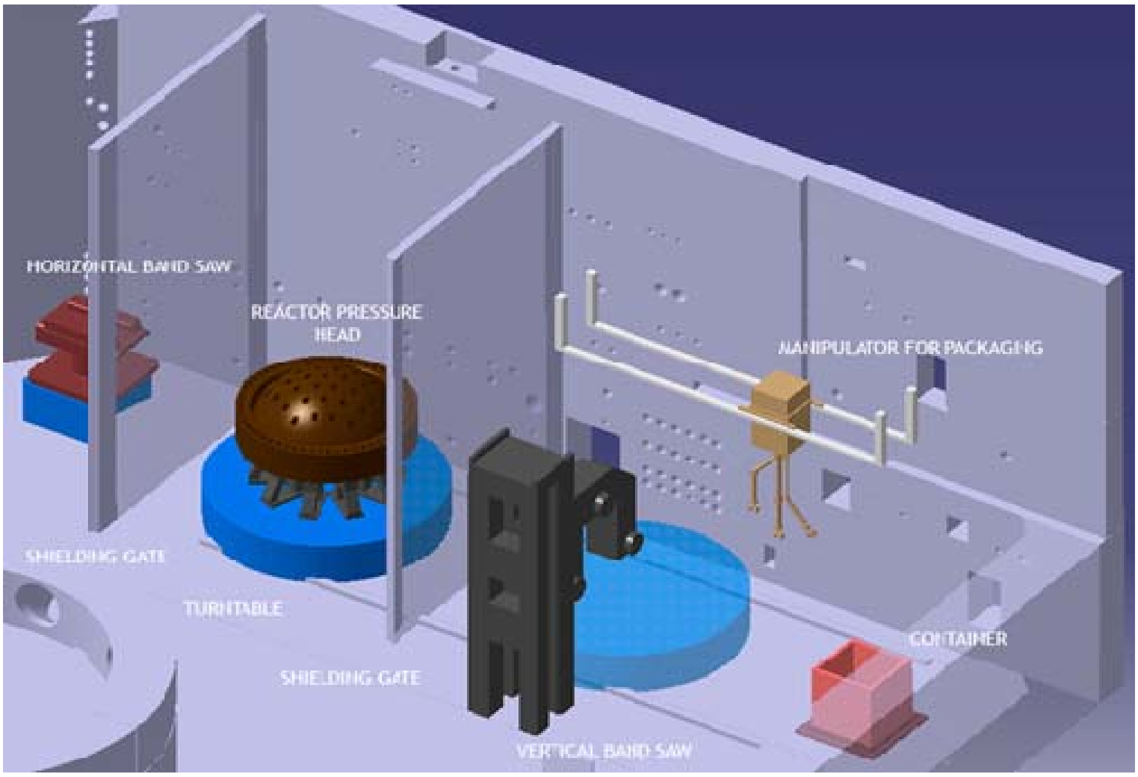
Graph No. 34. Reactor vessel pressure head



8.1.11.1 *Dry cutting area preparation*

Refer to section 8.1.2.6 (Dry cutting zone preparation).

Graph No. 35. Dry cutting area 3D model



8.1.11.2 *Reactor shaft protective lid removal*

Reactor shaft protective lid shall be removed as described in section 8.2.2.6.6.

8.1.11.3 *Upper block removal*

Upper block and reactor pressure vessel head shall be disconnected from the reactor pressure vessel and located in the reactor pressure vessel head stand.

Upper block and reactor pressure vessel head shall be unbolted once they will be required for dismantling activities.

The RPV head dismantling sequence contains the following main phases:

- Preparatory works.
- Mock-up and tests.
- Dry cutting zone preparation.
- RPV head lifting and transportation to the cutting area situated in the SG-MCP bay (room R002/1).

8.1.11.4 *Preparatory works*

- Reactor shaft protective lid removal.
- Upper block removal.

- Pressurizer wall removal in elevation -1.80 m.
    - Demolition equipment lowering to level -1.80 m.
    - Wall demolition.
    - Equipment removal.
- Level -1.80 m. clearance of material:
    - Steam Generators removal.
    - MCP removal.
    - Valves, piping, structures removal.

8.1.11.5 *Mock-up and tests*

- Crane tests (Load test, emergency blocking test).
- Lifting means load tests.
- Structures integrity and structural analysis (structures load tests, civil structures analysis).
- RPV head mock-up:
    - Area preparation.
    - RPV head Mock-up manufacturing.
    - RPV head Mock-up transportation.
    - Cutting station implantation.
    - Cutting process development.
    - Packing process development.
    - Mock-up test report elaboration.

8.1.11.6 *Dry cutting zone preparation*

See 8.1.2.6 (Dry cutting zone preparation).

8.1.11.7 *RPV head lifting and transportation to the cutting area situated in the SG-MCP bay (room R002/1).*

Before proceeding to the RPV head transportation, the following activities shall be performed:

- Main lifting devices preparation (traverse beam, slings, hoists, shackles).
- Transportation route clearance. Working areas delimitation and marking.

Vessel head transportation shall imply the following main activities:

- Traverse beam connection to the bridge crane hoist.
- Traverse beam connection to the RPV head.
- RPV head lifting.
- RPV head transportation to the R002/1 area.
- RPV head lowering over turntable and structure.

- RPV head fixation.

Note: Both RPV heads shall be dismantled in the same area

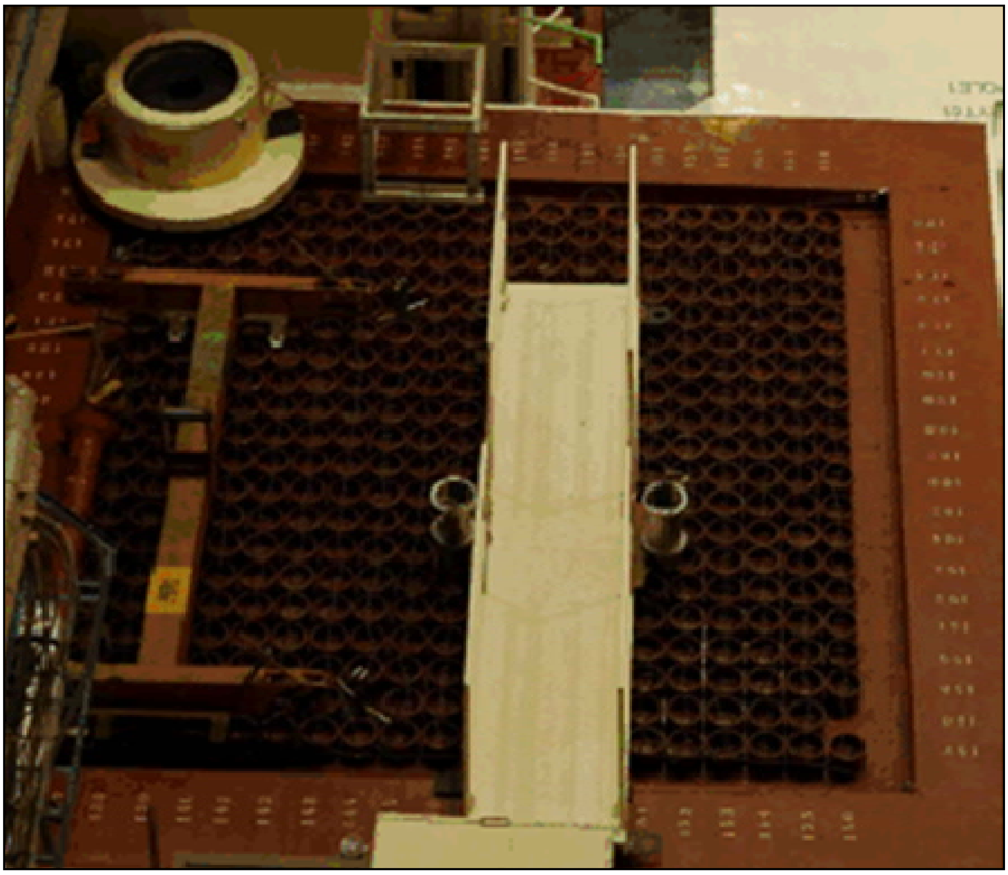
8.1.12 Mogilnik

Mogilnik consists of large number of contaminated pipes and a small volume of concrete. It´s situated at the V1 NPP reactor hall, elev. +10.50 m. These pipes storage remote handle waste (high activity). The concrete may be treated in order to separate potentially contaminated upper layer from potentially clean concrete with a concrete shaver.

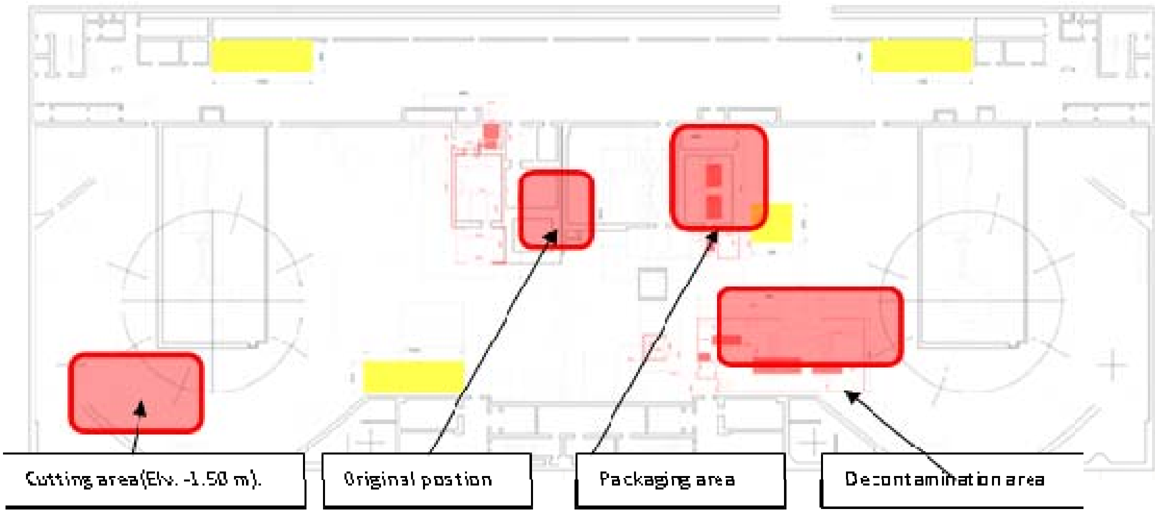
Dismantling strategy followed for the Mogilnik dismantling shall consist on the pipes fragmentation on the SG-MCP bay, in the same dismantling area defined for the SG tubes fragmentation. Decontamination activities shall be conducted in the F&D areas.

In order to extract the Mogilnik pipes from their original position, the embedded concrete shall be removed for allowing the pipes slung with the central hall crane.

Graph No. 36. Mogilnik



Graph No. 37. Dismantling location



Preparatory activities shall include every necessary activity for the dismantling activities correct performance. This point includes scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

Apart from preparatory works, the following milestones must be completed before Mogilnik dismantling:

8.1.12.1 *Components stored into Mogilnik removal*

Prior to Mogilnik dismantling, the solid waste stored in the tubes shall be removed.

In order to extract the solid waste stored inside the Mogilnik, a special device shall be used.

8.1.12.2 *Cutting area preparation*

Interferences shall be removed prior to Mogilnik fragmentation, mainly the SGs & MCPs, but also components such as connection pipes, valves, pumps, etc.

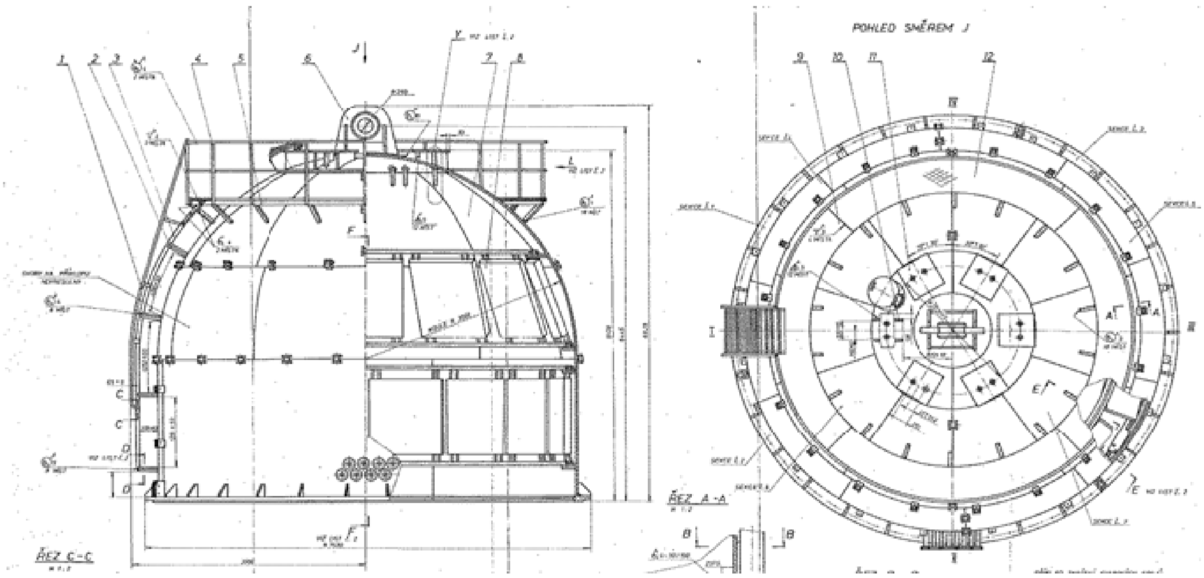
8.1.12.3 *Protective tent installation*

A protective tent shall be erected over the Mogilnik in order to avoid contamination dispersion. This protective tent shall be connected to the ventilation system for air treatment during the concrete removal operations.

8.1.13 Reactor shaft protection lid (RSPL)

Reactor shaft protective lid itself is formed by a vertical cylindrical and semispherical cap bolted to the concrete slab of the Reactor Hall. RSPL body is shown on Graph No. 38.

Graph No. 38. Reactor shaft protective lid



The strategy for the RSPL dismantling shall consist on performing a primary fragmentation on their original position, for transporting the pieces to a post-fragmentation area (C7-A3), where the pieces shall be fragmented with maximum dimensions of 1.2 x 0.8 x 0.8 m., and loaded into containers.

Graph No. 39. Cutting areas

The cutting zone is arranged around RSPL at the reactor hall (room R301), level +10.50 m., which shall be free from other equipment and structures for the dismantling operations.

The dry cutting zone shall consist on a working area separated from others by a protective tent.

The cutting zones consist on a set of the following components:

- Protective covers.
- Scaffolding.

- Anchoring protective structure.
- Oxyacetylene cutting torch.
- Diamond wire rope.
- Lifting mechanisms, wire ropes and traverses.
- Ventilation and gas filters.

Preparatory activities shall include every necessary activity for the dismantling activities correct performance. This point includes scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

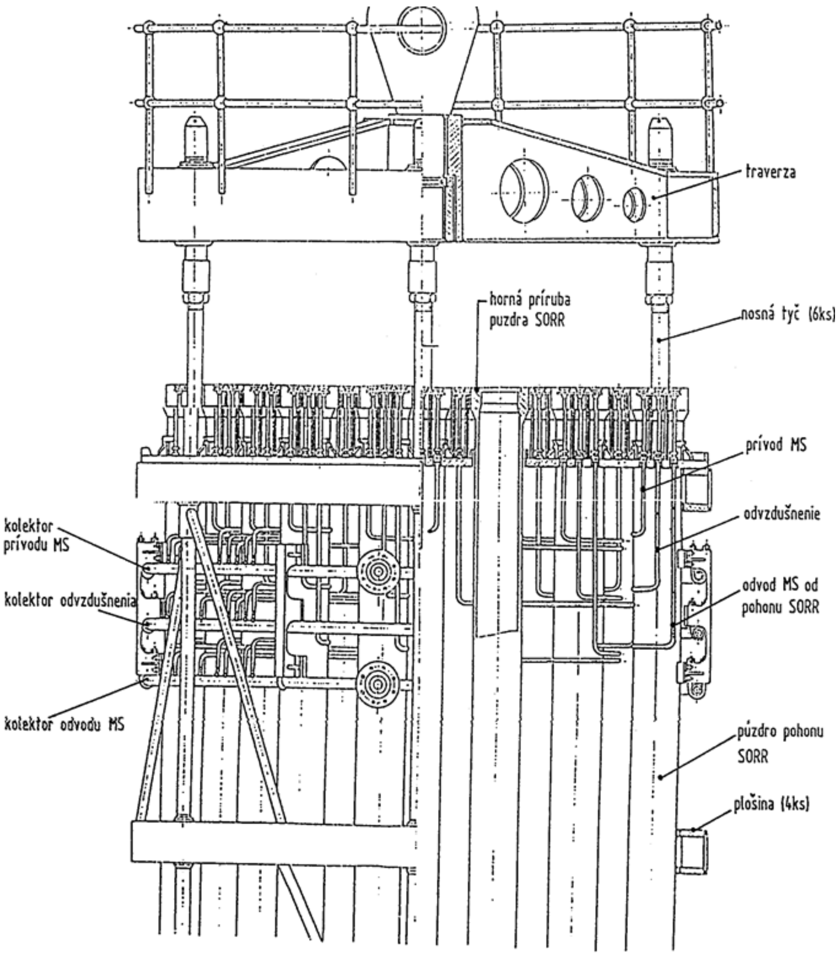
8.1.13.1 *Cutting area preparation*

Dismantling of the protective lid of the reactor shaft is carried out in the central hall (because the size of the lid does not allow it to be transported beyond the limits of the central hall).

To this end a metal tray is arranged in the central hall for the purpose of collecting fine concrete fragments. Tray's diameter is 9 meters.

A 7.5 m high double-layer tent with a ventilation hose attached to it is erected around the protective lid of the reactor shaft. The distance between the tent and lid's surface has to be no less than 1.2 meters.

Graph No. 40. Upper block



8.1.13.2 *Reactor vessel head upper block*

The Upper Block is the part of the Reactor Head which acts as a vertical guidance for the Control Rod Bars, involved in the emergency control and protection of the Reactor Pressure Vessel. It consists of a ring-form steel structure with 6 bars which act as stiffeners, and 37 control rod bar guidance that goes as far as the upper side of the Reactor Head.

Preparatory activities shall include every necessary activity for the dismantling activities correct performance. This point includes mock up and tests, scaffolding installation, zones identification and marking, consumptions connections, evacuation routes cleaning and obstacles removal.

Upper block and reactor pressure vessel head are located in the reactor pressure vessel head stand. Upper block and reactor pressure vessel head shall be unbolted (6 bolts M36) once they will be required for dismantling activities.

8.1.13.3 *Cutting area preparation*

Steam generators and main coolant pumps, as well as all other equipment (valves, structures, pipes, etc.) shall be removed, so to eliminate any interference and allow enough room for the cutting station installation.

8.1.14 Other facilities in and out of Control Zone

Dismantling and segmentation are aimed at subsequent disassembling of technological units of the nuclear power plant and, to the utmost possible extent, their release for further use, or segmentation to a size that allows for secure transportation to the F&D station for further processing.

This section describes the dismantling techniques used during dismantling / removal systems for the following main categories:

- Piping.
- Tanks and containers.
- Heat exchangers.
- Pumps.
- Valves.
- Piping feedthroughs.
- Diesel generators
- Auxiliary systems
- Electrical Systems

Pre-dismantling decontamination will be performed on-site facilities. The aim of in situ decontamination is the removal of residual contamination, in order to reduce the exposure of workers to radiation during subsequent dismantling work such as cutting and removal.

8.1.15 Piping

The following activities shall be taken as a standard methodology for the dismantling activities applicable to all the piping in the nuclear power plant of Bohunice:

- Remove insulation (if not previously done in project D4.3A – "Dismantling of Insulation in Controlled Area").
- Install contamination controls (if contaminated, RT3 and above).
- Set up torch/powersaw/track mounted torch.
- Rig pipe before cutting.
- Cut in fragments to fit the corresponding container.
- Remove torch/powersaw/track mounted torch.
- Cap pipe ends with temporary covers.
- Remove contamination controls (if contaminated, RT3 and above).
- Remove piping to transfer container and send to free release (if piping is clean, RT1 or RT2).

8.1.16 Tanks and containers

Before removing any tank is required to remove sludge. Some tanks will be decontaminated in place before the removing.

The following activities shall be taken as a standard methodology for the dismantling activities applicable to all the tanks and containers in the nuclear power plant of Bohunice:

- Remove insulation (if not previously done in project D4.3A – "Dismantling of Insulation in Controlled Area").
- Install contamination controls (if contaminated, RT3 and above).
- Disconnect inlet and outlet piping.
- Cap openings.
- Unbolt from floor.
- Set up cutting tool.
- Rig segment for removal .
- Cut in fragments to fit the corresponding container.
- Remove segment, accumulate and send batch to packing area.
- Remove contamination controls (if contaminated, RT3 and above).
- Remove and transfer to free release (if clean, RT1 or RT2).

Remove, wrap in plastic, decontaminate if applicable, and finally send to ISF, RWTC or Clearance station as function of decontamination results (if contaminated, RT3 and above).

8.1.17 Heat exchangers

The following activities shall be taken as a standard methodology for the dismantling activities applicable to all the heat exchangers in the nuclear power plant of Bohunice:

- Remove insulation (if not previously done in project D4.3A – "Dismantling of Insulation in Controlled Area").

- Mount pipe cutters.
- Install contamination controls (If contaminated, RT3 and above).
- Disconnect inlet and outlet lines.
- Cap openings.
- Unbolt from mounts.
- Remove contamination controls (If contaminated, RT3 and above).
- Rig for removal.
- Cut in fragments to fit the corresponding container.
- Remove and transfer to free release (if clean, RT1 or RT2).
- Remove, wrap in plastic, decontaminate if applicable, and finally send to ISF, RWTC or Clearance station as function of decontamination results (if contaminated, RT3 and above).

8.1.18 Pumps

The following activities shall be taken as a standard methodology for the dismantling activities applicable to all the pumps in the nuclear power plant of Bohunice:

- De-energize.
- Disconnect power lines to pump motor.
- Drain coolers and oil reservoirs.
- Remove insulation (if not previously done in project D4.3A – “Dismantling of Insulation in Controlled Area”).
- Install contamination controls (if contaminated, RT3 and above).
- Disconnect suction.
- Discharge connections.
- Unbolt frame from foundation.
- Cap openings with temporary covers.
- Remove contamination controls (if contaminated, RT3 and above).
- Unbolt motor from pump and frame (if motor-driven turbine).
- Rig motor for removal (if motor-driven turbine).
- Remove motor and send to free release (if motor-driven turbine is clean, RT1 or RT2).
- Remove, wrap in plastic, decontaminate if applicable, and finally send to ISF, RWTC or Clearance station as function of decontamination results (if contaminated, RT3 and above).
- Rig pump for removal.
- Cut in fragments to fit the corresponding container.

- Remove and transfer to free release (if pump is clean, RT1 or RT2).
- Remove, wrap in plastic, decontaminate if applicable, and finally send to ISF, RWTC or Clearance station as function of decontamination results (if contaminated, RT3 and above).

8.1.19 Valves

The following activities shall be taken as a standard methodology for the dismantling activities applicable to all the valves in the nuclear power plant of Bohunice:

- Remove insulation.
- Install contamination controls (if contaminated, RT3 and above).
- Set up cutting tool.
- Rig valve before cutting.
- Cut in fragments to fit the corresponding container.
- Remove cutting tool.
- Remove contamination controls (if contaminated, RT3 and above).
- Place valve and stem in transfer container for removal to laydown area (if valve is clean, RT1 or RT2).
- Remove, wrap in plastic, decontaminate if applicable, and finally send to ISF, RWTC or Clearance station as function of decontamination results (if contaminated, RT3 and above).

8.1.20 Piping feedthroughs

The following activities shall be taken as a standard methodology for the dismantling activities applicable to all the piping feedthroughs in the nuclear power plant of Bohunice:

- Remove insulation if exists (if not previously done in project D4.3A – "Dismantling of Insulation in Controlled Area").
- Install contamination controls (if contaminated, RT3 and above).
- Set up cutting tool.
- Rig pipe before cutting.
- Cut both ends of the pipe in order to detach them to the feedthrough.
- Cut in fragments to fit the corresponding container.
- Remove contamination controls (if contaminated, RT3 and above).
- Remove piping feedthrough to transfer container and send to free release (if piping feedthrough is clean, RT1 or RT2).
- Remove, wrap in plastic, decontaminate if applicable, and finally send to ISF, RWTC or Clearance station as function of decontamination results (if contaminated, RT3 and above).

8.1.21 Electrical systems, management and control system

The dismantling of electrical systems includes the dismantling of metal structures, equipment and components. All these technological facilities have different shape, size and weight. They are manufactured from different materials such as stainless steel, carbon steel, non ferrous metals or from different steels covered by thin stainless steel liner.

The steps expected for electrical equipment dismantling are the following:

- Provision of necessary areas and workplaces for storage of dismantled facilities and material.
- Dismantling of facilities containing hazardous waste.
- Dismantling of other technological facilities.
- Dismantling cable distribution.
- Dismantling auxiliary, support and other structures, shelters, small installation material, cabinets and cable trays.

8.1.22 Other equipment

This section includes information regarding dismantling techniques of several equipment types considered relevant for its importance during decommissioning, dimensions, or number of individuals in the Plant. Therefore this section does not cover all other minor equipment types.

- **Doors**: generally a door shall be dismantled prior to demolition works and after the dismantling of the communicated areas is finished (because door can avoid the spread of contamination between areas); in some cases, a door shall be dismantled first (in example if the door is in the middle of a transport route). Dismantling method for doors is a combination of manual/mechanical/thermal methods depending on the size/weight of the door and its radiological status. Door will be disposed according to its material and radiological status. In general, door frames will not be dismantled until demolition works, in case any frame should be dismantled first (in example because the door should be enlarged for any reason), it will be dismantled using mechanical methods.
- **Linings**: Dismantling of lining shall be performed by mechanical/thermal methods taking into account its radiological status. Embedded parts of the linings will remain in the civil structure until demolition of the building. Linings will be disposed according to its material and radiological status.
- **ČN Evaporator**: ČN system shall be operative while liquid generation in building SO800 is potentially high. Once the liquid generation is low, liquid RAW could be managed at RWTC and therefore the system could be dismantled. Evaporator shall be drained previously to the dismantling process. Mechanical dismantling shall be considered as preferable method for its dismantling.
- **Containers KVČR and BEKO**: fragmentation of these containers could be done in both dry cutting area, or in a dedicated area to be implemented in the Reactor Hall taking into account its radiological status for the selection of the fragmentation method.
- **250 t Reactor Hall crane**: 250 t crane dismantling shall be performed after the removal of the roof of the Reactor Building (see 5.9.3.4). Beams and trolleys shall be

dismantled by means of an external crane. First the trolleys will be lifted and removed, after that the beams will be removed in one lifting (both together in the same lifting manoeuvre). Finally the crane will be transported to the storage area for final dismantling.

8.2 RAW management

Processing of RAW aims at safety and economic efficiency of handling with them. Basic approaches comprise volume reduction, removal of radionuclides and modification of composition (incineration, pressing, vaporisation, ion exchange, filtration, decontamination, neutralisation, coagulation, flocculation of chemical substances and similar), storage and final disposal. The individual methods are often combined in such a way as to achieve the maximum decontamination effect. This can lead to generation of secondary RAW (contaminated filters, saturated ionex materials, sludge). Processing of RAW at JAVYS a.s. is carried out, depending on the RAW type, at the nuclear facilities RWPTT or at A1 NPP.

8.2.1 General procedures of handling RAW

In course of operation and decommissioning of a nuclear facility a wide range of radioactive waste is produced that must be isolated from the population and the environment. Radioactive wastes are classified according to various criteria, such as:

- Their state of matter: solid, liquid and gaseous,
- The activity level: Very low, low, medium and highly active,
- Processing possibilities: Pressable, incinerable, non pressable, non incinerable, liquid.

The following targets are pursued by waste processing:

- To lower the amount of wastes by reducing their volume.
- To create a safe form suitable for their storage/disposal by fixation.
- To provide sufficient barriers against radioactivity leaks into the environment during their disposal in the repository.

Wastes originating from the controlled zone are divided already upon their generation into radioactive and non-radioactive (suitable for release into environment) and subsequently separated according to the activity level and the possibilities of further processing (Catalogue of RAW types).

All radioactive wastes are carefully stored, observed and, over the entire time of work with them, monitored, registered and controlled. Liquid and solid wastes are modified by means of suitable technologies to a form appropriate for long-term storage or final disposal in the repository. Gaseous wastes are purified on special filters and released in form of gaseous discharges.

Modification of radioactive wastes represents activities by which their physical-chemical features are altered and a form created that is suitable for secure manipulation when storing and placing them to their final destination. One of these is fixation - solidification of liquid RAW. The liquid component containing radionuclides is incorporated into a solidifying agent providing a solid and stable form in the long run. Among the most used solidifying agents for fixation of radionuclides there belong cement, bitumen and glass. Fixation can be also carried out by means of synthetic or ceramic materials. The decision as to which agent is to be used is guided mainly by chemical and radiological features of RAW to be solidified, their amount, procurement expenses of the individual technologies and further handling with the solidification product.

JAVYS a.s. currently avails itself of the following RAW modification technologies:

- Bitumenation
- Vitrification
- Cementation
- Sialisation

8.2.2 Fragmentation

8.2.2.1 *Fragmentation of the reactor pressure vessel*

For purposes of the reactor pressure vessel fragmentation a zone of dry cutting shall be set up at V1 NPP. The zone consists of the following complex of components:

- Protective dome.
- Anchoring protective structure.
- Band saw with a positionable saw blade (allowing for horizontal and vertical cuts), or alternatively two band saws (a vertical and a horizontal).
- Transferable turning-table with fixing brackets.
- Conveyor.
- Gripping manipulators.
- Detectors of background radiation.
- Heaving mechanisms, wire ropes and traverses.
- Aerosol filters.
- Exhausters.
- Cameras and steering process monitoring detectors.
- Safety walls, gates and revision openings.

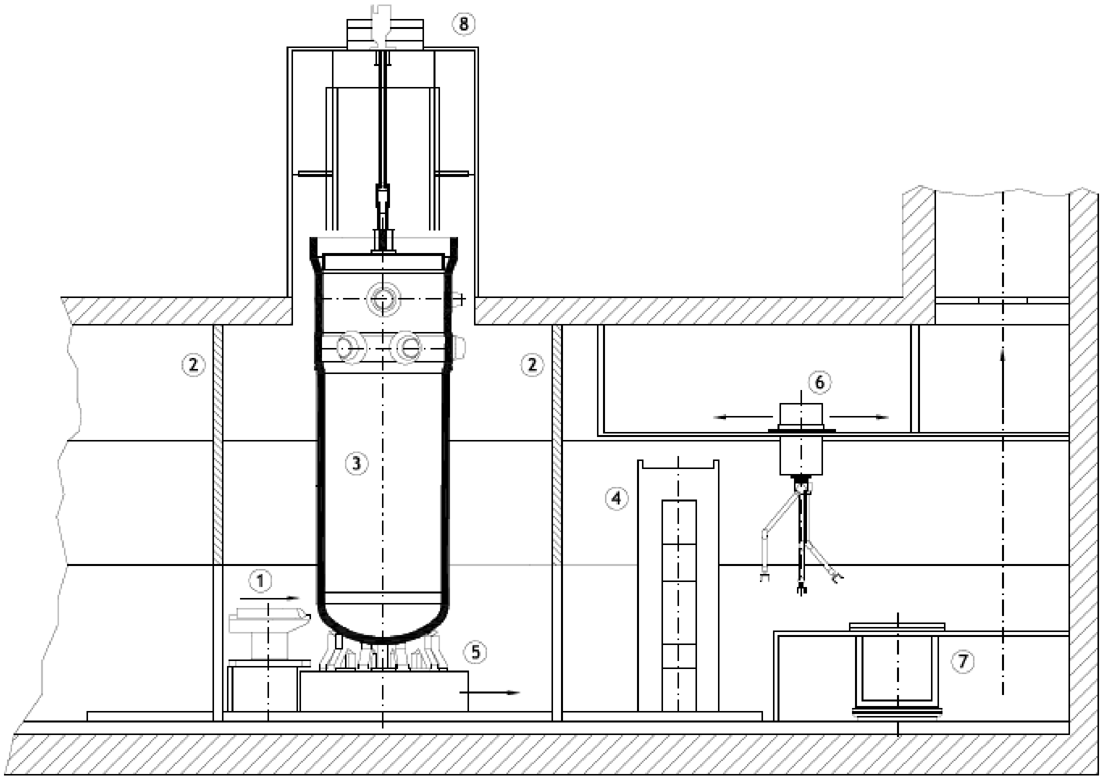
The dry cutting zone consists of individual work stations in a row divided from each other by protective barriers:

- Primary cutting area.
- Fragmentation area.
- Loading area.

The reactor pressure vessel, dismantled from its spot will be lowered through the mounting opening to the box ST-MPC (PG-HCČ) and anchored in the construed frame. Above the mounting opening, a protective dome of 4.500 x 4.500 mm and 5 m height will be erected. The dome structure features "connecting" ropes that serve as an interconnection between the transporting traverse of the RPV and the 250 t hook of the reactor hall crane. The reactor pressure vessel will be suspended by the reactor hall crane through the protective dome.

Then the reactor pressure vessel will be cut by means of a band saw into large annular fragments. The cutting process will begin with the lower vessel part sustained by the reactor hall crane.

Graph No. 41. Dry cutting station



1. Horizontal Band Saw
2. Shielding Gate
3. Reactor Pressure Vessel
4. Vertical Band Saw
5. Turntable
6. Manipulator for packaging
7. Packaging station
8. Lifting facility

The cut-off large-scale fragment will be removed to the fragmentation area furnished with other cutting devices and manipulators. Secondary cutting will be carried out in the fragmentation area, providing the storage of all fragments into containers (except from the upper part of the reactor).

Cutting of the reactor pressure vessel in the dry cutting zone is carried out up to the pipe bottom. The remaining upper vessel part is to be fragmented by a standard machine band saw in the main cutting area.

Graph No. 42. Horizontal band saw

8.2.2.2 *Secondary cutting area (Fragmentation area)*

Once that initial cutting has been performed in the primary cutting area, the transportable turntable shall conduct the ring-shaped fragment to the secondary cutting area.

The fragmentation area is equipped with a vertical band saw for performing the final fragmentation of the ring-shaped vessel portions.

Graph No. 43. Vertical band saw

The cut-off large-size fragment is placed into the fragmentation area equipped with additional cutting devices and manipulators. It is in the fragmentation area where secondary cutting takes place making it possible to package all of the parts into containers (except for the upper part of the reactor).

The fragments of the lower and upper reactor parts will be disposed in fibre-concrete containers. Fragments from the central part of the reactor pressure vessel will be disposed in shielded containers, while monitoring whether the dose rate on the surface of the containers does not exceed the value of 10 mSv/h. For this purpose individually manufactured containers with the required dimensions shall be used (this way the optimum thickness of the container walls for specific devices to be placed inside can be chosen, hence reducing the necessary storage space).

In total the reactor pressure vessel is cut into 190 fragments with the following breakdown:

- 132 fragments making up the central (activated) part of the vessel
- 58 fragments coming from:
    - 12 fragments from the flange
    - 16 fragments from the pipe stub ,
    - 30 fragments from the reactor bottom zones.

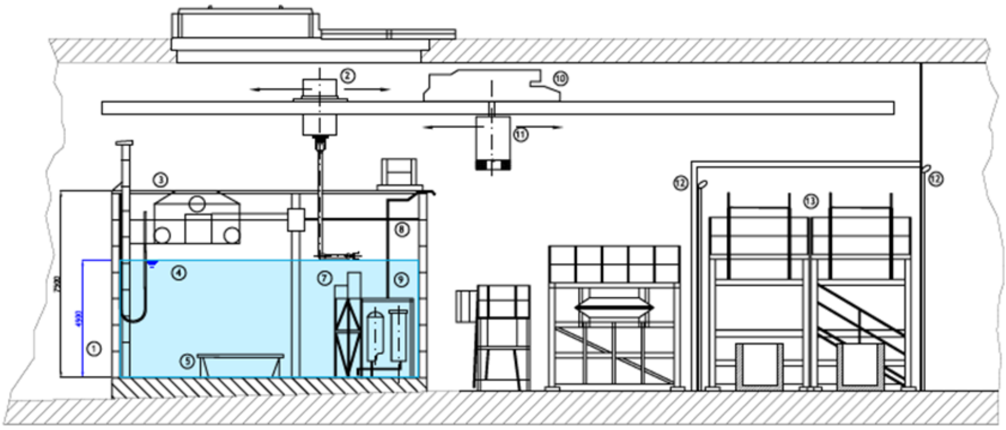
Totalling, packaging of RPV fragments will require 32 FCC and 44 CFM containers. Quantities are estimated for one unit.

8.2.2.3 *Fragmentation of internal reactor components*

Internal reactor components comprise:

- Protective Tube Unit
- Active zone basket.
- Barrel.
- Barrel bottom.

Graph No. 44. Front view wet cutting area



1. Working and intervention area
2. Power manipulator for packaging
3. Cutting device
4. Reactor component
5. Rotating table
6. Tool support system
7. Rack to insert baskets
8. Cutting pond
9. Water cleaning system
10. Overhead crane
11. Shielding cast
12. Shielding door
13. Packing station

A wet cutting zone will be set up for purposes of fragmentation of internal reactor components and will consist out of the following main devices:

- Band saw with a positionable saw blade (allowing for horizontal and vertical cuts), or alternatively two band saws (a vertical and a horizontal).
- Plasma cutter.
- CAMC tool (contact-arc-metal-cutting).
- Transferable turning-table with fixing brackets.
- Conveyor.
- Gripping manipulators.
- Detectors of background radiation.
- Heaving mechanisms, wire ropes and traverses.
- Water exchange system.
- Aerosol filters.
- Water treatment filters.
- Exhausters.
- Cameras and steering process monitoring detectors.
- Protective barriers and air seals.

Wet cutting zone will be set up in the fuel exchange basin and the spent fuel basin which are interconnected by a corridor with an air seal.

8.2.2.3.1 Fragmentation of the Protective Tube Unit (PTU)

In terms of fragmentation the PTU is the most complex item of all the RIS. The issue of PTU fragmentation lies in the complicated geometry of the PTU structure whose elements have varying wall thickness (8 to 300 mm).

In the table below, it is presented the dismantling sequence and cutting means for PTU dismantling:

Tab. Nr. 1. Dismantling sequence of primary circuit

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

8.2.2.3.1.1 Protective Tube Unit cutting

- PTU transportation inside the container to the cutting station.

NOTE: Since PTU dimensions imply that it cannot be completely submerged, the container shall not be disconnected until PTU is cut so the water level is over the PTU maximum height.

- PTU placement on the turntable.
- Central part horizontal cut on the turntable.
- PTU lifting inside the container.
- Ring shaped vertical cut on the turntable.
- Pieces insertion into transportation basket.
- Shielding cask installation over the transportation basket.
- Cask transportation to packaging area.
- Shielding doors closing.
- Packaging into containers.
- Containers extraction.
- PTU+ RIS container lowering over turntable for the following cutting steps with the same sequences.

In total the PTU is cut into 336 fragments 202 of which are protective tube fragments, 86 are fragments of the upper and lower grates, 48 are fragments of upper and lower shells.

Fragments of the upper part of the PTU and protective pipes belong to the LLW category.

Fragments of the lower slab and lower shell belong to the MLW category.

Fragments of protective pipes are subject to packaging inside fiber-concrete containers together with other fragments. 6 fiber-concrete containers will be required overall.

8.2.2.3.2 Fragmentation of the core basket

The core basket is cut into fragments. Cutting of the basket is done top to bottom as parts become accessible in the following order:

Tab. Nr. 2. Core basket dismantling sequence

Step	Description	Cutting technique
1	Fragmentation of the lower slab	CAMC + Plasma cutting
2	Fragmentation of the shell to the lower slab	Band saw
3	Fragmentation of the upper part of the shell	Band saw

8.2.2.3.2.1 Core basket cutting

- Core basket fixation over turntable.
- Horizontal cut on the turntable.
- Ring shaped vertical cut on the turntable.
- Pieces insertion into transportation basket.
- Shielding cask installation over the transportation basket.
- Cask transportation to packaging area.
- Shielding doors closing.
- Packaging into containers.
- Containers extraction.

The core basket is cut into 109 fragments. The 300 mm thick lower slab poses the greatest challenge in cutting of the core basket.

Core basket fragments belong to the MLW category and are subject to loading into Medium Level Waste containers. 20 such containers are required overall.

8.2.2.3.3 Fragmentation of the barrel

The reactor barrel is cut into segments with a band saw from top to bottom as parts become accessible.

According to classification during cutting the reactor barrel will have three zones: fragments of the upper and lower zones are LLW, fragments of the central zone of the reactor barrel are MLW.

8.2.2.3.3.1 Barrel cutting

- Barrel transportation inside the container to the cutting station.

- Barrel placement on the turntable.
- Central part horizontal cut on the turntable.
- Barrel lifting inside the container.
- Ring shaped vertical cut on the turntable.
- Pieces insertion into transportation basket.
- Shielding cask installation over the transportation basket.
- Ensemble Cask and basket transportation to packaging area.
- Shielding doors closing.
- Packaging into containers.
- Containers extraction.
- Barrel + RIS container lowering over turntable for the following cutting steps with the same sequences.

The reactor barrel will be fragmented:

- The central part (MLW) into 40 fragments.
- The upper and lower parts (LLW) into 32 upper part and 16 lower part, total 48 fragments.

Fragments belonging to the MLW category are loaded into Medium Level Waste containers. Overall 6 such containers will be required.

Fragments belonging to the LLW category will be loaded into fiber-concrete containers used for disposal in the Mochovce repository. Overall 7 such containers will be required.

8.2.2.3.4 Fragmentation of the barrel bottom

8.2.2.3.4.1 Barrel bottom cutting

- Barrel bottom fixation over turntable.
- Horizontal cut on turntable.
- Ring shaped vertical cut on turntable.
- Pieces insertion into transportation basket.
- Ensemble shielding cask installation over the transportation basket.
- Cask transportation to packaging area.
- Shielding doors closing.
- Packaging into containers.
- Containers extraction.

The bottom of the reactor barrel is cut into segments with a band saw, upper and lower shell part 74 pieces, central tubes 111 pieces and central shell 18 pieces, total 203 fragments. Fragments of the reactor barrel bottom belong to the LLW category and are subject to loading into fiber-concrete containers. Overall 8 fiber-concrete containers will be required.

8.2.2.4 *Fragmentation of the reactor shielding assemblies, absorbers of the control rod drives, connection rods*

Fragmentation of shielding assemblies shall be performed in the wet cutting zone by means of remote operations. This alternative consists on cutting the activated elements into fragments which can be packed into containers suitable for interim storage in the ISFS or disposal.

8.2.2.4.1 RSA/ the control rod drives cutting

- RSA/ the control rod drives fixation.
- RIS/RSA container extraction.
- RSA / the control rod drives fragmentation (1 m. pieces).
- Pieces manipulation into transportation basket.
- Shielding cask installation over the transportation basket.
- Cask transportation to packaging area.
- Shielding doors closing.
- Packaging into containers.
- Containers extraction.

Cutting devices available in the wet cutting station shall be used for shielding assemblies cutting. A dedicated guillotine knife is used for fragmentation (a device similar to the one used in cutting of fuel assemblies in “hot” chambers). Nevertheless, band saw cutting installations already available for RIS dismantling operations might be used as well, due to thickness limitation of guillotines. During next engineering definition phases, the cutting method shall be precisely defined.

Items are cut into fragments no longer than 1 m. The cut-off parts shall be introduced by means of a manipulator into a basket. The basket is set into a MLW type container.

RSA are completely activated therefore there is no consideration of separation LLW from MLW and complete assemblies shall be sent to ISFS for long term decay storage. RSA fragments will remain there until they are suitable for further management.

Transportation shielding sets from the storage pool of 2.unit to the cutting area will be carried out by a conventional protective channel for shipping. The set will be launched and anchored below the water surface.

Fragmentation of the connecting rods will be carried out in dry cutting zone, see chapter 8.1.1.1.1.

8.2.2.5 *Fragmentation of the annular water tank*

Fragmentation of the annular water tank will be performed in order to divide the activated part of the tank with a weight of 10.2 t (maximum weight of the inner casing, considering a protective cylinder and filling of less than 25 t) from the remaining structures and to obtain the possibility to store the activated tank fragments in fibre-concrete containers.

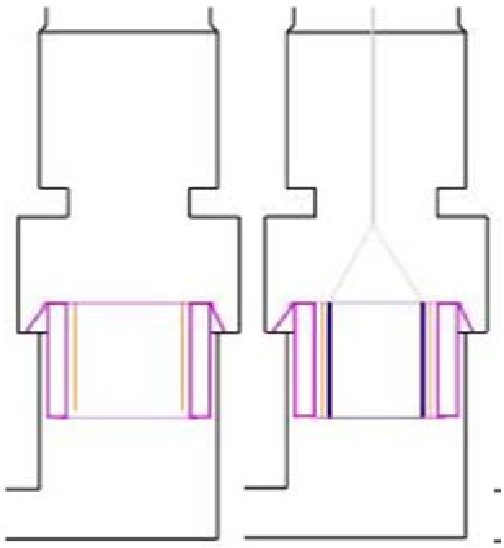
Cutting of annular water tank will be carried out in the dry cutting zone set up for the reactor pressure vessel.

It will be performed by means of a band saw. The bases and middle rings will be cut off at the inner casing of the annular water tank. In the next step, the inner casing fragment shall be cut in approximately 4 parts.

Main activities for AWT dismantling are, in sequence are:

1 Protection installation: A 25 mm thick wall and 9.8 Tons weight cylinder shall be installed onto the internal surface of the tank. This protective cylinder has two functions: immobilization of the heat insulation on the internal surface of the tank and additional protection against radiation. Cylinder and internal Shell are fixed with an immobilizing solution that fills the space between these two components. The backfill solution could be cement, resin, polymer, etc. so its total weight would be 2-5 Tons depending on the material.

Graph No. 45. Protection installation



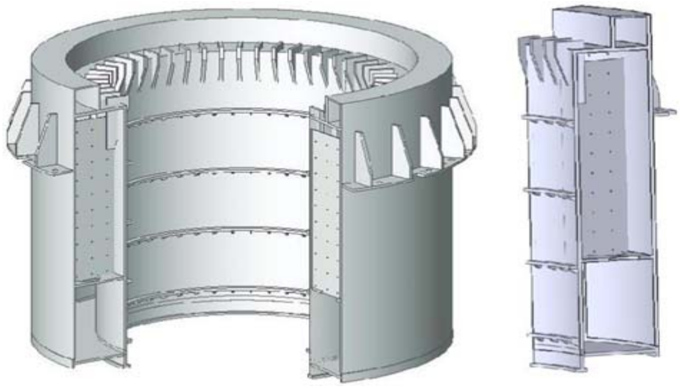
2 Water draining.

3 Filling of the internal space with grout (LDCC), by injection, with the purpose of prevent vibration during cutting process and reduce dose rate for operators. LDCC has a lower density and a lower thermal conductivity than regular concrete.

4 Primary cutting (on-site) into 12 fragments. During cutting of the AWT, the reactor shaft is closed off at the level of the concrete ledge. The cutting is done with a wire rope. It´s

necessary to take into account that ex-core neutronic flux measure channels pass through the AWT.

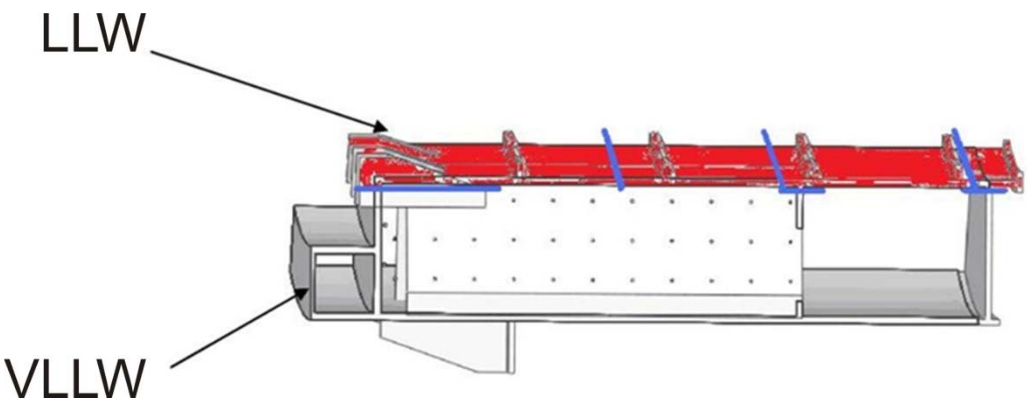
Graph No. 46. AWT primary cutting



5 Lifting and transportation of cut-off fragments to the dry cutting area.

6 Secondary cutting (fragmentation) of the AWT, in dry cutting area. The objective of this activity is to separate the activated part of the tank (LLW) from the rest of structures (VLLW) and obtaining the possibility to package activated fragments of the AWT into FCC´s. The bottoms and the middle ring are cut off in areas adjoining the internal shell of the annular water tank.

Graph No. 47. AWT secondary cutting



Each 12 fragments obtained from the primary cutting is cut into five parts (four LLW pieces and one large VLLW). These secondary cuts are represented by the blue lines in the figure above. Three of the four LLW parts are 1400x1080x22mm (large fragments) and the other one is 300x1080x22 (small fragments).

It´s strictly necessary that, during design phase of the dry cutting area, shape, weight and dimensions of the fragments of the AWT have to be taken into account.

Four FCC´s (Fiber-concrete containers) will be necessary for packaging all the activated parts of the AWT. Each FCC will store 9 large and 4 small fragments. Then, they will be removed by the maintenance aperture.

VLLW fragments are extracted from the dry cutting area by the Steam Generator aperture and stored in 6m ISO containers.

8.2.2.6 *Fragmentation of the contaminated equipment of PC*

Annex 2 shows the dismantling and treatment stages contaminated materials from PC and the sequence of activities of dismantling and treatment of contaminated materials is shown in Annex 3.

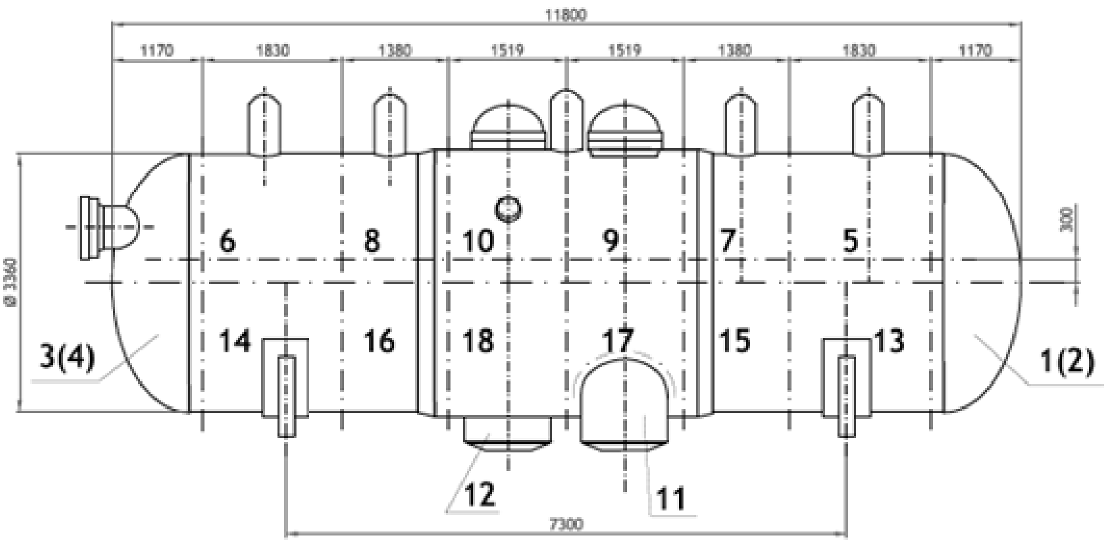
8.2.2.6.1 Steam generators

8.2.2.6.1.1.1 Large fragmentation

Initially, each steam generator is cut into large parts by means of gas cutting, as presented in the figure below. A PFU shall be used to maintain on depression the SG meanwhile the cutting works are taking place connection the aspiration section to the steam pipe stub (on the SG body) and eventually connected to the regular exhaust ventilation system of the region.

Overall number of fragments is 18 pieces, including the two headers which shall be dismantled as a whole.

Graph No. 48. Steam generator cutting scheme



Regarding the tubing, it shall be removed as 5 m long pipes. In the area of the U-shaped bend the tubing shall be cut by means of a wire rope saw. Afterwards, pipes shall be post-fragmented in order to fit into the transportation containers.

8.2.2.6.1.1.2 Post-fragmentation

The additional fragmentation on site shall be conducted in the free spot left by the steam generator which has been previously extracted as a whole. In this area, a vertical band saw machine shall be installed in order to obtain small parts, up to 800 mm, which shall be inserted into containers and extracted through the erection aperture.

The large fragments transportation from the SG initial position to the post-fragmentation area shall be performed by means of a mobile gantry, composed by beams and hoist with enough capacity for assuming the large fragments loads and enough spam to charge the small fragments into the containers. Gantry is designed with the adequate dimensions and bearing capacity by steel beams, including a lifting device and rollers in the bottom part, to allow the dismantling and transporting of the different pieces.

8.2.2.6.2 Pressurizer (PZR) with bubble tank

8.2.2.6.2.1.1 Fragmentation of PZR

The pressurizer dismantling location shall be established using rooms R106/1 (unit 1) & R106/2 (unit 2), as well as adjacent rooms R002/1 (unit 1) & R002/2 (unit 2).

Pressurizer tank dismantling location shall be established in rooms A502/1 (Unit 1) and room A502/2 (Unit 2).

The dry cutting zone shall consist on work areas separated from others by SAS. It is divided into four different areas:

- Primary Fragmentation PRZ.
- Secondary Fragmentation PRZ.
- Fragmentation PRZ Tank.
- Transport and packaging.

The Cutting zones consist of a set of the following components:

- Protective covers;
- Scaffolding;
- Anchoring protective structure;
- Overhead gantry (over monorail);
- Oxyacetylene cutting torch;
- Wire rope saw;
- Jib crane;
- Radiation background sensors;
- Lifting mechanisms, wire ropes and traverses;
- Ventilation and gas filters;
- Shielding walls, gates, and manholes.

Regarding different areas in the cutting zone, the following activities shall be performed.

8.2.2.6.2.1.2 Primary Fragmentation PRZ

The primary cutting area is located at R106/1 (unit 1) & R106/2 (unit 2) at el +2.70. It shall be equipped with oxyacetylene torch for large ring-shaped fragments. The cutting process begins with the top part of the PRZ while it is secured by the monorail. It shall have appropriate man basket or scaffolds that have to be adapted to the cutting conditions.

8.2.2.6.2.1.3 Secondary Fragmentation PRZ

This area shall be implemented in the room R004/2 (unit 1) & R004/4 (unit 2) and is separated from the primary one SAS. Once that initial cutting has been performed in the primary cutting area, the monorail shall conduct the ring-shaped fragment to the secondary cutting area, where the ring-shaped piece shall be lowered to the floor for secondary fragmentation.

The fragmentation area is equipped with another oxyacetylene torch to perform the final fragmentation of the ring-shaped PRZ portions

8.2.2.6.2.1.4 Fragmentation of bubble tank

The fragmentation area for the bubble tank is located at Room 502 1 / 2 at El +14.70, equipped with wire rope saw and oxyacetylene torch as primary cutting method.

The fragmentation area is also equipped with additional cutting devices and manipulators. It is in this area where cutting takes place making it possible to transport to the packaging area in order to place all of the parts into containers.

The fragmentation shall be conducted in the bubble tank room, and pieces shall be transported through the adjacent room (A503/1 (unit 1) & A503/2 (unit 2)) to the extraction room (A511/1 (unit 1) & A511/2 (unit 2)). These rooms present removable concrete slabs as ceiling. Here, pieces shall be lowered by means of the existing bridge crane to level +10.50 m.

8.2.2.6.2.1.5 Main fragmentation

- PRZ tank cut marking.
- PRZ tank cut by means of wire rope/ acetylene torch.
- Fragments transportation to room A511/1 (unit 1) or A511/1 (unit 2).

8.2.2.6.2.1.6 Packaging and transportation

- Container installation in level -1.5.
- Fragments load by bridge crane.
- Transportation to container.
- Fragments loading into container.
- Container closing.
- Container extraction.

8.2.2.6.3 Main coolant pumps, main valves and primary piping

The proposed dismantling method assumes maximization of free release and avoiding arrangement of new fragmentation and decontamination facility in the V1 Turbine Hall. All equipment is fragmented in-situ to small fragments suitable for fragmentation and decontamination in C7-A2 and C7-A3 facilities.

Due to the reduced space and difficult access, previously to the RPV lifting the main cooling pipeline shall be cut close to the RPV nozzle, it will be performed with remote internal cutting equipment.

Graph No. 49. Cutter introduction

Primary pumps and valves will be fragmented by thermal (mainly) and mechanical methods. These methods are described in previous sections of this document.

Dismantling of the MCP (Main Coolant Pump) consists in removal of the extractable part in accordance with the maintenance process and cutting of the MCP shell into fragments of up to 800 mm.

The MCP shell is cut manually. The shell is cut into two parts with an acetylene cutter. A cut-off part of the MCP shell is transferred for cutting with a band saw machine equipped with a system of turning band saw guides and preliminarily installed in the SG bay.

The MCP shell is cut into 10 fragments with the band saw machine.

The pipelines are cut into 34 fragments (for one loop) of up to 800 mm in length. Average weight of one fragment is about 300 kg.

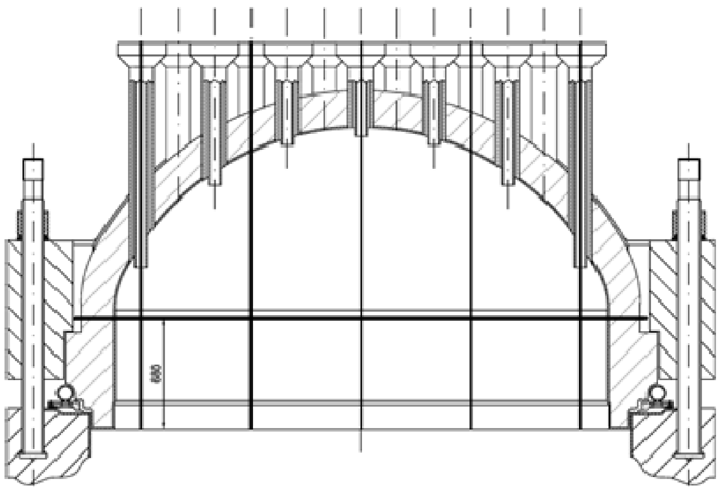
8.2.2.6.4 Reactor vessel head

Remote operated dry cutting process shall be the option implemented for RPV head dismantling. This alternative consists on cutting contaminated elements of the reactor pressure vessel head into fragments that can be packaged into containers.

As it has been described in previous sections (for the RPV dismantling), the cutting process to be performed for the RPV head dismantling shall consist in dry cutting by means of band saws, both vertical and horizontal.

In the primary cutting area, RPV head shall be horizontally cut. For the cutting process, the band saw is driven from the intervention area to the pre-cutting area. The cutting is automatically performed and monitored from the control room by a camera system.

Graph No. 50. RPV head horizontal cut



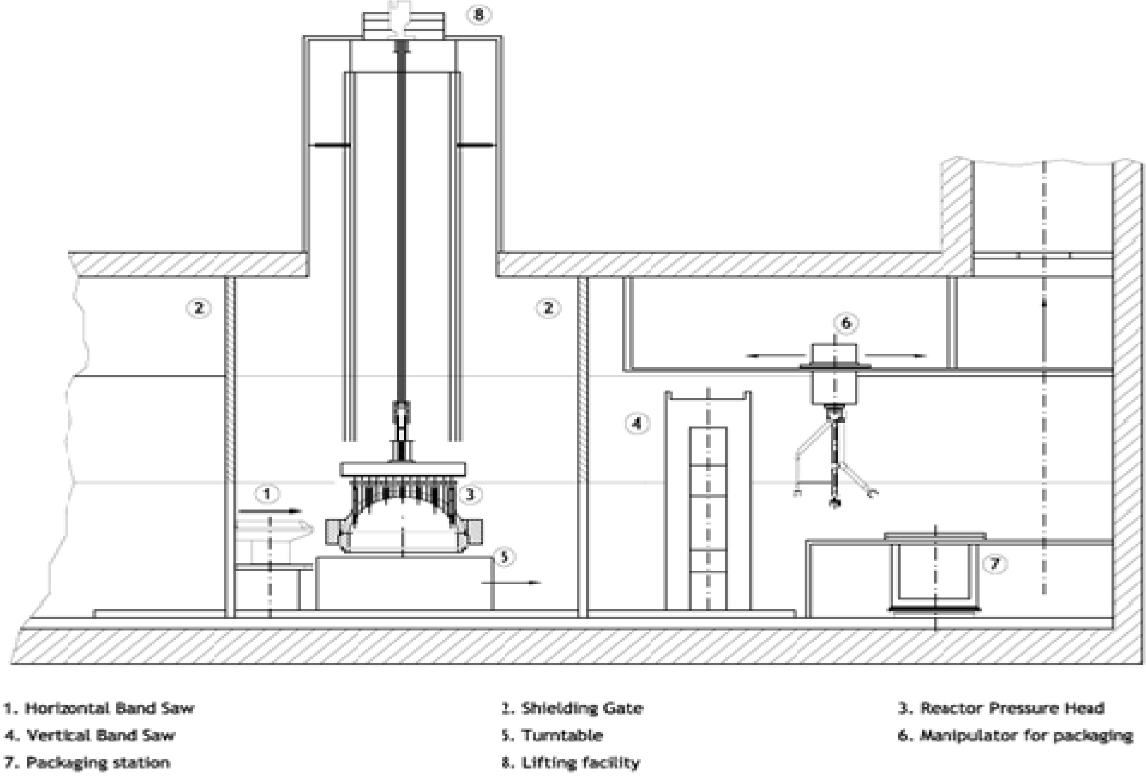
Main activities involved:

- Vessel cut marking
- First cut performance until depth is achieved.
- 180º RPV head rotation.
- Next cut performance and sequence repetition until horizontal cut is finished.
- Saw blade retreat to the pre-cutting place.
- Fragment and turntable transportation to the secondary cutting station.
- Shielding doors close.

8.2.2.6.4.1.1 Secondary cutting

- Vessel head cut marking.
- Vertical cutting.
- Rotation for next vertical cut.
- Pieces transportation to packaging area (over turntable).

Graph No. 51. RPV head initial position for horizontal cutting



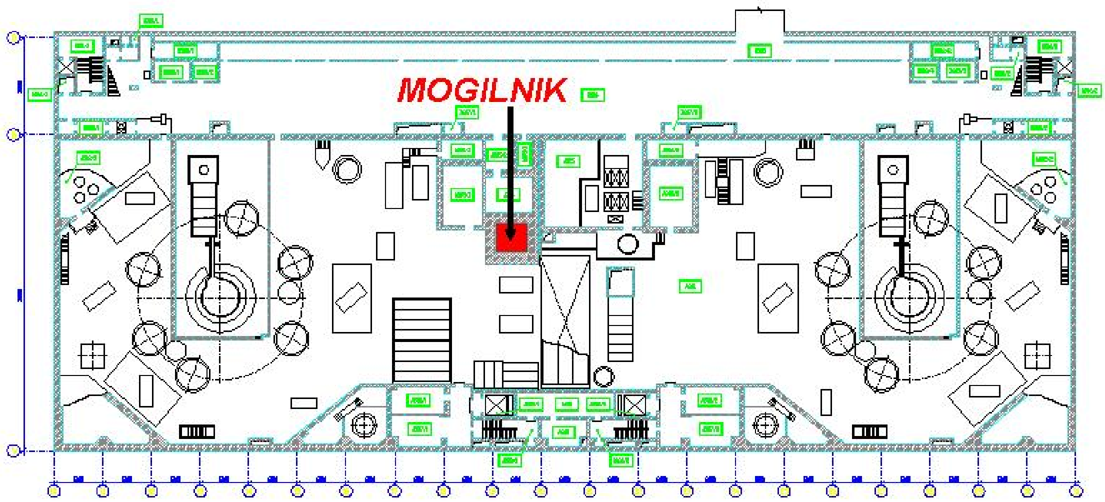
8.2.2.6.5 Mogilnik

The historical high level radioactive solid metallic wastes stored in the waste storage facility, called "*mogilnik*" (derived from the Polish term for "graveyard" or "burial place") comprise mostly inner reactor metallic parts (connection rods, absorbers of control rod assemblies and neutron flux measurement channels) that are, besides the surface contamination, activated within their overall volume due to neutron flux.

The major part is constituted by connection rods and absorbers. The *mogilnik* storage facility is accessible directly from the reactor hall in the main reactor building and it is designed as a dry pit.

The concrete cover of *mogilnik* will be destroyed down to a depth of 1 m, starting from the corner of *mogilnik*. In doing so, rods become accessible and will be pulled out by the crane. At the same time, a safety floor is constructed at the lower side of the *mogilnik* plate (*mogilnik* dividing grid) in order to prevent persons, equipments and fragments from falling to the bottom of *mogilnik*. *Mogilnik* rods are designated for further fragmentation. For this purpose, the rods will be lowered by crane to the SG box in the reactor hall where they will be cut by means of band saw.

Graph No. 52. Mogilnik location in V1 NPP Reactor Hall



The scope of this activity includes:

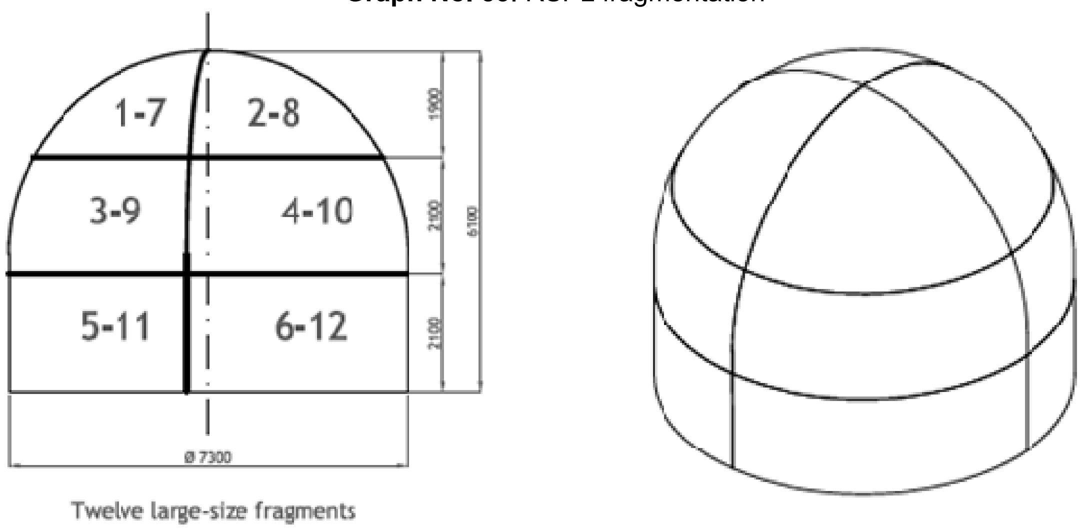
- Removal of waste,
- Classification of waste,
- Fragmentation,
- Packaging into shielded metallic containers or to FCCs.
- Transportation of containers to the Interim RAW Storage Facility or the Bohunice Processing Centre for final conditioning.

The metallic RAW will be processed into a form acceptable for storage or final disposal in the repository.

8.2.2.6.6 Reactor shaft protection lid (RSPL)

The reactor shaft protective lid is cut into twelve large-size fragments. For the purpose of cutting the lid the layer of concrete is first of all removed in areas marked for primary cutting.

Graph No. 53. RSPL fragmentation



After removal of the concrete in the marked areas, the metal part of the lid is cut by means of acetylene cutting. The fragment to be cut off is preliminarily slung.

The concrete has little adhesion with the metal surface of the protective lid and is held by embedded parts (brackets). Removal of concrete is performed with a chasing tool and hydraulic jack-hammer.

Fragmentation of the reactor shaft protection lid in the central hall with dispatch of fragments for free release. Obtained fragments are placed on the buffer storage site arranged in the central hall for subsequent fragmentation.

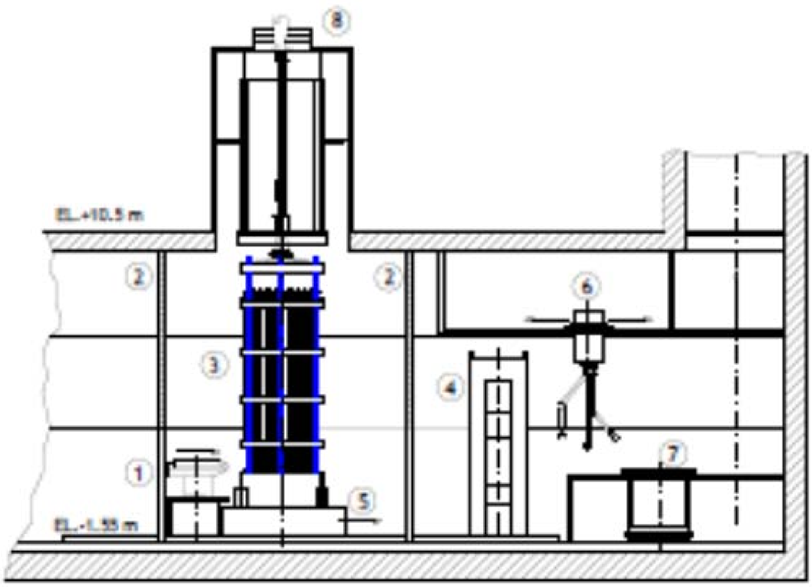
After the fragmentation in big parts, then complete fragmentation will be performed in C7-A3 area. Secondary fragmentation will be done with diamond wire rope.

8.2.2.6.7 Reactor vessel head upper block

The cutting process to be performed for the Upper Block dismantling shall consist in dry cutting by means of band saws, both vertical and horizontal.

Cutting steps shall be similar to the RPV dismantling process. The cutting process begins with the bottom part of the Upper Block while it is held by the central hall crane. After it, the first cut part will be removed from the cutting table and the held component will descend to the second primary cut position and successively.

Graph No. 54. RUB initial position for horizontal cutting



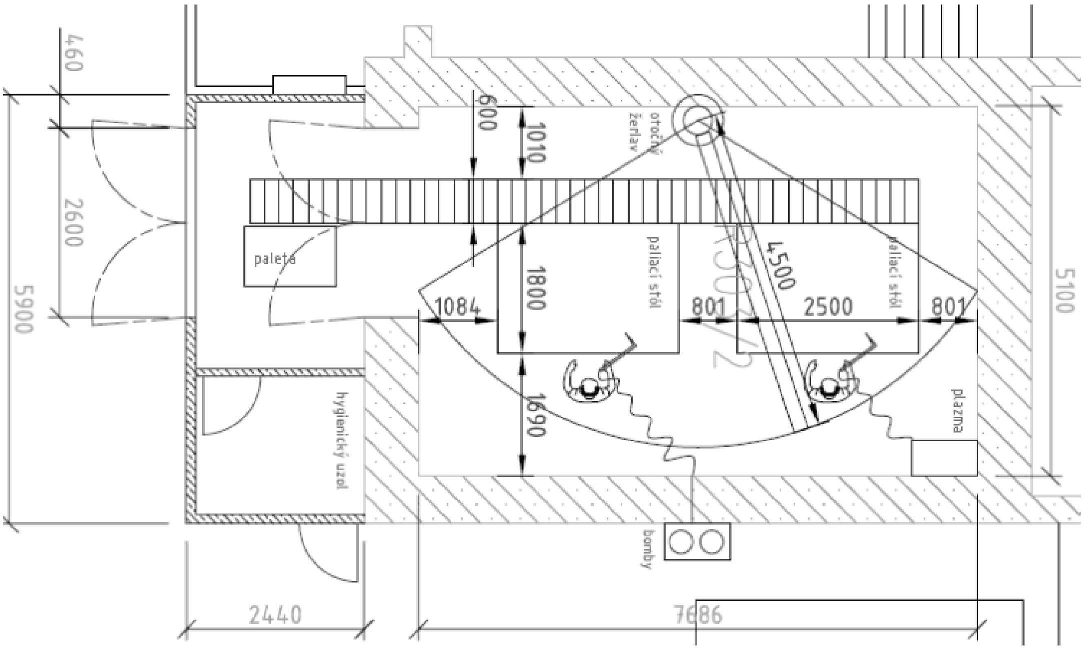
By this cutting, a total of 643 fragments are obtained (407 parts from the tubes, 66 from the stiffeners and 170 from the shell).

Packaging requirements and activities are the same as taken into account for Reactor Pressure Vessel dismantling.

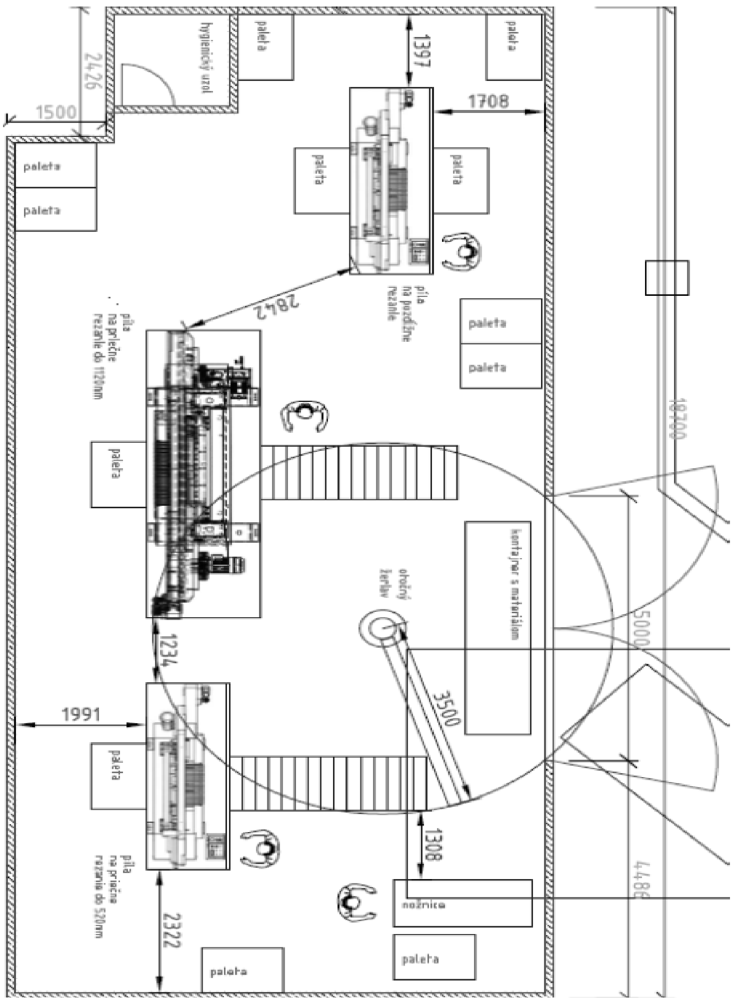
8.2.2.7 *Other contaminated equipments of PC*

Any other components of the PC will be, after dismantling, transported to F&D stations in the framework of projects C7-A2 and C7-A3 and subsequently released to the environment, stored or placed.

Graph No. 55. Fragmentation workplace 1-termic NPP V1 +10.5 m



Graph No. 56. Fragmentation workplace 2-mechanical NPP V1 +10.5 m.



8.2.2.8 *Other equipments in and out of the CZ*

The fragmentation process aims at dividing materials using the suggested devices into smaller pieces, which can be transported to the F&D stations. Fragmentation activities will be carried out at fixed work stations assigned for this purpose. The individual work stations will be adjusted to the given applied methods, with focus put on providing maximum safety at work and minimizing the generation of radioactive wastes and will be connected to exhauster ventilation systems of the power plant V1 NPP, which are equipped with large-volume highly effective aerosol filters and empty into the ventilation stack of V1 NPP.

The individual fragmentation tasks will be carried out by:

- Low speed segmentation.
- High speed segmentation.
- Hydraulic segmentation.
- Thermal segmentation.

8.2.2.8.1 Hydraulic cutting

- Usage – for materials where we don´t expect next processing (including internal decontamination) e.g. pulse pipes, cables,…
- Advantages – prevention of radioactive contamination and ambient air
- Disadvantages – it cannot be used for large equipment, shape deformation hinder potential internal decontamination.
- Impacts – zero emissions and radioactive contamination

8.2.2.8.2 High speed cutting

- Usage – in places where we can´t use other mechanical methods, preferably during materials dividing with low contamination.
- Advantages – division rate
- Disadvantages – risk of dispersion radioactive contamination, thermal fixation of contaminant into material, fire risk.
- Impacts – emissive production, potential deterioration of the working environment

8.2.2.8.3 Low speed cutting

- Usage – for materials with higher decontamination
- Advantages – minimization of radioactive contamination and ambient air, elimination of thermal fixation of contaminant into the material.
- Disadvantages – longer time for dividing materials, higher special requirement.
- Impacts – minimization of the impact on the environment.

8.2.2.8.4 Thermic cutting

- Usage – in places where we can´t use any other mechanical methods.

- Advantages – division rate.
- Disadvantages – risk of toxic gas inception, dispersion radioactive contamination. thermal fixation of contaminant into material, high fire risk.
- Impacts – emissive production, potential deterioration of the working environment.

8.3 Decontamination of equipments

8.3.1 Activated equipments

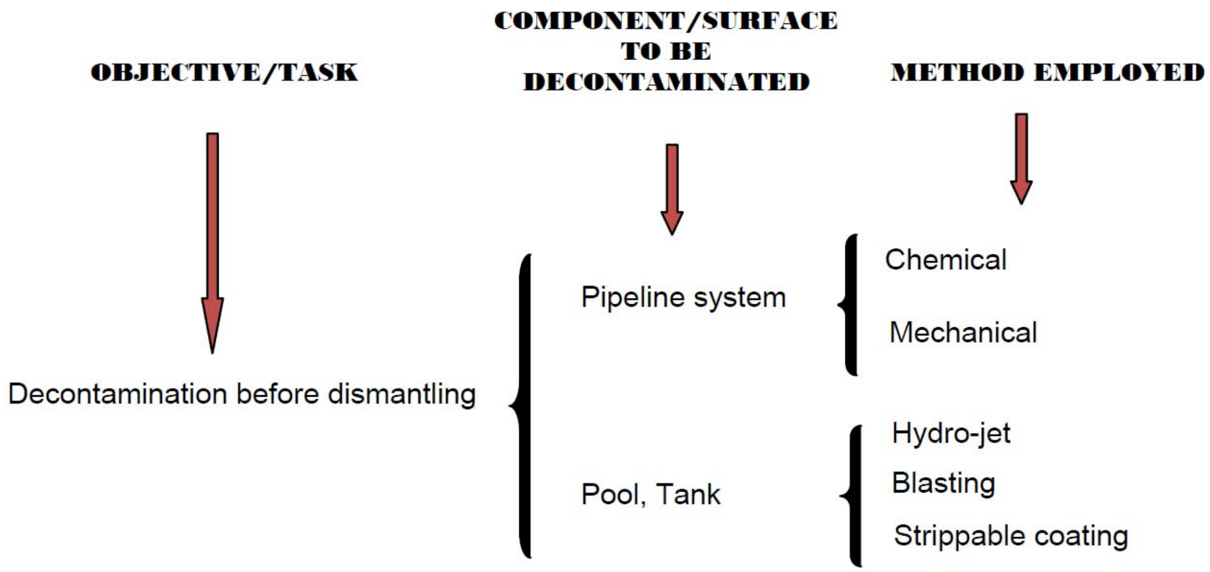
There will be no decontamination of activated equipments.

8.3.2 Contaminated equipments

8.3.2.1 *Decontamination of contaminated equipments in situ*

Decontamination is defined as the removal of contamination from the surfaces of facilities or equipment by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

Graph No. 57. Decontamination methods



The reduction of radiological contamination implies the following benefits:

- Removal of loose radioactive contaminants and fixing the remaining contamination in place in preparation for further treatment.
- Reduction of radiation exposure of workers who will carry out subsequent dismantling activities in the areas where the equipment is located.
- Reduction of the volume of radioactive material requiring storage and disposal.

- Limiting costs of maintenance and surveillance during waiting periods prior to dismantling.
- Facilitating final dismantling, disassembly and cutting and the resulting operations of manipulation and handling.
- Reduction of additional facilities required to ensure safety and protection during operations.

8.3.2.2 *Decontamination of tank*

All the tanks have to be drained and cleaned from sludge, crystals and other remaining materials prior to any decontamination process.

For the removal a portable underwater vacuum cleaner will be used. This equipment will be able to remove the non-soluble particles accumulated in the bottom of the tanks reducing the operator radiation dose uptake.

The equipment will consist in a pump that permits high volumetric flow suction, with a flexible collection end designed to permit the coupling of a number of accessories (i.e. remote vehicle, brushes, variety of nozzle shapes, etc.). It will be provided with an extensible pole to allow the operability of the equipment from the ground level.

The equipment will be connected by a flexible hose with a suitable high efficiency particulate air filter (HEPA).

Remotely operated high pressure water lancing will be used to decontaminate tanks surfaces due to it is very effective in removing contamination with minimal dose uptake to the worker.

Inside large tanks with highly contaminated surfaces, chemical foams and gels will be applied prior high pressure washing. Decontamination agents (acid) will be mixed with organic foam or gel which will be applied to a surface with a spray nozzle.

Waste produced due to the decontamination of tanks will be drained if possible to the V1 NPP liquid waste processing system. If drainage systems were not available at that decommissioning stage, the waste will be collected on the bottom of each tank and removed by pump. Pumped waste will be collected to be transported for its treatment and conditioning.

8.3.2.3 *Pipes and heat exchangers decontamination*

Equipment will be firstly isolated from the rest of the system. The decontamination equipment will consist of chemical injection equipment, a particulate filter, temporary ion exchange columns with shielding and a process heater/cooler.

The decontamination will consist on the exposition of contaminated parts to chemical solutions which dissolve the radioactive deposits which have accumulated on the process equipment. The spent decontamination solutions are then treated by ion exchange to retain all the chemical and radioactive burden of the decontamination solution on the resin, while clean water is returned to the system.

Dissolved deposits, including removed activity, and chemical agent residuals shall be trapped and retained on ion exchange resins.

Waste resins from the decontamination have to be processed or stored at an appropriate location which may be some distance from the decontamination equipment.

8.3.2.4 *Decontamination of spent fuel pools*

After racks removal, some samples of the sludge will be taken and will be analysed in the laboratory to estimate gamma spectrometry and gross alpha. These data will aid in the planning of removal works for the radiological protection of workers.

On the basis of experience, it has been found that dirt, corrosion products and foreign material tend to accumulate under and along the sides of spent fuel racks. The loading of spent fuel racks adjacent to the spent fuel pool wall (lined with stainless steel) may increase radiation levels to areas adjacent to the exterior portion of the particular wall because of the closer proximity of the spent fuel to the wall.

For the sludge removal a portable underwater vacuum cleaner will be used. This equipment will be able to remove the non-soluble particles accumulated in the bottom of the pool and also the particles that are in suspension due to the rack decontamination process.

The equipment will consist in a pump that permits high volumetric flow suction, with a flexible collection end designed to permit the coupling of a number of accessories (i.e. remote vehicle, brushes, variety of nozzle shapes, etc.). It will be provided with an extensible pole to allow the operability of the equipment from level 5.67 m. The equipment will be connected by a flexible hose with a suitable high efficiency particulate air filter (HEPA). Some flexibility in the collection pipework will be provided to maneuver the nozzles around the pool floor.

This remote equipment will reduce the operator radiation dose uptake arising from hands-on manipulation of the debris, by installing the unit below the water, thus obtaining radiological protection from the pool water itself.

After the waste go through the filters it will be disposed in 200 l drums.

Floating skimmer will be also used to remove particles from the pool surface which would depose and re-contaminate the walls. It will serve also to facilitate the remote operations from the top by maintaining good visibility. Following completion of the sludge removal, the remaining pool water will be suctioned.

When the pool is empty a remotely operated technique is required for the activities in the pool to lower the radiation dose rates to a safe working level.

In order to remove the loose contamination, the complete surface of walls and floor of SFPs and will be pressure washed by means of high pressure water.

After that it could be necessary to do manual brushing to eliminate the contamination from hot spots that will be identified measuring gross alpha and beta from smears and using the dose rate meters.

Then, the remaining water will be pumped and send to the Bohunice RWTC.

Strippable coating of pools surfaces will be applied to protect the materials against recontamination until their dismantling.

8.3.2.5 *Post-fragmentation decontamination*

Post-fragmentation decontamination aims at reducing the surface contamination to such a level that the materials can be released into the environment in accordance with the legislation valid at the time of the release, or to the level applicable to the chosen disposal method. Decontamination calls at the same time for creation of conditions for processing of secondary waste that will comprise the major part of radioactive inventory from the contaminated facilities of V1 NPP.

Only such decontamination media will be used for decontamination purposes that meet the conditions for processing and disposal in the NRR Mochovce. Decontamination work stations will be connected to the exhauster ventilation systems of the V1 NPP plant furnished with highly effective large-volume aerosol filters which empty into the ventilation stack of V1 NPP. At the same time, these work stations will be connected to the system of collection and processing of radioactive contaminated waters.

Proposed methods of post-fragmentation decontamination:

- Electro-chemical decontamination in the decontamination tank.
- Ultrasound decontamination in the decontamination tank.
- High-pressure blasting in the decontamination tank.
- Abrasive blast cleaning in a basket.
- Manual abrasive blast cleaning.

8.3.2.6 *Electro-chemical decontamination in the decontamination tank*

To be applied for removal of fixed contamination from the surface of dismantled and fragmented installations, parts of contaminated equipments.

8.3.2.7 *Ultrasound decontamination in the decontamination tank*

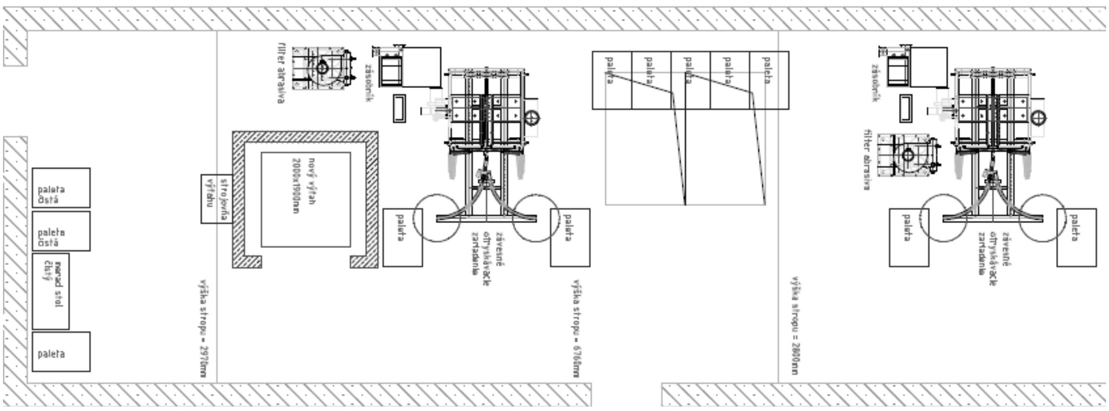
To be applied for final cleaning of materials from lightly fixed contamination using ultrasound, following electro-chemical decontamination.

8.3.2.8 *High-pressure blasting in the washing tank*

To be applied for washing of materials and removal of remaining non-fixed contamination even at badly accessible surfaces, following electro-chemical and ultrasound decontamination

8.3.2.9 *Blast cleaning*

Graph No. 58. Decontamination workplace 1- Abrasive in a basket NPP V1 +2.6 m



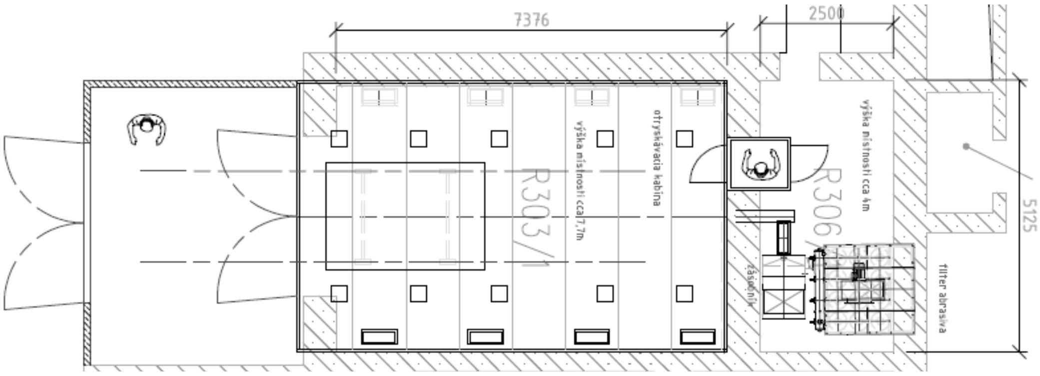
8.3.2.9.1 Abrasive blast cleaning in a basket

To be applied for blast cleaning of fragmented metal components with surface contamination that are loosely introduced into the basket (in form of single charges) by the movement of which they rotate and are blast cleaned.

8.3.2.9.2 Manual abrasive blast cleaning

To be applied for manual blast cleaning of large-scale thick-walled objects with surface contamination.

Graph No. 59. Decontamination workplace 2- Abrasive manual NPP V1 +2.6 m



8.3.2.9.3 Dry mechanical abrasive blast cleaning

The principal method applied for decontamination of carbon steel surfaces will be dry blast cleaning of surfaces of fragmented parts by abrasives. This method aims at removing the superficial layer (protective paint, corrosion layer) down to the basic material.

Dry abrasive blast cleaning methods will be applied for primary removal of materials such as oil, lubricants, oxides (corrosion) and paint or other varnishes. Abrasive blast cleaning will be also applied to stainless steel to ensure the effectiveness of electro-chemical decontamination that can be inhibited by the presence of materials sticking to surfaces of components to be decontaminated.

Any equipments to be provided for this purpose must feature an exhauster system with a suitable filtration module. The equipment must be capable of removing any tightly adhering material including corrosion layers.

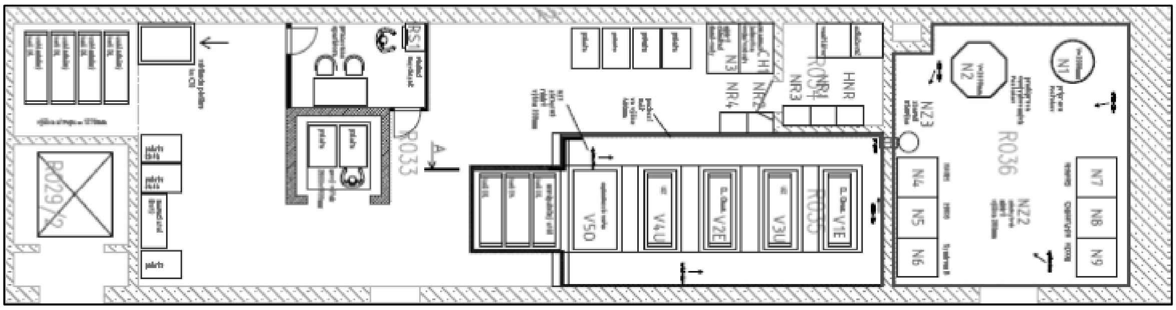
The work station must also be equipped with manipulation tables, electric chain hoists, fork lifters and trucks for handling of pallets

8.3.2.9.4 Electro-chemical tank decontamination

Electro-chemical tank decontamination method complemented by cleaning in ultrasound tanks and high-pressure water blasting will be applied for decontamination of stainless steel. Mechanical processes can be applied for cleaning of areas with the highest activity (scouring and blast cleaning with abrasives).

The decontamination line must be provided with tools allowing for preparation and filling up of decontamination solutions, filtering and regeneration of used solutions, management of decontaminated materials, operational monitoring of material contamination, operational control, separation and transport of generated RAW to the processing station for secondary RAW.

Graph No. 60. Decontamination workplace 3-Electrochemical and ultrasound NPP V1 -1.8 m



8.4 Other RAW modification and treatment technologies

8.4.1 Cementation facility (Bohunice RAW Treatment Center, BRWTC)

Radioactive wastes in solid form are introduced into the FCC and sealed with active cement mixture. This mixture is produced in the cementation facility - inclined cement mixer. The cement mixer comprises a dispenser tank into which RAW are introduced either directly (concentrates) from the concentration facility or through the entrance reservoirs (resins - ionexes or sludge).

Following proved formulas, the inclined cement mixer is filled by RAW dispensed from the dispenser tank and admixtures and cement from the reservoirs.

After thorough mixing, the cement product is filled into a fibre-concrete container (volume 3 m^3). Containers with maturated and hardened cement are sealed, checked and transported to the NRR Mochovce.

8.4.2 Incineration facility (Bohunice RAW Treatment Center, BRWTC)

Here, solid and liquid wastes are incinerated. Combustible waste is packed in the separation facility into plastic sacks with a volume of approximately 15 l and put into 200 l barrels to be transported to the incineration plant where the sacks are filled by means of the dispenser facility into the oven. The facility has a capacity of 30 kg/h solid waste and 10 kg/h liquid waste in the combined incineration mode and 50 kg/h of solid RAW in the solid waste incineration mode. Solid wastes are dispensed through a system of boxes into the feeding box that represents a safety pass-through - loop.

The incineration furnace itself consists of two chambers (the main incineration furnace and a combustion chamber), constructed as shaft oven. There are no internal build-in parts in the furnace. Incineration is carried out in two zones. In the lower zone, incineration with a steam-air mixture takes place, by which it is ensured that the temperature of the burning material is 900 °C and hence excluding that clinker and caking are produced at the furnace walls. In the upper zone, the major amount of air is lead directly above the burning material (operation with oxygen surplus) and the amount of air is set so as to produce a burning temperature of 750 ÷ 950 °C.

Gaseous residues, ash and fly ash from the furnace are further incinerated in the combustion/ post-burning chamber at a temperature between 950 ÷ and 1150 °C. Ashes are regularly discharged and processed into the reinforced agent paraffin, in which they are mixed to form a homogeneous mass.

Prior to the release into the environment the combustion gases are purified in washing devices and filtered, using HEPA filters. Residue washing water is conveyed for cementation and subsequently solidified into a solid agent. The combustion residues are continuously monitored as to the content of chemical pollutants and radiologic characteristics, before they are discharged through the ventilation stack.

8.4.3 Pressing facility / Compactor unit (BRWTC)

In the pressing facility, the compressed waste is sorted and packed into 200 dm^3 barrels. The barrels are compacted in the high-pressure compactor with a capacity of 20,000 kN. The compacted material is then loaded into fibre-concrete containers and poured over with cement mixture.

8.4.4 Separation facility (BRWTC)

It consists out of an enclosed suction separator. The non-separated solid RAW is transported into the separator in the following conditions:

- Loosely placed fragments in a foil.
- In 200 dm^3 sacks.
- In 200 dm^3 barrels (2 units).

RAW separated by the device is put into 200 dm^3 barrels and, depending on the type, it is transported for further processing to the following destinations:

- Incombustible, but pressable waste to the pressing facility.
- Incombustible and not pressable waste to the collection point for cementation.
- Combustible waste, packed in 25 l sacks, placed in a 200 dm^3 barrels to the tipping facility of the incineration plant entrance unit.

8.4.5 Concentration facility/ Evaporator (BRWTC)

The concentration facility serves for reduction of liquid RAW. The concentrate is subsequently reinforced by the cement agent.

The facility uses continuous-flow evaporation and consists out of 3 U-shape units. The capacity of the evaporation facility is 500 dm^3/h, provided the salinity of the dispensed waste is 200 ÷ 300 g/l.

The bride condensate is used to rinse pipes of the concentration facility and as a filling of washers in the cleaning system of gaseous residues from the incineration unit. The superfluous amount of the bride condensate is, after cleaning at the cleaning station, discharged into the environment.

The output product - the concentrate is collected in a collector tank from which it is transported into the cementation facility.

8.4.6 Bituminization plants PS 44, PS 100 and a plant for bituminization of radioactive sorbents PS 44/II Stage

Bituminization plants PS 44, PS 100 and the plant for bituminization of radioactive sorbents PS 44/II constitute interconnected technological units. The basic element of the bituminization plant is the rotary film evaporator with a capacity of about 120 dm^3/h. The principal function of the evaporator is to evaporate water from concentrated liquid RAW and to coat the dry fine crystals of dried salts with bitumen – fixing agent. The final product is emptied into 200 dm^3 zinc-coated barrels which are sealed, placed into FCC and poured over with cement mixture.

The bride condensate is cleaned by an oil remover, a vapex and carbon filter and pumped to the purification station of waste water for final cleaning.

The operational unit PS 100 consists out of a similar bituminization unit like PS 44 to which a purification line for low-level contaminated water is added.

Water treatment at this purification station is performed by evaporation in an evaporator with natural circulation. The bride vapour is, after condensation, cleaned by sorbent columns. Once the volume activity has been reduced below limit values the condensate is released into the environment in organised manner. The condensed fraction is, after reaching optimum concentration, treated at the bituminization plants PS 100 or PS 44.

The facility for bituminization of radioactive sorbents consists of the basic components: macerator, decanter, centrifuge, dryer and two homogenizers.

Sorbents are conveyed in transport containers to the reservoir tanks from which they are pumped by dosing devices into the macerator. Here pieces bigger than 5 mm are ground. The mixture is conveyed from the macerator to the decanter. In the decanter, any heavy solid particles are separated out of the transported water. These particles fall out of the decanter as solid phase. The solid phase is dosed into the dryer. Water coming out of the decanter is lead through a compensation tank into the centrifuge where particles bigger than 0.005 mm are separated. Sludge from the centrifuge is lead through the sludge tank into the dryer. Dried sludge and ionexes from the dryer are dispensed into the homogenizer, mixed with bitumen and aggregates to form a homogeneous product. The product is filled into a 200 dm^3 barrel. Once hardened the product is transported into the fibre-concrete container.

8.4.7 Waste water cleaning station - operational part (build. 41)

Serves for collection and cleaning of low-contamination waste water with total gamma volume activity up to $3.7.10^6$ Bq/dm^3.

Water contaminated mechanically, chemically and radio-chemically is cleaned by evaporation in boiler evaporator equipped with an external heater. The designed capacity of the evaporator is 1.5 m^3/h of evaporated water, however the actual capacity depends on the composition of processed water.

Bride condensate is then cleaned by ion exchange filters until the volume activity of radionuclides in the condensate drops below limit values. The condensate is then moved to the bituminization facility PS 44 or PS 100 to fix the salts into a bituminization matrix.

Note: The impacts of the applied technologies of modification and treatment of RAW provided in this chapter (8.2.3) are subject to a separate Environmental Impact Assessment procedure. They are mentioned by this Environmental Impact Assessment Report merely as processes associated with management of RAW emerging out of V1 NPP decommissioning.

8.4.8 Special sewage and waste water system ŠOV-3

The nuclear facilities of V1 NPP are equipped with a functional system of draining (a special sewage system) and cleaning of waste water (waste water processing ŠOV-3) that serves the draining, storage and processing of waste water. The system works in connection to the liquid RAW storage system that drains and stores waste water from the auxiliary premises and the system of drainage water cleaning. The liquid RAW storage facility is designed for transport, admission and storage of RAW. It is further designed for homogenisation, heating, compression, tapping and transport of liquid RAW.

Liquid RAW is stored in stainless steel tanks or ferro-concrete vaults with stainless steel casing.

The purification station ŠOV 3 thus fulfils two basic functions - concentration and cleaning. The concentration function is monitored by the density and total amount of dissolved substances in the concentrated sludge. The cleaning or decontamination function of the evaporator is defined through measurements of the evaporator condensate quality. Cleaning is carried out on ionex filters.

The components of the cleaning unit: evaporator, post-evaporator, condenser - deaerator, dephlegmator, filters with ionex charge, air ejector, pumps, expander with a cooler. The evaporator with automatic circulation of the processed content consists out of a heating chamber and a separator interconnected on the water and steam side. The evaporator distillate is, after ion exchange post-cleaning, collected in control tanks. Upon completion of radio-chemical analysis, the purified water is lead into tanks of cleaned condensate or it can be discharged into the outer sewage system under strictly set conditions. If water does not meet discharge limits it is emptied from the control tanks into the waste water tanks for repeated cleaning.

8.5 Transport, storage and final disposal of RAW

According to the definition provided by the Atomic Act transportation of radioactive waste comprises: activities associated with loading of radioactive waste from a nuclear facility, institutional radioactive wastes, abandoned radiators, radioactive wastes of unknown origin and unused radioactive radiators at the loading place, their transport and unloading at their destination, carried out within a nuclear facility or between individual nuclear facilities.

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.

8.6 RAW from activated facilities

Separation of low-activity from medium-activity waste ensures optimum exploitation of the NRR Mochovce.

8.6.1 Transport to interim storage

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.

8.6.2 Placement in the interim storage

The described equipments and containers will be placed for temporary storage into the third and fourth module of the interim storage facility.

8.6.3 Transport to final disposal

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.

8.6.4 Final disposal

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.

8.6.5 RAW from contaminated PC equipments and other equipments in and out of CZ

8.6.5.1 *Temporary storage*

Collecting (solid very low level radioactive waste, transitional RAW and conditionally releasable waste, i.e. waste with activity approximately to 100Bq/cm2) means temporary storage for a short period until it is possible to process the waste or to place it in a new certificate storage facility. The subject to the conditioning is the civil building 801/A:V1 and C809:V1, which are located in the premises of V1 NPP.

The Auxiliary building 801/A:V1 is located in the controlled area, intended for RAW storage and thus it is suitable for conditioning for the purposes of collecting the radioactive waste with lower activity, i.e. for the purposes of the project C16.2 implementation. By emptying and conditioning of this part of the building with the ground floor dimensions of approximately 60 x 10 m and vertical distance of 8 m, it would be possible to gain approximately 600 m2 of area, including the area needed for handling.

CB C809:V1 – Cementation facility building originally served for treatment and storage of RAW. Even though there are several rooms with equipment that needs to be maintained in the building, there is enough free space that can be used for VLLW collecting. There will be additional area after the cementation facility has been dismantled and removed. Total area of the premises (including the handling premises) with vertical distance of approximately 4 m, which will be available in this building, makes approximately 294 m2. Minor maintenance works in the building can start immediately. After completion of works and installation of control and safety systems, the building can be used for a specific purpose.

8.6.5.2 *Transport to the disposal destination*

Transport to the repository will be carried out according to valid transport legislation.

8.6.5.3 *Final disposal*

At present, a repository for low-activity waste is available at the Mochovce site and construction of a repository for very low-activity waste 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.

8.6.5.4 *General waste management for activated and contaminated main equipment*

This section aims to define the waste management coming from the RCS large components dismantling activities. RCS large components include activated equipment such as the Reactor Pressure Vessel (RPV), Reactor Internal Structures (RIS), Reactor Shielding Assemblies (RSA) and the Annular Water Tank (AWT); and contaminated equipment (Steam Generators, Pressurizer, Main coolant pumps, Main valves, Reactor Vessel Head, Primary piping, Mogilnik and Protection lid).

On dedicated sections for each RCS component is described the waste management activities related to treatment, conditioning, storage and disposal for each component and according to the radiological and physical-chemical characteristics.

This section describes the packages used for RCS equipment, the handling means and transport routes either in-site and outside, as well as the technical requirements that shall comply as a function of:

- The location of the equipment in the plant.
- The dismantling technique.
- The equipment characteristics, both radiological and physical-chemical.
- The waste end-point.
- Radiological and safety protection.

Table 4 and 5 summarize the general management strategy for each RCS large component waste stream, activated and contaminated respectively.

Tab. Nr. 3. Packages and waste flows for activated equipment

EQUIPMENT	DISMANTLING PROCESS	CLASSIFICATION	CONTAINER	STOCKPILING - BUFFER AREA	ON-SITE TRANSPORT	CONDITIONING	STORAGE	OUT-SITE TRANSPORT	DISPOSAL
RPV	Size reduction by dry fragmentation / radiological separation	LLW	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 (LLW repository)
		MLW	CFM	Reactor Hall level +10,5m	RH to IS-RAW by truck	—	Safe long-term storage at IS-RAW	—	—
RIS	Size reduction by wet fragmentation / radiological separation	LLW	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 (LLW repository)
		MLW	Collection basket into CFM	Reactor Hall level +10,5m	RH to IS-RAW by truck	—	Safe long-term storage at IS-RAW	—	—
RSA	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	—	—
AWT	Size reduction by dry fragmentation / radiological separation	LLW	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 (LLW repository)
		VLLW	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 (VLLW repository)

Tab. Nr. 4. Packages and waste flows for contaminated equipment.

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	LLW	200l drums	—	LLW	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 (LLW repository)
Metallic	Size reduction by dry fragmentation / radiological separation	VLLW (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	—	—	—	—
					VLLW (not decontaminated)	ISO Container 20'	Reactor Hall level +10,5m	RH to VLLW storage	—	VLLW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLLW repository)
		VLLW (not decontaminable)	ISO Container 20'	Wrapped in polymer film	VLLW	ISO Container 20'	Reactor Hall level +10,5m	RH to VLLW storage	—	VLLW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLLW 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
					VLLW (not cleared)	ISO Container 20'	Reactor Hall level +10,5m	RH to VLLW storage	—	VLLW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLLW repository)

Tab. Nr. 4. Packages and waste flows for contaminated equipment.

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
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 dumps/Recycling
		VLLW (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	—	—	—	—
					VLLW (not decontaminated)	Box pallets 1,2x0,8x0,8	Reactor Hall level +10,5m	RH to RWTC by truck	Treatment at RWTC	VLLW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLLW repository)
		VLLW (not decontaminable rock wool)VLLW	200l drums	—	VLLW	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	VLLW storage at SO801 or IS-RAW	Bohunice to Mochovce by truck	NRR Mochovce (VLLW repository)

8.6.6 Historical RAW (HRAW)

These RAW consist of used sorbents (A category) and sludge (B category) and are located in the building No. 801 V1 NPP. A common scheme of HRAW treatment for both categories is provided by the graphics in the Annex 9.

The following table indicates volumes and amounts of HRAW in the individual storage pools in the building No. 801 (building of active auxiliary premises V1 NPP).

Tab. No. 2. Amounts of waste (HRAW) in the individual storage pools

Storage tank No.	Data provided by the Technical characteristics of the Project C7-B	
	Total volume of RAW [m^3]	Total mass of sludge dry residue [t]
ZT20N-1	315	87
ZT20N-2	18	9
ZT20N-3	101	59
ZT20N-4	5	3
ZT10N-1	5	3
ZT10N-2	21	13
ZT10N-3	21	13
ZT10N-4	25	16
ZT10N-5	31	20
ZT10N-6	35	29
ZT10N-7	14	9
ZT10N-8	13	8
ZT10N-9	26	16
ZT10N-10	20	13
Total:	**650**	**298**

Source: Plan for management of radioactive waste from decommissioning of V1 NPP for the Project C7-B „Treatment of historical waste – sludges and sorbents“ JAVYS, 2012

8.7 Decontamination of building structures

The amount or RAW will be minimised by decontamination of fragments with help of C7-A2 and C7-A3 equipments. For fragmentation in situ and decontamination, capacities of existing and currently planned facilities will be utilised. Additional new installations are not required. Capacities of NRR Mochovce and existing transportation routes will be used as well.

This activity presupposes that the majority of PC equipments will be released into the environment under the condition that the required decontamination coefficients after dismantling will be reached.

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.

8.8 Decontamination of 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.

Activities in the framework of decontamination will be carried out according to zone classification. The following activities fall within the scope of work:

- Monitoring and control of the area, initial examination in order to identify the contamination levels and places with high activity of structure surfaces and build-in contaminated elements.
- Choice of the most suitable method or methods of decontamination depending on the level and depth of contamination penetration.
- Preparatory activities.
- Dismantling of build-in contaminated elements, removal of contaminated steel constructions.
- Decontamination of structure surfaces until required release activity levels are reached, applying the proposed methods.
- Dosimetric measurements on structure surfaces after decontamination in order to secure that the elements meets release criteria.
- Handling of concrete debris and waste produced in course of decontamination, its loading into the respective packaging (barrels, containers and similar), transport to the waste management stations and provision of other activities of waste management until its disposal.
- Final zone cleaning and maintenance.

Metal residual waste will be processed and modified in accordance with the radioactive and other residual materials management procedures. Secondary waste generated in course of surface decontamination (abrasion/scarification residue) will be processed by the existing technologies of the Bohunice Processing Centre of RAW.

8.9 Demolition of structures and filling up of construction pits

The activity objective is dismantling of remaining structures subsequent demolition of structures during the Stage II of decommissioning (after decontamination, if necessary) and waste management, including waste disposal. The activity comprises work in connection with demolition of these structures and buildings (including underground structures), waste management and provision of tools and equipments to be used. The activity scope also includes dismantling the remaining non-contaminated systems and components located in the buildings before demolition works.

Even to demolition, individual building elements will be dismantled, such as metal staircases, platforms, construction steel, e.g. painted steel beams, metal board, embedded pipes etc. The dismantled building parts will be handled as waste and processed and conditioned according to the type of waste. RAW waste management is subject to procedures described in the Chapter 2.8.1.2 above. Conventional waste will be managed pursuant the legal requirements applicable for waste management.

Once emptied the structures 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 previously described 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 towers.

When carrying out demolition activities described above, the workers will be protected to the utmost possible extent, minimising vibrations, dust, noise level, emission of gases or smoke, according to the applicable laws of Slovak Republic (in particular the Act No. 355/2007 Coll.). The workers will reduce dustiness by suitable management of work, sprinkling and cleaning of roads.

Demolition activities will be performed gradually in a planed manner. The scope of activities includes:

- Radiological, chemical and radio-chemical controls.
- In case of contaminated objects, decontamination in situ (if necessary) will be applied to the utmost possible extent.
- Removal of contaminated components by cutting and dismantling in a suitable form, allowing for transport to decontamination facilities or waste management facilities.
- Preparatory activities: disconnection of elements from networks, disconnection of feeder from connection lines, assuring the operation of main lines after disconnection, if necessary.
- Elaboration of a demolition plan, a detailed schedule of work plan and necessary procedures, obtaining authorisation for demolition for buildings according to the act 50/1976 Coll.
- Securing disconnected elements and provide protection systems prior to dismantling.
- Prior to any dismantling activities, the respective dosimetric control and verification of work safety will be performed.
- First removing auxiliary elements, such as metal staircases, platforms, construction steel, e.g. painted steel beams, metal board, embedded pipes etc.
- Handling the dismantled material and generated waste and transport to recycling/storage destinations.
- Demolition of buildings to the foundations.
- Removal of underground pipes and structures situated below buildings ground.
- Backfilling of pits with debris generated during demolition works at V1 NPP (if debris cannot be recycled or reused) or with clean debris from the A1 NPP. After these activities, terrain conditioning and landscaping will be performed and finally recycling/disposal of produced waste.

8.10 Release of decommissioned materials into the environment

The ideal approach to manage materials from NPP decommissioning is, from the environment point of view, their decontamination and release from administrative control for unrestricted use. The project BIDSF C10 "Release of decommissioned materials" is performed for purposes of continuous monitoring of materials in order to decide on their possible release from administrative control. This project aims is supply equipments assigned for classification and selection of materials generated in course of V1 NPP decommissioning, in a manner allowing for their use in accordance with applicable laws.

The decision on the future use, including final disposal alternatives will depend on the radiological features of the material. 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.

The release of radioactively contaminated materials aims to achieve effective V1 NPP decommissioning, while securing sufficient protection of public against ionising radiation.

Release of material generated from the nuclear power plant decommissioning is subject to authorisation by the Public Health Authority of SR according to the Act No. 355/2007 Coll. on Protection, Support and Development of Public Health and on Amendments and Supplements to Certain Acts, as amended, § 45 paragraph 5, "Permission to release radioactive substances and radioactively contaminated subjects produced or used in activities resulting to irradiation, which were carried out with a permission by the PHA SR, under administrative control".

Only will be released into the environment non-contaminated or low-contaminated materials with mass activities below the release level values established by the Appendix No. 8 to the Regulation No. 345/2006 Coll. and at the same time meeting the criteria for release of radioactive substances into the environment provided by the part II of the Appendix No. 3 to the Regulation No. 345/2006 Coll. According to the point 3, part II of the Appendix No. 3 to the Regulation No. 345/2006 Coll., the release criterion pursuant point 2, part II. of the Appendix No. 3 to the Regulation No. 345/2006 Coll is considered as fulfilled if the average effective dose to an individual of the critical group of public does not exceed in any calendar year the value of 10 μSv while, at the same time, the collective effective dose does not exceed 1 manSv.

In order to measure the activity of the contaminated materials classified for release from administrative control, in the framework of the BIDSF project, four work stations have been provided and equipped with respective tools and a central software for registering data from monitored material. At work stations, radiological characterisation of materials will be carried out not only by measuring and evaluation of volume activity and surface contamination activity but also a radiological characterisation control will be performed.

The 4 work stations are:

- Work station with a large-volume measuring chamber. At this station a large-volume measuring chamber will be placed in the delivery track corridor at the border of the controlled zone and will work in shielded regime.
- *Work station for measuring of large-volume materials*. At this station a large-volume measuring facility with a large-volume container will be placed.
- *Work station for large-volume material*. At this station, to be situated outside of the controlled zone of V1 NPP, large-scale components of V1 NPP equipments will be controlled. Measuring facilities will consist in devices for measurement of surface contamination and local gamma spectrographic systems.
- *Work station for release of building structure components*. This station will be used for release of surface contaminated structural parts of V1 NPP. Measuring facilities will consist in devices for measuring of surface contamination of large-scale construction

components, working in scanning regime, devices for measuring of surface contamination and local gamma spectrography systems.

The equipment of the work stations will also include manipulation mechanisms and scales. Documentation on metrological certification and calibration will be available for all applied measuring devices.

The locations No. SO 800-2:V1, SO 800/c:V1, SO 490-2:V1 and the newly constructed No. 510/2:V1 serving the temporary storage of released material for purposes of PHA SR I have been adjusted to accommodate the monitoring equipments and logistics.

Various materials will be released into the environment, such as: metal, thermal isolation, construction waste and soil, large-volume and large-scale materials and parts of buildings. Materials will be released in form of fragmented metal materials in pallets and construction material waste in containers. Large-volume and large-scale materials and parts of buildings will be measured in situ.

The total material amount to be released is ca 722 thousands tonnes. Out of the total amount of 235 thousands tonnes of primary circuit material, 228 thousands tonnes are expected to be released and7 thousands tonnes of radioactive material will have to be further processed as RAW. All the individual activities performed are optimised to produce as little as possible adverse influence on the working environment, workers and surroundings of the nuclear facilities V1 NPP.

The use of the buildings during decommissioning is the following:

- Building 760-II.3,4,5 (Maintenance Training Centre) for buffer storage of conventional (non contaminated) large components and packaged forms.
- Building 740-VII.1A (Workshop for Machinery) for buffer storage of conventional non-hazardous waste.
- Building 760-I.3 (Workshop-abrasive plant) for storage of spare parts and tools for maintenance purposes and eventually for the operation of the cable recycling plant (provided in the frame of different BIDSF project).
- Building 760-III.1 (workshop on V1 site) for buffer storage of small quantities of oils and chemical waste.
- External area for open-air storage of soil, construction debris materials, containers and for parking of vehicles

8.11 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 final use . Finally, the superficies of the site will be conditioned so as to match with the surrounding field.

It is presumed that the volume of contaminated soil that will have to be decontaminated in order to release the site for new industrial use is approximately 170 m^3. The volume of soil contaminated by other non-radioactive polluting substances is estimated at about 320 m^3.

If so required, the activity would also comprise site restoration works in case this will be deemed necessary due to measured contamination above the release levels in the first stage of examinations within the final site survey.

Site restoration works in course of the Stage II of decommissioning will be performed in an integrated manner and in parallel to the demolition and removal of foundations.

8.12 Final examination and site release

The main target of this activity is to carry out the final radiological survey at the end of the decommissioning process and prepare the documentation to be submitted to the authorities in charge.

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 restored again.

8.13 Management of other and dangerous waste (conventional waste)

The preferred approach in case of conventional (non-active, non-contaminated) wastes will be their valorisation (recycling or reuse). Waste will be disposed at dumping sites only if no other possibility is available and the capacity of the surrounding dumping sites is sufficient. Management of diverse types of conventional waste and their destinations are summoned up by the following table.

Tab. Nr. 5. Flows and treatment of waste

Waste stream	Treatment	Destination
Conventional waste	Size and volume reduction: - pressing - Crushing (concrete) - fragmentation	Valorisation/disposal
Decontaminated material		Valorisation/disposal
Hazardous waste		Valorisation/disposal

Conventional wastes out of V1 decommissioning will be handled in common manner like in cases of non-nuclear industrial facilities and sites (recycling, filling up of construction pits, transport to dumping sites, if applicable). A basic prerequisite is constituted by separation of waste into categories at the place of its generation (other, hazardous and waste types according to the Regulation of the Ministry of Environment SR No. 284/2001 Coll. on the Establishment of a Waste Catalogue). That is to say, these wastes will be sorted according to the Waste catalogue and will be valorised or disposed of according to the possibilities given for the individual waste types.

Generation of three waste groups is expected:

- Waste assigned for back-filling of foundations pits created through demolition of buildings - construction debris conditioned by a crushing machine into the necessary size, with separation of reusable metal waste.
- Waste for free reuse - waste will be transported out of the JAVYS, a.s. site and which can be used as secondary raw material directly without further conditioning, once it has been partially conditioned and sorted out or recycled. This concerns mainly metal waste from dismantling and metal waste separated out of construction debris.
- Waste not suitable for free reuse - wastes in the categories of "other" or "hazardous", which will be transported out of the JAVYS, a.s. site for valorisation or disposal. These are, e.g. floor materials, thermal roof isolation, suspended ceilings, external panels, waterproof isolations, floor claddings, wood products, sanitary facilities and similar.

8.14 Material valorisation of construction waste

Valorisation of non-radioactive construction wastes will be performed by means of mechanical modification - crushing, separation and fragmentation of the individual materials. Valorisation will aim at obtaining secondary raw materials (metal) and backfilling materials for use on site. Mobile crushing equipments will be applied to this end, provided by the unit responsible for demolition works for each project separately.

The new crushing machine shall have a min. capacity of 300 t/h and will allow for separation of iron reinforcements from concrete and separation of crushed concrete according to the particle size. The maximum input material size on will be 1,100 x 900 mm. The maximum size of crushed products shall not exceed 5 cm.

Construction iron will be, after separation from concrete, fragmented according to transport requirements.

The priority of conventional waste management is to enhance the recycling level of construction and demolition materials which will not be transported out of the JAVYS, a.s. site considering the necessity of their utilisation for backfilling of construction pits of the demolished buildings themselves. Thanks to such waste utilisation the traffic on road will be released considerably. Only materials assigned for disposal or valorisation by organisations specialised on recycling and disposal of the individual waste types will be transported out of the site.

Hazardous wastes may be collected at the waste collection yard or at the storage of NW at the JAVYS site or directly in suitable, properly labelled containers located close to the buildings to be demolished and protected against leakage, theft and climate conditions. Construction material containing asbestos must be stabilised prior to transportation to a dumping site.

8.15 Modification of systems and equipments and mounting of new equipments for decommissioning purposes

The main objective of this activity is to prepare the reactor building, the auxiliary building and, if necessary, other locals and outdoor spaces for dismantling and hence facilitate the performance of subsequent activities and minimise time consumption and collective doses.

The following activities belong herein:

- Building adjustments required due to dismantling
- Steel supporting platforms for steam generators PG11 PG6
- Building a collection places or storage of materials
- Purchase of equipment for personnel and tooling
- Establishment of a special workplace for fragmentation activated equipment
- Developing special fragmentation workplace for contaminated equipment PC
- Installing manipulators fragmentation of RPV and accessories
- Installing the manipulators for the fragmentation of contaminated equipment PC
- Purchase special containers for the activated and contaminated equipment (RPV, PC equipment, Mogilnik ...)
- Adapting systems as electricity, telephone, water, sewage water removal, garbage removal, etc..

- Reconstruction of LAN infrastructure and telecommunications
- Implementation of modified reactor hall ventilation system to prevent contamination of the air and radioactivity leak into the environment,
- Construction of the necessary access ramps and transport holes, lifting devices for moving large components to / from the premises of the building reactors,
- Purchase or rental of special equipment needed for the decommissioning work and transport waste from decommissioning (if applicable)
- Identification and marking of equipment and borders contaminated and uncontaminated areas by individual systems, while scheduling dismantling shall be done for individual areas; scheduling identifies all the preparatory measures for a given section of the plant.
- Disconnecting from the interim spent fuel storage from auxiliary building
- Installation of laundry facilities
- Buying or renting - portable filtration units to filter and maintain workspace (suction recirculation)

Tab. Nr. 6. Most important changes, modifications and investments

Modification and upgrading HVAC system SV-12/62 (V2/V2a)
Modification and upgrading HVAC system SV-11/61 (V1/V1a)
Modification and upgrading HVAC system SR-11/61
Modification and upgrading HVAC system SR-14/64
New portable filtration unit . 2000 m3 / h
New portable filtration unit . 3000 m3 / h (2 units)
Modification and upgrading of the ventilation system supply the reactor hall
Modification and upgrading of the ventilation system SV - 03 (V3)
Modification of V- 1s . 5- PO - 045
Modification of V- 16s . 5- PO -047
Modification of O - 20th 5- PO - 046
Modification of P - 2s . 5- PO - 020
Modification of P - 20th 5- PO - 046
Modification of P - 15s . 5- PO -047
Modification of P - 1s . 5- PO - 045
Modification and upgrading HVAC system SV-14/64
Modification and upgrading HVAC system SP-14/64 .
Modification and upgrading of the ventilation system SP - 06th
Modification and upgrading HVAC system SV-16/66 .
Demineralized water supply system - interim spent fuel storage
Drainage system - interim spent fuel storage
System of regeneration of ion exchangers - interim spent fuel storage
Collecting water in emergency pools - interim spent fuel storage

Tab. Nr. 6. Most important changes, modifications and investments

HVAC cooling water system - interim spent fuel storage
HVAC system cooling water - SO 800 and SO 801
HVAC system cooling water - SO 631
HVAC system cooling water - SO 803
HVAC system cooling water - SO 636
New hoist at +10.50
New hoist on the ceiling of the room R045 / 1.2
New hoist on the ceiling of the room B008
New hoist at +6.30
The new hoist in rooms SK115 and SK012 / 1 at +2.70
Overhaul two 32/8 t lifting equipment in the reactor hall
Compressed air system
Demineralized water system
cooling Systems
Modification of liquid radioactive waste
auxiliary steam
drainage system
New openings at the levels +14.70 m and +12.15 m
New steel support platform for the steam generator PG11 (PG6 and the second reactor)
New maintenance hole
Removal of concrete walls and slabs pressurizer (only one reactor)
New braces for wet sawing area
The doors of the corridors R015 / R015 and 1 / 2 must be larger that there is a hole about 3x3 m
Removing a wall between rooms R027 and R026
New opening - linking rooms V105 / 1 and 2 corridor V114/1-4
New opening - link R115 and V113
Extending the opening of V304 to R301
Hole - linking Newark and VLLW room SK013 / 8
Opening between rooms SK013 / SK105 8 and
Breast door opening to the side walls between rooms to SK017 SK021
New hole in the wall . Room SK012 / 1 and 2 to +2.70
Access escarpment between rooms and SK017 SK 021
New opening between rooms SK115 and SK012 / 1.2
Extension of the low-voltage power TS2 for SO 800 : V1

Activities will also comprise conditioning and modification of other locals and outdoor areas to adequate for their utilisation during the Stage II of decommissioning, such as buildings accommodating the turbine, storage areas, the maintenance halls and other outdoor buildings.

8.16 Operation, control and maintenance of auxiliary systems

In order to achieve reliable operation during the decommissioning stages it is necessary to carry out supervision and maintenance of remaining systems in order to assure operational applicable prescriptions for full or restricted operation. If a system reduction is performed during the decommissioning process, a readjustment or updating of operational prescriptions and provisions for maintenance and supervision of equipments is required.

General requirements to maintenance of equipments in the NPP are:

- To comply with the valid legal provisions of SR, EU and recommendations by IAEA.
- To secure nuclear safety and radiation protection in any operational phase.
- Keep operational technological equipment in good technical state in respect to reliability.
- To focus on the quality of any activities when carrying out maintenance tasks.
- To ensure technical safety.

In difference to maintenance of traditional industrial facilities, in a nuclear power plant, the factor of radioactive radiation has to be considered since it represents a certain risk for the maintenance personnel. This risk must be taken into consideration in respect to the general requirements as follows:

- The effective doses to which personnel is exposed during maintenance works must be minimised - ALARA principle.
- Maintenance will be carried out taking into consideration the recommendations of supervisory organism and IAEA.
- It is indispensable to allow for inestimable experience gained in its own operation and during completed decommissioning of other NPPs.
- Maintenance tasks are carried out under an effective system of prevention of human errors.
- The maintenance unit is to keep the special appliances, manipulators and other equipment for special maintenance tasks in good technical condition.
- Maintenance works are carried out so as to possibly minimise the direct and indirect maintenance costs.

The following maintenance tasks will be carried out during decommissioning following the 1st Stage of decommissioning:

- Preventive maintenance.
- Corrective maintenance.
- Predictive maintenance.

8.17 Control and maintenance of systems applied during decommissioning

Planning of maintenance and repairs is to continue during the decommissioning process like in course of normal operation. Equipments assigned for decommissioning will be in short time will be gradually excluded from the work. Some equipments will be needed until the very end of the decommissioning process of technological systems and will be removed as last. Control and management system and groups of systems which belong to the most important ones in the decommissioning process, are described in the following chapters.

8.17.1 Control and supervision systems

Control and supervision systems can be divided, as to the functions, into these three subsystems:

- Supply systems.
- Supervising systems.
- Information systems.

Control and supervision systems serve the purpose of securing a safe operation of the system. They provide for supervision of operational processes, control of operational parameters and deviations from them, protection of equipment against dangerous operation stages, remote transfer of measured values, command of operational components, automatic keeping of set values, starting of reserve equipment together with signalisation notifying the personnel in case of non-compliance with required parameters and similar.

The required condition of equipment operation is fulfilled when the prescribed operational values depending on the type of the operated equipment are observed (e.g. pressure, flow volume, speed, level height and similar).

The operational equipment of supervision and control system is situated in switch boards and SKR panels.

Maintenance is performed according to maintenance planning through yearly and long-term plans. Updating of plans is provided by means of IT systems of automatised maintenance process management. The system provides complex information on the state of the equipment, allows for notifications on break-downs, creation of tasks and work instructions.

8.17.2 Air technical systems

Air technical systems (air-conditioning, heating, cooling and ventilation) provide for suitable working conditions for personnel and technological equipments. Prevention of leakage of radioactive substances through air technical systems into the atmosphere is provided by means of aerosol filters and air filters conducted away from locals in which activity can occur. Upon filtration, air is released through the ventilation stack into the atmosphere.

The required condition of equipment operation is fulfilled when one of the aggregates of the given system is operational, while keeping the prescribed operational parameters (e.g. air flow volume, humidity, temperature, pressure on entry, pressure on exit, pressure drop on filters, reduced pressure in HP and similar).

The air technical systems considered are as follows. Circulation systems and air supply systems to spaces and rooms with active operation are situated in the reactor building. Most of the supply and exhauster air technical systems are situated in the rooms of the longitudinal and lateral intermediate building. An exhauster system provides a reduced pressure in air proof spaces and other rooms with contaminated equipments.

The system ARSOZ provides complex information on the state of the equipments, allows for notifications on break-downs, creation of tasks and work instructions. Workers of the air systems maintenance unit carry out corrective maintenance on the basis of the issued instructions as well as planned maintenance in prescribed periods.

The periodicity of maintenance is determined by operational procedures applicable for air technical systems of the reactor building, BPP (auxiliary building) and PB (operational building).

8.17.3 Radiation control system

Radiation control systems are utilized for control of the radiation levels in the operational locals of the NPP with operation in course (HVB - main production building, BPP - auxiliary building and the ventilation stack). A systematic control of activity levels in individual environmental points is provided for in the surroundings of the NPP. From the functional point of view are provided: radiation monitoring (RM) of the working environment, RM of the technological process, discharges and the NPP surroundings and RM of persons - dosimetric control. Monitoring is secured by means of a centralised autonomous supervision-measurement system of radiation monitoring that allows for continuous measuring of the monitored parameters.

The required operational condition is continuous surveyed and secured by a central IT system of RM.

Operational work stations of the central system are the radiation control room, supervision rooms of the two units, TPS in the permanent shelter below the administration building and in the building of the Laboratory of Radiological Environmental Monitoring (LRKO). Detectors of the centralised measurement system are placed in all operative rooms significant from the point of view of RM.

Our objective is to ensure a safe condition of the equipments by means of organised systems maintenance. Maintenance is performed according to maintenance planning through yearly and long-term plans, applying an IT system of automatised maintenance process management. The system ARSOZ provides complex information on the state of the equipments, allows for notifications on break-downs, creation of tasks and work. Workers of the maintenance unit of radiation monitoring equipments carry out corrective maintenance on the basis of the instructions generated by the system as well as planned maintenance in prescribed periods.

The periodicity of maintenance is determined by operational procedures for Radiation Monitoring in HVB (main production building) and BPP (nuclear auxiliary building). The yearly plans are introduced into the ARSOZ system which generates instructions to carry out regular control and maintenance of equipments.

8.17.4 Service water supply system

Service water supply systems consist out of a reservoir unit (tank or pit), a pumping unit, a pipe system for distribution of water to the individual components to be cooled, a system of return pipes leading into the draining collector of used heated water and a device to cool de water (cooling towers). The system provides for pumping of service water, its draining and repeated cooling and usually works in a closed circuit (tank-pump-component-cooling tower-tank).

The pumping unit together with the reservoir tank represents an auxiliary system with non-active water located in a separate building. The pipes are placed in pipe channels that enter into the building to feed components. Here, the pipes branch out into the individual components. The return line leads again through the pipe collector to the cooling device (ventilation cooling tower) from where service water flows back to the reservoir tank.

Organised maintenance of service water supply system secures prevention of break-down situations and system operation failures. Maintenance of the facility is carried out according to planning determined in yearly and long-term plans provided for by the ARSOZ system. Pursuant to instructions issued by the ARSOZ system, workers of the maintenance unit (of pumping devices, turning machines, armatures, servo-armatures, regulation valves and their equipment) carry out corrective maintenance as well as planned maintenance in prescribed periods.

The periodicity of maintenance is determined by operational procedures applicable to the given operational equipment or system. The facility supervisor participates in drafting of yearly maintenance plans to be introduced into the ARSOZ system which generates instructions for regular control and equipment maintenance. The maintenance period and extent are determined by the plant leader and are provided for in the respective operation manuals.

8.17.5 Energy supply systems

Electric energy supply systems play an important role and hence must be paid due attention. Considering that they belong to specific equipments they must fulfil specified parameters and a required technical condition. These systems are subject to particular provisions and checks. These systems are to supply the individual consumers with electric energy according to the required parameters and safety conditions, (e.g. suitable isolation, current and voltage protection, separation of circuits, isolation of active parts, setting up barriers and similar).

In decommissioning conditions, focus is put on supply with energy of important electrical consumers necessary for securing of a failure-free decommissioning process. In this period, distribution lines for illumination of building structures play a crucial role.

The electric equipment is placed in the respective main switch board rooms to which secondary switch boards are connected which are placed close to consumers electrical bars. From the secondary switchboards electricity is distributed by cable lines to the individual consumers. Room illumination circuits in buildings are projected as separate circuits.

Maintenance of the electrical installations is carried out according to planning determined in yearly and long-term plans by means of the ARSOZ system. Apart, a special system of revision management applies to specific equipments. As a rule, revisions are carried out on the basis of updated project documentation in respect to electricity supply and the initial revision report on the facility condition. Regular revisions of the electric facilities are carried out periodically as established by the applicable legal provisions for specific equipments.

The periodicity of maintenance is determined by operational procedures. The equipments are subject to general maintenance according to the yearly maintenance plans and, apart, repeated equipment revisions are carried out according to maintenance procedures. The facility supervisor participates in drafting of yearly maintenance plans to be introduced into the ARSOZ system which generates instructions for regular control and equipment maintenance.

8.17.6 Lifting devices

The purpose of lifting devices is to provide the movements of loads of different size and weight during dismantling operations, fixing of the individual components prior to division of fragments (e.g. pipes) and similar.

In the context of nuclear facility decommissioning, lifting devices constitute a significant element of dismantling activities, with extraordinary requirements as to their functionality, reliability and safety.

Maintenance of the facility is carried out according to planning determined in yearly plans, lubrication plans and long-term plans provided for by the ARSOZ system. Lifting devices belong to the specific equipments and are subject to a special system of revision checks management.

8.17.7 Control and maintenance of building structures

From the functional point of view, building structures represent a significant barrier preventing the diffusion of radioactive substances into the environment. In course of decommissioning activities, increased occurrence of aerosols, particles due to material fragmentation, generation of liquid and solid RAW can be expected and there is a certain, even if remote, risk of their diffusion into the environment, spreading out of contamination and affecting exposure of public. Therefore, it is essential to maintain building structures in good technical state, focusing on leak proofness of isolations of roof structures, wall penetrations structures etc.

Maintenance of building structures is based on the executive project documentation, including amendments and supplements on the performed changes of structural character.

8.18 Security (security and health protection at work (SHPW), fire protection (FP), physical security)

8.18.1 Radiation protection

Within the process approach of the integrated management system applied by JAVYS, a.s. "Radiation protection" forms part of the process "Security". The radiation protection concept is based on requirements and international recommendations issued by IAEA; ICRP, further on IEC and ISO standards and criteria and national provisions on radiation protection of personnel working with radiation sources in conditions defined by technological processes. JAVYS, a.s. has provided a summary of legal provisions valid in SR in the sphere of radiation protection, a description of the working environment radiation control system, protection of persons against exposure to ionising radiation, definition of zones subject to radiation control and work management in these zones in the sub-process guidelines "Radiation protection" and in operational documentation.

Radiation control of working environment focuses on health protection and monitoring of observance of radiation protection rules in the locals of the controlled zone.

8.18.2 Basic principles of radiation protection

The radiation protection system of the Jadrová a vyraďovacia spoločnosť, a.s. is based on the following basic principles:

- Activities that can result in irradiation may be only carried out if it is justified. An activity resulting in irradiation is justified if the health damage potentially caused by the activity is outweighed by the expected advantages it brings for the individual or society (principle of justifiability).
- Anybody performing activities resulting in irradiation is obliged to ensure that the number of exposed persons, level and probability of them being irradiated be permanently kept as low as can reasonably be achieved considering economic and social perspectives (the so called ALARA principle of protection optimisation).
- Anybody performing activities resulting in irradiation is obliged to reduce radiation total personal doses in individuals from all performed activities to values below the irradiation limits set by the regulation no. 345/2006 Coll. (so called principle of limiting personal doses).
- Observance of basic principles and standards of safety culture at all management levels of the company pursuant to BZ/JB/SM-02 (safety culture).
- Projects, operational provisions, procedures and other documentation of work with sources of IR must comprise in-depth protection in order to compensate for potential operational events in respect to radiation protection (principle of in-depth protection).

Any activities carried out in presence of ionising radiation sources are, prior to permission, during and after their performance, subject to optimisation of radiation load according to the valid national laws and the internal system of quality assurance.

Radiation protection of workers carrying out activities resulting in irradiation is assured in particular by:

- Justification of activity and optimisation of radiation protection of working conditions including prior evaluation of the character and extent of a possible threat to workers' health, risks connected to the planned activity and regular re-evaluation considering the operational experience,

- Demarcation of supervised zones and controlled zones at the work place, focusing on estimation of expected irradiation during standard operation and probability and extent of potential irradiation,
- Categorisation of workers,
- Ensuring permanent monitoring of radiation protection, regulatory and control measures, providing the work station with appliances, equipments and tools in sufficient number and quality in order to enable the measurements determined in the monitoring plan, emergency plan or the quality assurance program, providing workers with personal worker protection equipment with adequate shielding effect and protective tools,
- Monitoring of working conditions in determined protected zones and, where necessary, also by means of personal monitoring,
- Health attendance.

All persons working in the controlled area are subject to control and regulation of irradiation. Monitoring of radiation load in the individual employees and suppliers and measurement of received doses during work in environment with ionising radiation is basically carried out by means of a film badge dosimeter. Any person working with sources of ionising radiation is at the same time obliged to wear operative electronic signal dosimeter and, if prescribed, also a supplementary thermoluminescent dosimeter. Apart, measurement of internal contamination by radionuclides is provided for in form of regular examinations and following activities bearing higher risks (such as activities with increased risk of inhalation of radioactive aerosols).

Any new activities to be carried out in the controlled zone of V1 NPP must be described in detail in the respective project or work plan. Any such activity/work process must include a chapter on radiation protection that shall indicate all safety measures and calculated expected doses in accordance with the directive BZ/RO/SM-02 "Enforcement of the ALARA principle". These work processes are subject to permission by the radiation protection department. If these activities are significant from the point of view of radiation protection they will be examined by the supervisory authority (PHA SR) or by the ALARA Commitee. Activities in the controlled zone are performed upon the Radiation instruction.

The character of the activities determines the extent of radiation monitoring:

- Monitoring of dose rate level in the working environment.
- Monitoring of volume activity of radioactive aerosols in the working environment, ahead of and behind the aerosol filters.
- Monitoring of surface contamination of working surfaces, equipments (tools), transport routes and means (mobile dosimetric systems).
- Monitoring of contamination levels and radiation loads of personnel.
- Monitoring of gaseous discharges from ventilation systems.
- Monitoring of activity and radionuclide composition of RAW.
- Monitoring of dose rates of the processed product.
- Monitoring of discharged liquid effluents.

8.18.3 Monitoring of gaseous and liquid discharges

Monitoring of discharges in course of decommissioning is carried out by the control measurement system of gaseous and liquid discharges. Monitoring of liquid discharges from nuclear facilities in Jaslovské Bohunice is organised in stages, that is to say, discharges of the individual appliances (according to the principle of monitoring at the source) and of the whole locality are monitored. Continuous monitoring is carried out at the obj. 880 (discharge water control station) - water conducted to the Dudváh recipient and obj. 368 (monitoring station of discharge water activity) - water directed to the Váh recipient.

The air exhausting system in the controlled zone provides for transfer of air, filtered on absolute filters with 99.95% effectiveness for 0.3 micron particles according to respective operational specifications, to the ventilation stack of V1 NPP by means of an exhausting system operating in reduced pressure regime. The ventilation system provides for a fast air renewal in the individual types of rooms (non-attended, semi-attended and attended) and also guarantees suitable climatic conditions (temperature, relative humidity).

8.18.4 Safety

The basic function of the sub-process "Standard safety" is based on the requirements of the Act of NC SR No. 124/2006 Coll. on Safety and Health Protection at Work, the Act of NC SR No. 311/2001 Coll. Labour Code and the Act of NC SR No. 314/2001 on Fire Protection, in respect to:

- Provision of fire prevention at JAVYS, a.s. and supervision in the frame of safety and health protection at work, SHPW (supervision of BTS - safety-technical services and PO - fire protection technicians),
- Maintenance and processing of documentation related to SHWP and OPP - protection against fire,
- Provision of checks, revisions and repairs of fire extinguishers.

Safety and health protection at work is determined by the respective basic quality directive BZ/KB/ZSM. Its objective is to set basic conditions for safety and health protection at work, exclude or reduce occurrence of work accidents, work diseases and other health damages owing to work and rule on liability, competencies and processes in respect to performance of tasks in the frame of SHPW at JAVYS, a.s.

8.18.5 Nuclear safety

The main objective of the sub-process "Nuclear safety and licensing" is determined by requirements of the Act of NC SR No. 541/2004 Coll. on Peaceful Usage of Nuclear Energy (Atomic Act) and corresponding regulations issued by the Nuclear Regulatory Authority of SR (ÚJD SR) related to:

- Assessment and independent evaluation of nuclear facilities operation from the point of view of nuclear safety (monitoring of parameters of nuclear safety and operational reliability, activity of the nuclear safety committee).
- Assessment of the extent and content of modifications of NPP and evaluation of their impacts on nuclear safety.
- Registration of nuclear materials as required by international guarantees given by Slovak Republic.
- Notification and analysis of operational events at the JAVYS, a.s. Nuclear facilities (organisation of the activity of a break-down commission, monitoring and evaluation of

tendencies in respect to operational events at the JAVYS, a.s. Nuclear facilities, notification of events to supervisory authorities as required by law).

- Maintenance of safety documentation on the JAVYS, a.s. Nuclear facilities and specified operational documentation in respect to nuclear safety (safety news, limits and conditions of safe NPP operation, reliability analyses, emergency operation prescriptions, prescriptions assessed and authorised by the nuclear regulatory authority (ÚJD SR).
- Coordination of intercourse with supervisory authorities of SR (methodical management of intercourse with supervisory authorities, preserving of writs issued by supervisory authorities).
- Obtaining of approval or authorisation of necessary activities by the supervisory authority (ÚJD SR).

8.18.6 Physical security

Protection against theft and other threats is ensured by physical security provided according to the Act No. 541/2004 Coll. Physical security is subject to liability of the authorisation holder in the extent of the authorised activity. The authorisation holder (JAVYS, a.s.) guarantees by meeting the requirements of the Regulation of ÚJD SR No. 51/2006 Coll. that effective protection of nuclear materials, RAW, building structures and technological equipments is guaranteed on the basis of their categorisation. The main objective of this protection is to reduce to the maximum extent the risk of misuse of nuclear facilities and nuclear materials for purposes of threatening the life and health of persons and environment. The physical security issue is subject to separate documents called "Physical Security Plan" for each nuclear facility. This plan defines the physical security level, technical means to be applied and similar. In course of gradual decommissioning of equipments the requirements on physical security levels will be modified as required.

9. Alternatives of the proposed activity

The proposed activity is presented for assessment purposes as one alternative (Alternative 1), which 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 next (industrial) use.

Pursuant to the law, the other alternative is the zero alterantive (Alternative 0) representing the state where the proposed activity is not implemented in the given time and place. In this specific case, Alternative 0 includes execution of the previously assessed and permited Stage I of V1 NPP decommissioning, with dismantling of no more required non-radioactive installations and systems and demolition of no more needed non-radioactive buildings. .

Up to now (October 2013) no civil structures have been demolished, but several dismantling works have been carried out in the internals of non-radioactive buildings. The current status is described in detail on figure 6 and in the Annex 18.

10. Total costs (tentative)

The total cost estimate for the whole decommissioning process of the NPP V1 Bohunice decommissioning is 1,141,295,594 €, valued in v $€_{2011}$. From this total amount, the costs of the 1st Stage decommissioning are estimated at 454.506.726 € (128.101.926 € thereof pre-decommissioning). Cost estimate for the 2nd Stage of decommissioning is 686.788.868 €. The costs are specified in the following tables.

Tab. No. 3. Cost estimate for the 2nd Stage of decommissioning according to categories ($€_{2011}$)

YEAR	2003-2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
TOTAL	454.506.726 €	41.125.242 €	85.224.518 €	119.445.118 €	89.279.585 €	98.195.547 €	86.177.410 €	50.277.549 €	49.688.963 €	44.383.599 €	12.225.212 €	10.766.126 €
Total labour	212.572.481 €	20.434.547 €	42.090.442 €	63.289.671 €	55.002.368 €	57.981.596 €	45.742.214 €	18.411.306 €	18.008.116 €	16.024.415 €	3.965.436 €	3.164.403 €
Total investment	98.675.188 €	1.505.756 €	11.536.492 €	16.180.291 €	6.015.795 €	2.395.017 €	1.632.052 €	269.207 €	269.207 €	263.447 €	386.010 €	0 €
Total other expenses	136.064.840 €	16.237.281 €	19.725.924 €	22.997.899 €	17.234.356 €	28.159.866 €	31.779.256 €	29.798.286 €	29.559.450 €	26.429.464 €	7.682.781 €	7.436.672 €
Total contingencies	38.600.794 €	2.947.658 €	11.871.660 €	16.977.257 €	11.027.065 €	9.659.068 €	7.023.888 €	1.798.750 €	1.852.190 €	1.666.273 €	190.984 €	165.051 €
Aggregated totals	454.506.726 €	495.631.968 €	580.856.485 €	700.301.603 €	789.581.188 €	887.776.735 €	973.954.145 €	1.024.231.694 €	1.073.920.657 €	1.118.304.256 €	1.130.529.468 €	1.141.295.594 €

Tab. No. 4. Cost estimate for the 2nd Stage of decommissioning according to the basic activities ($€_{2011}$)

YEAR	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
01 Pre-decommissioning actions	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €
02 Facility shutdown activities	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €	0 €
04 Dismantling activities within the controlled area	6.625.044 €	15.231.574 €	29.993.735 €	16.486.139 €	15.969.911 €	10.973.750 €	2.413.642 €	2.423.242 €	2.128.466 €	598.514 €	0 €
05 Waste processing, storage and disposal	6.594.009 €	35.913.980 €	57.318.803 €	43.743.293 €	39.666.991 €	28.349.789 €	3.776.440 €	3.776.440 €	3.182.562 €	0 €	0 €
06 Site infrastructure and operation	9.307.981 €	7.703.782 €	7.175.295 €	6.536.972 €	6.085.762 €	5.668.844 €	5.283.612 €	4.927.658 €	4.598.756 €	4.294.850 €	4.014.042 €
07 Conventional dismantling, demolition and site restoration	3.105.325 €	1.532.485 €	0 €	0 €	20.140.421 €	29.514.861 €	29.514.861 €	29.739.501 €	25.999.556 €	395.339 €	815.223 €
08 Project management, engineering and support	13.547.108 €	21.623.079 €	22.928.391 €	20.432.792 €	14.236.113 €	9.695.452 €	5.600.000 €	5.040.000 €	4.620.000 €	3.080.000 €	1.820.000 €
09 Research and development											
10 Fuel and nuclear material	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €	1.040.256 €
11 Miscellaneous expenditures	905.519 €	2.179.361 €	988.637 €	1.040.132 €	1.056.093 €	934.457 €	2.648.737 €	2.741.866 €	2.814.003 €	2.816.252 €	3.076.606 €
TOTAL	41.125.242 €	85.224.518 €	119.445.118 €	89.279.585 €	98.195.547 €	86.177.410 €	50.277.549 €	49.688.963 €	44.383.599 €	12.225.212 €	10.766.126 €

11. Municipality concerned

The affected municipalities within a radius of 5 km from the centroid of V1 NPP are: Jaslovské Bohunice, Ratkovce, Žlkovce, Nižná, Pečeňady, Veľké Kostoľany, Dolné Dubové, Malženice and Radošovce.

12. Affected Self-Governing Region

Trnava Self-Governing Region

13. Authorities concerned:

Regional Public Healthcare Office in Trnava

District Office Trnava

District Office Piešťany

District office Hlohovec

14. Approving authority

Nuclear Regulatory Authority of the SR

Public Healthcare Authority of the SR

15. Departmental authority

Ministry of Economy of the SR

16. Statement on anticipated transboundary impacts of the proposed activity

We assume that the proposed activity will not cause any adverse environmental impacts beyond the state boundaries. This assumption is based on the following considerations, facts and conclusions of previous evalution:

In general, the NPP decommissioning process implies significantly less adverse impacts on human health and environment than the operation of the NPP, both in standard and non-standard conditions.

Generally speaking, the impacts of potential accidental scenarios during the decommissioning process are, regarding to their scope and character, incomparably smaller than during operation of NPP.

Thanks to the proposed activity the overall safety and quality of life is increased through removing of potential risks conected to the NPP operation.

The proposed activity does not imply any other transport of RAW produced during the NPP decommissioning (RAW out of dismantling of instalations, demolition of structures and decontamination of materials) than transport within the territory of the SR, namely between Jaslovské Bohunice and Mochovce.

In the framework of Bohunice NPP V1 decommissioning, several environmental impact assessments according to the Acts No. 127/1994 Coll. and No. 24/2006 Coll., as amended, have been carried out and in none of them transboundary impacts have been identified.

The most comprehensive EIA process has been EIA of V1 NPP decommissioning referred to as "Decommissioning of the Nuclear Power Plant V1", which was completed by issuing the Final Statement[2]. Ministry of Environment SR sent, in the framework of the legal procedure for the transboundary assessment , EIA reports to the affected parties represented by the respective ministries of environment of the following countries: Czech Republic, Hungary and Austria. In response, none of the affected countries reported its intent to take part in the trans-boundary assessment of the planned activity according to the EIA Act.

The Final Statement on the proposed activity „Decommissioning of the Nuclear Power Plant V1“ states: „Impacts exceeding the boundaries of the SR due to implementation of V1 NPP

[2] FINAL STATEMENT (Number: 8935/06 -3.5/hp) issued by the Ministry of environment SR according to the Act NR SR No. 12771994 Coll. on the assessment of environmental impacts, as amended, 7. 3.2007

decommissioning are not expected either in standard operation or in accidental scenarios. From the point of view of activities exceeding the boundaries of the SR, it can be stated that the contribution of the proposed activity to radiation characteristics of the affected area will be negligible in comparison with the NPP in operation and hence significant impacts exceeding the boundaries of the Slovak Republic are not expected.

EU has confirmed in its statement (2011) the following: "The European Commission has arrived at the conclusion that the implementation of the plan for disposal of radioactive waste in any form out of decommissioning of the NPP Bohunice V1, located in the Slovak Republic, will neither in standard operation nor in case of an accident of a type and extent described in the general indications, cause radioactive contamination of water, soil or air in another Member State"[3].

The assessment of the 1st Stage of V1 NPP decommissioning now in course is based on results of actual monitoring of impacts on the surrounding environment and population and shows a negligible radiological impact[4], which demonstrates that the decommissioning activity does not have and will not have an adverse impact on the neighbouring states (see Chapter III).

Taking into account technical facts, monitoring results from the 1st stage of V1 NPP monitoring as well as conclusions of the mentioned published documents we can state that adverse impacts of the proposed activity on the environment and human health exceeding the state boundaries are not to be expected.

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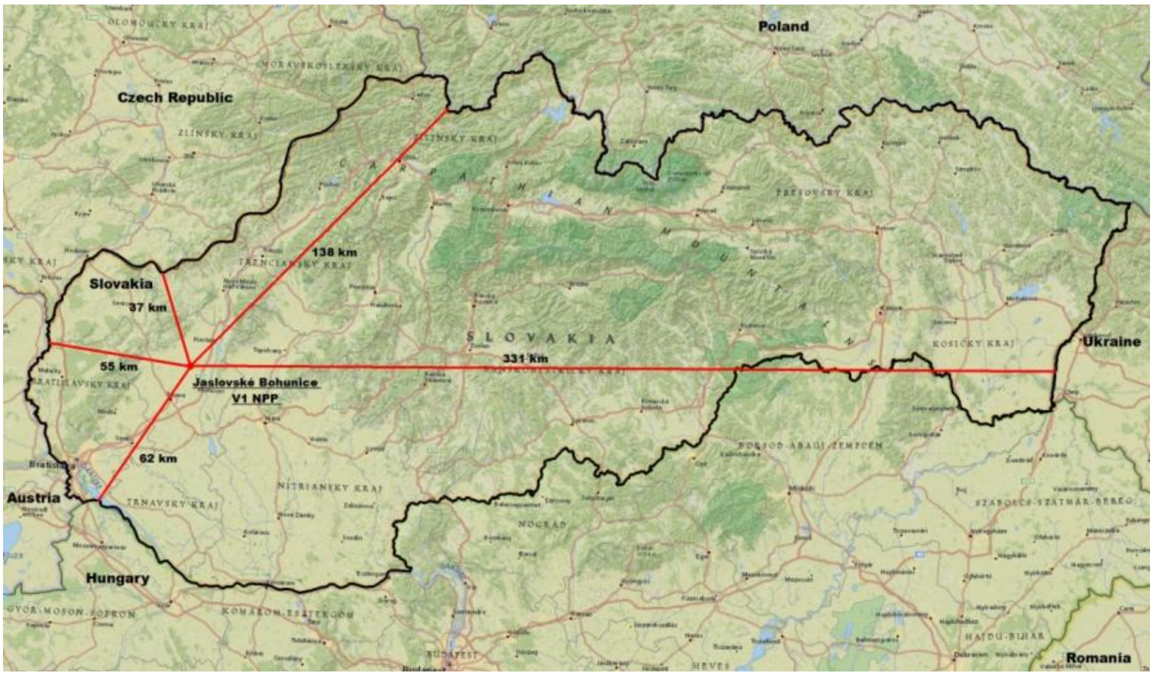
[3] COMMISSION OPINION of 15 July 2011 relating to the plan for the disposal of radioactive waste arising from the decommissioning of the Bohunice V-1 Nuclear Power Plant, located in the Slovak Republic, in accordance with Article 37 of the Euratom Treaty, (2011/C 210/05), Official Journal of the European Union 16 July 2011.

[4] In the inhabited area (referred to as 76) Ratkovce, Žlkovce, to the South-East of the nuclear site, the highest effective dose in a representative individual in the group of 2 - 7 year old reached the value 3.98 10-8 Sv (0.124 % of the per-year limit). The highest values of the individual effective dose in the not inhabited area (referred to as 1), to the North of the nuclear site, amounted to 6.63 10-8 Sv (0.207 % of the per-year limit), Comprehensive Report on the radiation protection at JAVYS a.s. and the impact of the JAVYS a.s. site on the surroundings, year 2012.

Graph No. 61. Shortest distance of V1 NPP from the state border



B. DATA ON DIRECT AND INDIRECT IMPACTS OF THE PROPOSED ACTIVITY ON THE ENVIRONMENT, INCLUDING HEALTH

I. Requirements on inputs

1. Land

All activities of the 2nd stage of V1 NPP decommissioning will be executed in the area of the existing site of NPP Jaslovské Bohhunice and an extension of the activities to so far not occupied areas is not planned. The proposed activity does not require new occupation of land.

2. Water

2.1 Extraction of surface water

Surface water is extracted by SE a.s. from the water reservoir Sĺňava and treated for purposes of technical use at a filtration station of JAVYS.

2.2 Extraction of groundwater

The nuclear complex at Jaslovské Bohunice is presently supplied with drinking water from two branches of the supply network administered by the Trnavská vodárenská spoločnosť (TAVOS, a.s. Piešťany). The implementation of the proposed activity will not require any new water sources.

2.3 Estimate of water consumption

In order to estimate water consumption, the following planned demands must be taken into account:

- The current drinking water consumption for personal hygiene of the staff amounts to approximately 178,000 m^3. In course of decommissioning, the volume will be slightly increased by an estimated 1% in the beginning and then gradually decreased.
- Technological water (for cooling of technological systems and heat exchangers, demineralised water for decontamination, water for RAW treatment and conditioning, water for steam production). The estimated volume is about 2,237 mil. m^3 per year in the beginning of 2nd stage of decommissioning, in the first years of the 2nd stage an increase of consumption is estimated by about 2-3 % and gradually the consumption will decrease.

A general characteristic of water consumption during the 2nd Stage of V1 NPP decommissioning is provided in the following table.

Tab. No. 5. Estimated water consumption

Activities 2nd stage of V1 NPP decommissioning	Demineralised water (m^3)	Steam (t)	Total amount (m^3)
Dismantling	16,175	1,142	17,317
Conditioning, storage and treatment of RAW	2,757	40,385	43,142
TOTAL AMOUNT	**18,932**	**41,527**	**60,459**

Source: B 6.2

3. Raw materials

The following activities will contribute to the consumption of raw materials:

- Decontamination of contaminated installations and building surfaces,
- Dismantling of technological installation in buildings,
- Demolition of buildings,
- RAW conditioning and treatment

Demands on some raw materials and energy expected in the 2nd Stage of V1 NPP decommissioning per each activity is provided in the following table.

Tab. No. 6. Consumption of raw materials and energy per each activity during the entire process of 2nd stage V1 NPP decommissioning

Activities of the 2nd stage V1 NPP decommissioning	Mineral oil (t)	Bitumen (t)	Cement (t)	Compressed air (Nm^3)	Oxygen (Nm^3)	Acetylene (Nm^3)
Dismantling	7	0	0	167,578	245,472	15,185
Conditioning, storage and treatment of RAW	497	293	1,639	100,234	74,497	4,966
Demolition, restoration and landscaping of the site	1,100	0	0	59,553	679,825	43,509
TOTAL AMOUNT	**1,604**	**293**	**1,639**	**327,365**	**999,794**	**63,660**

Source: Project B6.2

Apart from the materials mentioned above, treatment of historical RAW calls for application of other input materials and packages in the following amounts.

Tab. No. 7. Demand on specific materials and packages required for management of HRAW

Activity	Powder mixture SIAL (t)	NaOH (t)	FORKEM (t)	Steel barrels with a volume of 200 m^3 (piece)	Additive substances (t)
Treatment of HRAW - solving of crystalline sediments		20			
Transport of processed HRAW				4000	
Final treatment and fixation of HRAW	**500**		**13**		**16**

Source: Plan of management of radioactive waste waste originating from V1 NPP decommissioning in respect to the Project C7-B „Treatment of historical waste - sludges and sorbents“, JAVYS, 2012

For purposes of fragmentation and decontamination at the newly constructed facility (EIA process is now in course as independent assessment process), approximately 10 t of different raw materials will be needed as follows:

Tab. No. 8. Anticipated consumption of raw materials needed for fragmentation and decontamination at F&D facility

Chemical substances and materials	Consumption in 1 year (t)	Consumption in 8 years (t)
HNO_3 65% Nitric acid	0.9	7.2
$C_6H_8O_7 . H_2O$ - Citric acid	2.4	19.2
NH_4NO_3 - Ammonium nitrate	1.2	9.6
SYNTRON B - 30-35 solution of Tetrasodium salt of ethylenediaminetetraacetic acid EDTA	0.06	0.48
Abrasive	5.5	44.00

Source: EIS „Construction of a new large-capacity F&D facility“ JAVYS, 2013

Supply will be secured by chosen suppliers.

4. Energy supplies

Supply with electricity will take place from the existing supply network in the following quantities.

Tab. No. 9. Energy consumption

2nd Stage V1 NPP decommissioning activities:	Electric energy (kWh)
Dismantling	1,774,356
Conditioning, storage and treatment of RAW	624,297
Demolition, restoration and landscaping of the site.	155,332,631
TOTAL AMOUNT	**157,781,284**

Source: B6.2

An estimation of natural gas consumption of the proposed activity and the supporting facilities, and of the fuel consumption of all machines and transport vehicles for the entire duration of the proposed activity requires a detailed study.

5. Demands for transport and other infrastructure

There is a network of roads and railway lines in the affected territory. Realization of the proposed activities does not require construction of a new transport infrastructure and will not overburden the existing transport and technical infrastructures. Currently, no requirements for a new transport infrastructure are defined.

6. Demand for labour force

The 2nd Stage of V1 NPP decommissioning will increase new qualified job opportunities, and the estimated labour requirements are as follows:

Tab. No. 10. Demand for labour force

Activities of the 2nd stage V1 NPP decommissioning	Labour (10^3 hours)	Labour (Men Month)
Pre-dismantling decontamination	78.3	489.4
Demolition	1,233.4	7,708.8
Post-dismantling decontamination	535.2	3,345.0
Decontamination of buildings	328.0	2,050.0
Demolition	4,719.9	29,499.4
RAW management	271.2	1,695.0
Non-Raw management	182.7	1,141.9
Site restoration and landscaping	104.0	650.0
TOTAL AMOUNT	**7,452.7**	46,579.4

Source: B6.2

The existing staff of JAVYS will be allocated as much as possible for dismantling works, however, for some specific tasks external staff will be contracted.

7. Other requirements

The proposed activity evokes application of specific technical and technological equipment and installations, in particular:

- Laboratory equipment and equipment for radiation monitoring
- Specific equipment for dismantling and fragmentation of the primary circuit
- Specific installations for fragmentation and decontamination (F&D facility) and waste treatment (metallic RAW melting facility)
- Devices for crushing of construction materials/ concrete (shreders)

II. Data on outputs

1. Air

The activities of 2nd Stage V1 NPP decommissioning include the dismantling works, demolition of buildings, crushing and shreding of construction waste, fragmentation of plant and machinery, movement of vehicles and machinery and operation of supporting installations and systems. All these activities will result in emissions of radioactive and non-radioactive gases, particulates and aerosols, and will affect the quality of the air. A precise quantification of their volume is not possible at the present stage of the decommissioning process.

1.1 <u>Outpouts of radioactive character</u>

Among radioactive emissions these types of emission sources are expected:

Emissions from dismantling and fragmentation of activated and contaminated materials including the secondary contamination of materials,

Emissions from decontamination,

Emissions from RAW treatment.

The quality of emissions from the 2nd stage of decommissioning are provided in chapter 5 "Physical fields".

The air from controlled zones will be collected and discharged into the atmosphere in an controlled and monitored discharge. All potential area (or surface) sources of contamination thus become spot sources of air contamination, equipped with cleaning and monitoring devices.

Exhauster air technical systems at the individual work places are connected to the existing air technical system HVB JE V1 that discharges air from the working areas with a capacity of 54,000 $m^3.h^{-1}$. The air technical system is connected to the ventilation stack V1 NPP.

The assessment of the impact on the environment is published in the yearly reports and trimestral reports on the whole JAVYS site. The radioactivity of air discharges from each nuclear facility is assessed separately as to the percentage of the set limit.

1.2 <u>Outputs of non-radioactive character</u>

Regarding the quality of non-radioactive emissions of the basic pollutants (PM, SO_2, NO_2, CO, TOC) the following types of emission sources are presumed:

Emissions from all machines using fuel (construction and transport machines),

Emissions from the existing air static, mobile and surface area pollution sources in place, which will be in operation also in the 2nd stage of decommissioning,

Primary and secondary dust during demolition, fragmentation and mechanical waste treatment (operation of shredder) and landscaping (PM, PM_{10}).

JAVYS currently operates several air pollution sources of all three categories (small, medium and large sources) which will be in operation also during a certain period of the 2nd stage of decommissioning. Emissions from these sources have been defined and monitored; results are evaluated and published in annual reports. No problems of compliance with limits were registered in 2012.

Emissions, being current emissions from existing sources are specified in the chapter B.II.5.

In addition to the existing stationary sources of pollutants, the crashing facility for construction waste/concrete with a capacity of 100 t/hour will be another small source of pollution. It is assumed that four shreders will be used at four different spots of the site and will be in operation according to the actual needs.

2. Waste water

Waste water will come from social installations for employees and from technological procedures. For waste water collection and treatment the existing systems and facilities will be used, as follows:

- Rain drainage system enters the river Dudváh via the open channel Manivier.
- Sewage drainage system enters the waste water treatment facility – BIOCLAR and the purified water is discharged via pipelines SOCOMAN into the river Váh.
- Industrial drainage system collects water polluted by oil, leads the water into the central gravitational oil separator and after pre-cleaning the water is directed into the cooling water treatment facility at EBO V2.
- A special drainage system leads technological water into the collection tanks for special cleaning of radioactive water and for special treatment; after treatment and inspection, the waste water is discharged according to approved procedures.

- Final drainage system collector SOCOMAN drains the other waste water, including low radioactive water, from technological installations for RAW treatment into the river Váh.

Waste water discharged from JAVYS is monitored regarding the volume activity of corrosion and fission products and ^{3}H as well as chemical pollutants according to requirements of decisions issued for JAVYS by CA.

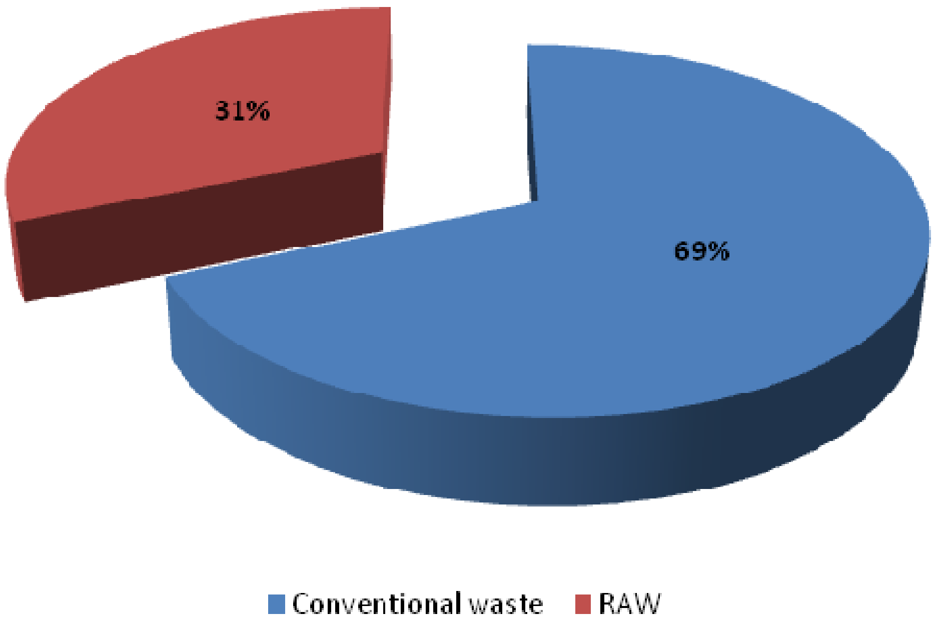
The total volume of waste water generated by the proposed activity is estimated at about 500 thousand m^{3} per year in the first years of the 2nd stage of decommissioning, later the volume will decrease.

A precise quantification of waste water release is not possible at the present stage of the decommissioning process.

3. Waste

During the 2nd Stage of decommissioning both, conventional[5] and radioactive waste in a total volume of cca. 775 thousand tonnes will be generated in the ratio shown in the following graph.

Graph No. 62. Ratio of waste generated during decommissioning



Tab. No. 11. Estimated generation of wastes during the whole decommissioning process

Material from dismantling and demolition of buildings of V1	Calculated total amount of waste (t)	Percentage from the total amount (%)
Concrete and aerated concrete	630,309	81
Bricks and stones	17,196	2

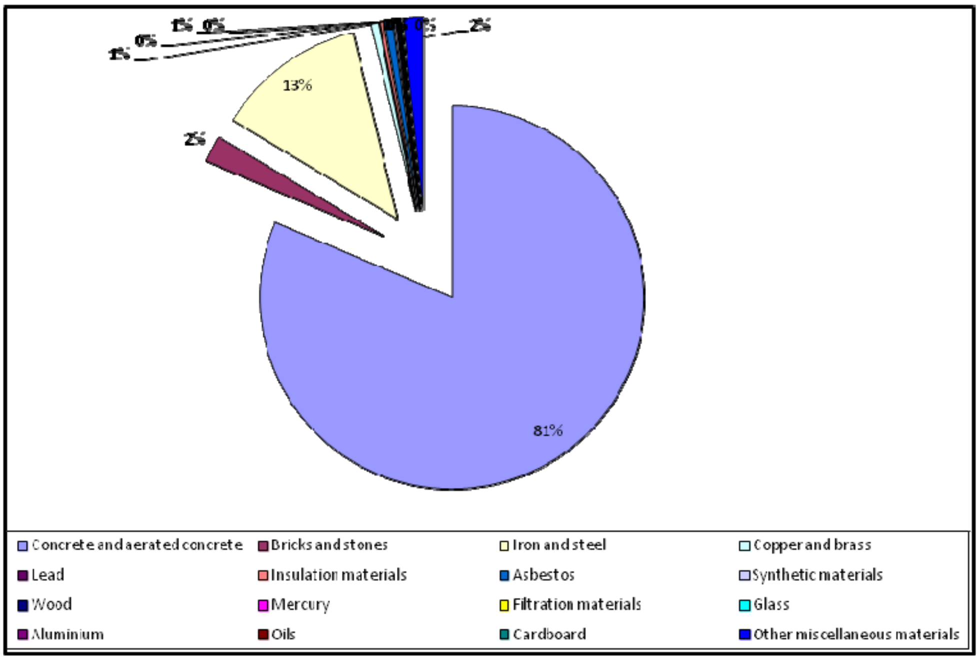
[5] Non-radioactive waste which classifies as waste under the scope of the Waste Act

Tab. No. 11. Estimated generation of wastes during the whole decommissioning process

Material from dismantling and demolition of buildings of V1	Calculated total amount of waste (t)	Percentage from the total amount (%)
Iron and steel	97,966	13
Copper and brass	4,891	1
Lead	59	3
Insulation materials	2,379	
Asbestos	5,083	
Synthetic materials	1,277	
Wood	876	
Mercury	0,418	
Filtration materials	77	
Glass	290	
Aluminium	719	
Oils	321	
Cardboard	253	
Other miscellaneous materials	12,789	
TOTAL	**774,492**	

The estimated composition of total waste is shown in the following graph.

Graph No. 63. Estimation of total waste composition



3.1 Conventional waste

Calculated amounts of materials which are during decommissioning to enter into the individual waste streams (conventional waste + RAW) are provided in the following table. Potential RAW will creat part of amount aprox. 242 thousand from the total amount of waste of aprox. 774 thousand tonnes, According to estimations, 532 tonnes of conventional waste will be generated in the categories and types provided in the following table.

Tab. No. 12. Estimation of conventional waste composition

Material from dismantling and demolition of buildings of V1	Calculated total amount of waste (t)	Code of waste according to waste catalogue	Waste category according to waste catalogue	Percentage from the total amount (%)
Concrete and aerated concrete	437 076	17 01 01	O	82
Bricks and stones	15 928	17 01 07, 17 09 03	O, N	3
Iron and steel	59 257	17 04 05	O	11
Copper and brass	4 590	17 04 01	O	1
Lead	34	17 04 03	N	3
Insulation materials	1 210	17 04 04	O	

Tab. No. 12. Estimation of conventional waste composition

Material from dismantling and demolition of buildings of V1	Calculated total amount of waste (t)	Code of waste according to waste catalogue	Waste category according to waste catalogue	Percentage from the total amount (%)
Asbestos	5 074	17 06 01, 17 06 03, 17 06 04	O, N	
Synthetic materials	1 173	17 02 03, 17 02 04	O, N	
Wood	875	17 02 02, 17 02 04	O, N	
Mercury	418	17 09 01	N	
Filtration materials	66	17 09 03, 17 09 04	N, O	
Glass	232	17 02 02	O	
Aluminium	627	17 04 02	O	
Oils	321	13 01 13,13 02 08, 13 03 10,	N	
Cardboard	253	17 03 03	N	
Other miscellaneous materials	5220	17 04 11, 17 05 03 , 17 08 02, 17 09 04	N, O	
Total	**531 936**			100

3.2 Hazardous waste

Installation and civil structures that contain hazardous substances (according to their material composition) or are contaminated by such substances will be sources of hazardous waste classified according to the waste catalogue pursuant to the valid Regulation No. 284/2001 Coll. and the Waste Act No. 223/2001 Coll. as amended.

It is estimated that, out of the total amount of waste, hazardous waste will amount to max. 22,508 tonnes, which represents approx. 3 % of the total amount of waste. This estimation is based on a conservative classification (not quantification) of hazardous substances in materials to be dismantled and demolished. The actual amount of hazardous waste will be likely much lower.

During the decommissioning process management of hazardous waste of the following categories (according to the waste catalogue) is expected:

Compounds and separated fractions of concrete, bricks, tiles, paving bricks, ceramics containing hazardous waste (waste catalogue code 17 01 06).

Glass, synthetics and wood, containing hazardous substances or contaminated with hazardous substances (17 02 04).

Coal tar and tar products (17 03 03).

Soil and construction stones containing hazardous substances (17 0503)

Insulation materials containing asbestos (17 06 01), including asbestos fibrous and asbestos insulation products.

Other insulation material out of hazardous substances or containing hazardous substances (17 06 02).

Lead batteries (16 06 01), including lead acid drained and undrained batteries.

Metal waste contaminated with hazardous substances (waste catalogue code 17 04 09), including ferrous metal scrap, ferrous metal turnings, iron scrap, iron corrugated sheets, steel scrap, ferrous swarf, steel cladding, steel pipes, steel wool, metal non-ferrous scrap and mixed ferrous and non-ferrous scrap.

Discarded equipment containing hazardous components, not containing PCBs, chlorofluorocarbons or free asbestos (waste catalogue code 16 02 13), including capacitors (without PCBs or PCTs), computers and computer screens, cathode ray tubes, electronic appliances and electronic equipment.

Waste containing mercury (17 09 01, 06 04 04), including mercury waste and residues and mercury compounds.

Diverse oils (13 01 13, 13 02 08, 13, 03 10).

3.3 Radioactive waste (RAW)

The following radioactive wastes are expected:

Primary RAW (activated materials and materials activated with radionuclides, generated during dismantling of equipments and systems and demolition of buildings in the controlled zone)

Secondary waste (resulting mainly out of usage of materials, equipments and tools for fragmentation and decontamination of activated and contaminated parts)

Historical RAW (sludges and sorbents situated in the tanks of the building No. 801)

On the basis of a total inventory provided in the next table, it is assumed that, out of the total amount of waste generated in course of dismantling and demolition of all decommissioned buildings and equipments, approx. 242,800 tonnes of materials will constitute RAW of different radiological categories, which are to be processed effectively in the facilities for RAW conditioning and treatment in order to reach the maximal rate of free release into the environment.

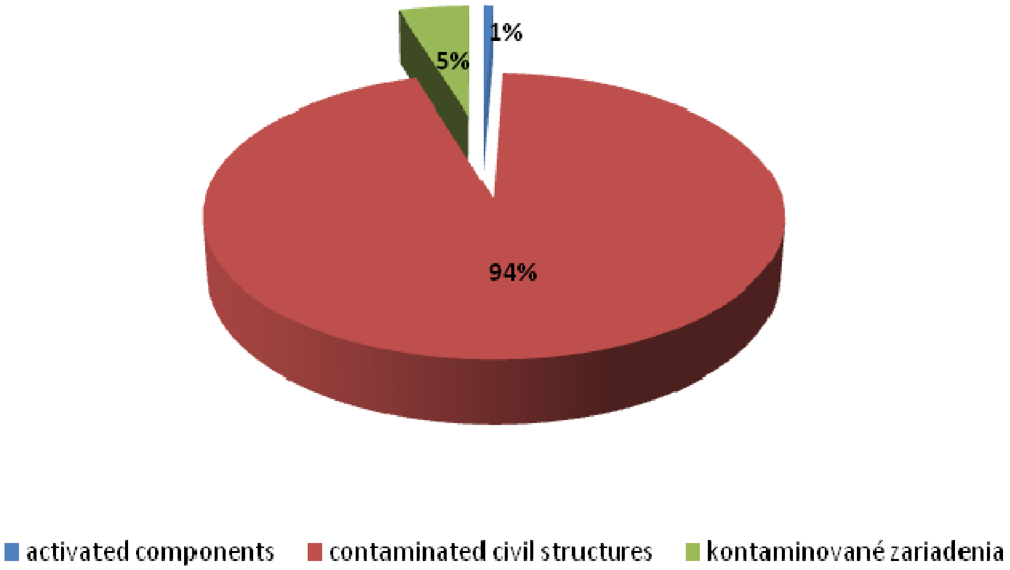
Tab. No. 13. Total radiological inventory of V1 NPP, mass and activity as of January 1, 2010

All civil structures		Activated components	Contaminated buildings structures	Contaminated equipments	Sum
Sum	Activity (GBq)	261.700.000	44,22	11.730	261.700.000
	Mass [tonnes]	1.576	229.600	11.560	242.800

Source EIA C7 A3

The composition of RAW according to its origin is provided by the following graph.

Graph No. 64. Composition of RAW from dismantling and demolition in controlled zone



Other way of radiological inventory presentation important in connection with decommissioning NPP V1 is division of installations and civil structures in defined radiological classes. Criteria for RC definition have been established by convention using the radiological index (RAI) and following list of RC was developed:

Class 1 – RAI < 0,3

Class 2 – RAI < 1

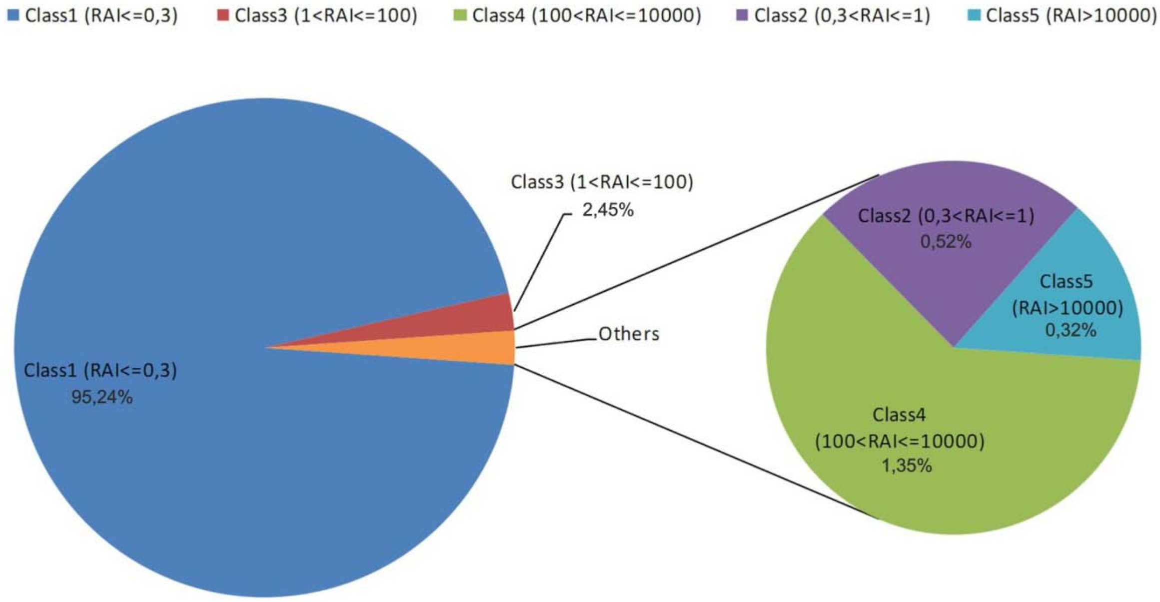
Class 3 – RAI < 100

Class 4 – RAI < 10000

Class 5 – RAI > 10000

On the basis of parameters in DDB value of RAI was calculated for each relevant item and RT was assigned. Result of this calassification of installations and civil structures showed that more than 95% mass of NPP V1 radiological inventory belongs to RT1. In contrast, installations belonging to RT 5 represents just 0,41% mass of NPP V1 radiological inventory.

Graph No. 65. Percentage of mass division according to radiological classes



It is expected that material with characteristics of radiological class (RC) RC1 and RC2 and about 60% of RC3 will comply with conditions for free release according to governmental decree of SR No 345/2006 Coll. Quantity of material which represents potential RAW divided according to radiological classes is shown in the following table.

Tab. No. 14. Quantity of materials according to radiolocal classification (kg)

Material	RC3	RC1 + RC2	RC1 + RC2 + 60%RC3	RC1 to RC5 together
Concrete	1 121,084	192 037,803	192 710,454	193 233,246
Bricks and stones	-	1 268,923	1 268,923	1 268,923
Iron and steel	2 376,876	32 556,848	33 982,974	38 710,265
Copper and brass	1,332	284,369	285,168	301,855
Lead	-	26,150	26,150	26,150
Insulation materials	5,869	1 161,865	1 165,387	1 169,555
Asbestos	8,092	1,316	6,172	9,409
Synthetic materials	293,60	104,116	104,292	104,409
Wood	-	1,118	1,118	1,118
Mercury	-	-	-	-
Filtration materials	493,20	10,150	10,446	10,670
Glass	0,115	58,400	58,470	58,516
Aluminium	2,490	90,002	91,496	92,493

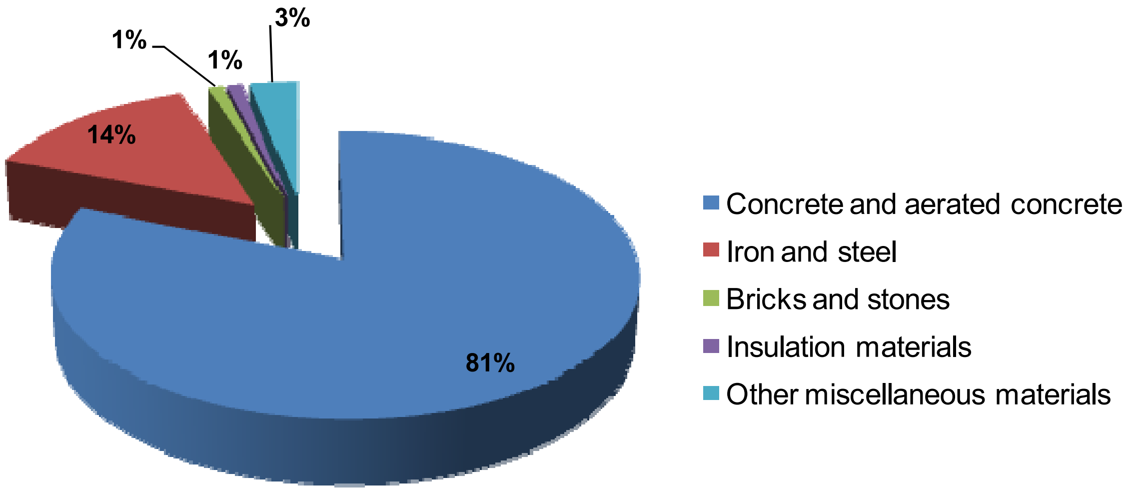
Tab. No. 14. Quantity of materials according to radiolocal classification (kg)

Material	RC3	RC1 + RC2	RC1 + RC2 + 60%RC3	RC1 to RC5 together
Oils		-	-	-
Cardboard	-	-	-	-
Other miscellaneous materials	75,468	7 494,610	7 539,891	7 570,078
Total	**3 592,117**	**235 095,675**	**237 250,945**	**242 556,692**

It can be concluded that from total amount of potential RAW nearly 98% part will represent material for free release.

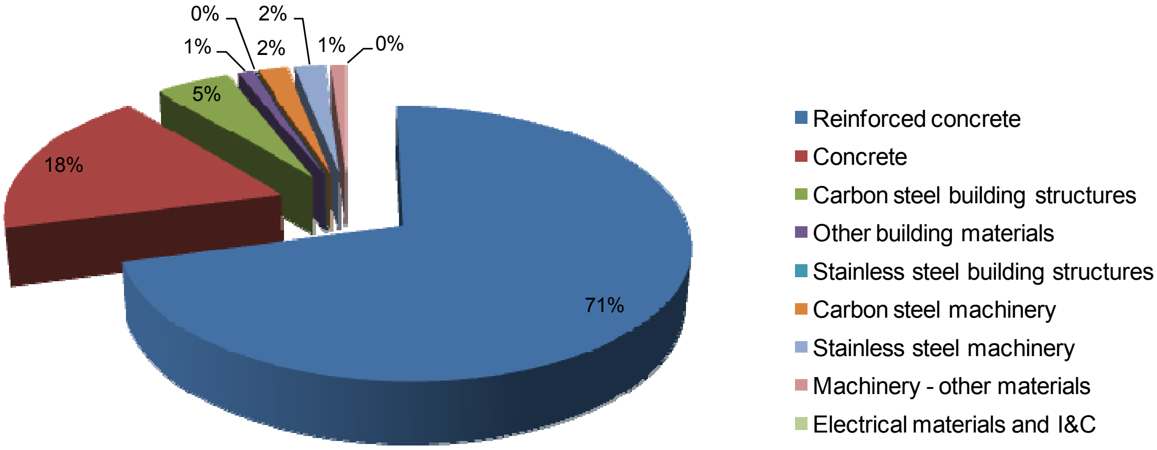
The following grah shows that dominant material for free relrease is formed from concrete, iron and steal, which together represent 95% part of total free release materials.

Graph No. 66. Ratio of free release materials according to kind of material



As it is shown on the following graph, materials from mashinery are, in comparison with civil structures are minority source of free release materials and represents just 5% part of total free release materials. Mass division according to source and kind of free release materials from NPP V1 is shown on the following graph.

Graph No. 67. Kinds of free release materials from NPP V1 decommissioning



Current limit value for free relrease of RAW is 300 Bq/kg. If currently discussed legislation decreases this value to be 100 Bq/kg (from year 2017) amount of free release RAW will decrease by aprox. 1,840 tonnes, what means that the difference will be just 0.24% in comparison with current state implementing limit value 300Bq/kg. Impact of legislative change will not significantly influence the total amount of free release RAW.

Regarding the radionuclides the corrosion products Fe-55, Ni-63 and Co-60 dominate in radiological inventory of NPP V1 and create 98% part of inventory. In comparison with corrosion products the fission products form tenths of one percent of total inventory.

It is assumed that after fragmentation, separation and in-situ decontamination aprox. 90% of 237,250 tonnes will be material for free release[6] and aprox. 10% will be processed at F&D facility – aprox. 23 thousand tonnes.

It is expected that materials for free release will be: metals, insulations, construction waste and soil, bulky waste and components of buildings. Materails will be released as fragmented parts in palletes, construction waste in containers.

[6] Free realease of non-contaminated or slightly contaminated materials with mass activity under the free release level established by decree No 345/2006 Coll. in Annex 8 and will comply with criteria for fre release stipulated in part II., Annex 3 of decree No 345/2006 Coll – Limit value of mass and surface activity provided in following table:

Class	Level of free release A_{Mrl} (Bq / kg) - uu_m	Level of free release A_{Srl} (Bq / cm^2) - uu_s
1	300	0,3
2	3000	3
3	30000	30
4	300000	300
5	3000000	3000

3.3.1 Secundary RAW

Secundary RAW will be generated in the process of abrasion of tools during segmentation and fragmentation, usage of chemical compounds during decontamination and other activities. It is assumed that total generation of secundary RAW will be about 6,858 tonnes of solid RAW and about 1190m^3 liquid RAW.

3.3.2 Summary

The following table provides the total amount of RAW for final waste condinioning and treatment during the whole 2nd stage of NPP V1 decommissioning.

Tab. No. 15. Total amount of RAW from NPP V1 decommissioning

RAW from dismantling and demolition	Secundary RAW	Historical RAW
2 351 t z F&D 1 600 t activated components 5 300 t contaminated components	cca 6 858 t solid RAW cca 1 190 m3 liqiud RAW	650 m^3

Source: EIA F&D, D7.1, C 7- A3

3.4 Management of conventional waste

Waste management will be carried out according to the Act No. 223/2001 Coll. on waste, as amended, and the Regulation No. 283/2001 Coll. on the execution of certain provisions of the Waste Act, as amended, and the Regulation No. 284/2001 Coll. on the establishment of a waste catalogue, as amended, the valid Waste Management Program (POH SR) and the basic principles of the European and national waste management strategies.

In particular, the following shall apply:

Principle of hierarchy of waste management (in particular, giving preference to reuse of waste and material recovery)

Principle of proximity and self-sufficiency (the majority of waste will be treated and used at the place of its origin)

BAT principle (recycling and disposal of waste will be subject to application of the best available technology in accordance with the Waste Act and other corresponding legal provisions)

3.4.1 Management of waste in the category "other waste"

The preferred waste management method will be securing a reuse of this waste (in situ or by selling it) and recycling of waste upon their mechanical conditioning oriented mainly at:

Consequent separation according to the material and reduction of the total volume (fragmentation, separation and pressing)

Reaching of the required structure/size of components (separation and crushing of construction waste - concrete)

The waste will be used mainly as secondary raw materials (mainly ferrous and non-ferrous metals) and as material for backfilling in situ. It is estimated that ca. 90% of the entire amount of waste will be recycled and ca. 10 % disposed on suitable waste disposal facilities..

Recycling of construction waste, in particular concrete, presupposes their previous mechanical conditioning. For this reason, 4 concrete shredders/crushers with a capacity of 100t/hour will be on place, distributed and opearted according to the needs throughout the site. Crushed waste will be used as backfilling material for filling of construction pits remaining after removal of buildings.

3.4.2 Management of waste in the category "hazardous waste"

In respect to this waste category observance of all conditions of their management must be secured as required by the valid legal provisions, namely in the spheres of collection, packaging, storage, denomination, transport and permits to handle hazardous waste. Major part of this waste consists of waste containing asbestos.

3.4.2.1 *Management of waste containing asbestos*[7]

Works of removing materials containing asbestos from buildings (roof cover, insulation of buildings, sewage system pipes, internal mounting of the cooling towers etc.) may be exerted only by legal persons which hold a permit by the Public Healthcare Authority SR and at the same time dispose of an approving decision by the Regional office of the Public Healthcare Authority.

Asbestos containing materials are classified according to the waste catalogue (Reg. No. 284/2001 Coll.) as hazardous waste (H), which is subject to special management – packaging in rigid packages (e.g., plastic bags thoroughly closed in such a way as to prevent leakage into the environment during transport, storage of waste packed in this way on a specific landfill for hazardous waste.

In the working environment, it is necessary to secure abidance by the provision of § 41 Act No. 355/2007 Coll., when removing asbestos or material containing asbestos from buildings: „An employer who assigns employees to carry out activities which can imply a risk of exposure to asbestos or materials containing asbestos is obliged to secure, according to a special provision, that technical, organisational and other measures be taken in order to exclude or reduce the exposition of employees to the smallest possible and practicable level."

Main requirements, as far as dismantling of asbestos is concerned, are as follows (Regulation of the Government of SR No. 253/2006 Coll. and Act No. 355/2007 Coll.):

Works must be carried out by qualified workers under application of methods that can guarantee the security of workers and the overall security of the population. Measures for environment protection must be defined prior to the beginning of works, during their implementation and after their completion.

The company in charge of these works must hold an authorisation to carry out such activities (§ 5 para. 4 n and § 41 para. 1 Act No. 355/2007 Coll.).

As far as demolition of buildings is concerned, first any crumbling or badly fixed asbestos materials are to be removed.

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[7] Asbestos are classified as substances with carcinogenic (cancer-causing) effect to respiratory organs. Health damage shows only after 10 - 20 years since the exposition period. It is proven that asbestos can cause if inhaled, owing to their airborne respirable fibres of microscopic size, pulmonary fibrosis - asbestosis, lung cancer, mesothelioma of pleura and peritoneum and deformations of pleura.

Compact asbestos materials in good technical state do not represent a significant risk. Attention is to be paid to the issue of dustiness as a result of dismantling.

Waste containing badly fixed asbestos is to be packed carefully.

Waste containing badly fixed asbestos is to be duly moistened prior to transport. Asbestos waste is to be transported in impermeable packages on covered trucks.

In respect to collection and temporary storage of this waste a specific time schedule is to be elaborated in order to prevent pollution of environment by any working activity.

Any waste contaminated with asbestos is, upon demolition, to be reduced to the maximum possible extent, moistened and transported altogether to an assigned dumping site.

Prior to removal of badly fixed asbestos surface detergents are to be applied.

Any asbestos waste transported for disposal on a dumping site is to be recorded.

The proponent is to work out a time schedule, or work plan, that is to be submitted prior to demolition and is to provide for all measures necessary to secure protection of health of workers, limits for fibres released to the air as well as the method of removing waste containing asbestos.

Representatives of the company in charge are to participate in the elaboration of this time schedule.

JAVYS, a.s. has collected extensive experience in respect to the management of waste containing asbestos and acts pursuant to the approved operational schemes. Works are carried out exclusively by legal persons that are authorised to carry out this type of activity.

In general, the work order is as follows:

- In premises with presence of asbestos, first, dismantling of this hazardous material is to be performed prior to any ohter works in such premises. Directly upon cleaning other works can be carried out.
- Prior to commencement of works the controlled area is to be marked out. Authorised to enter into the controlled area are only workers who have been assigned to handling of asbestos, are verifiably instructed on this technological method, equipped with the prescribed personal protection means and have passed a preventive medical check. The controlled area can only be removed upon total completion of dismantling works, transport of all partially stabilised waste designated as hazardous and final cleaning of the premises.
- In order to prevent a potential release of fibres stabilisation and fixation of fibres by preparations like Foster® 32-60/32-61 (Foster® Asbestos Removal Encapsulant) shall be carried out. It is applied during removal of materials and the subsequent fixation of the remaining fibres. The preparation is applied e.g. by means of a high-pressure airless atomizer. At next the dismantling itself and division of asbestos, mechanical conditioning and subsequent packaging and transport of the material are performed.
- Fractions that fall on the working floor or around the working area will be additionally stabilised by the preparation and collected into sacks with respective designation and

stored in a metallic barrel with a closing cover. Hereafter, any possibly remaining fibres will be removed by thorough vacuum cleaning with a cleaning device provided with a HEPA filter. (e.g., type SOTECO NEVADA CYKLON 640) with an effectiveness of filtration - retention of dust particles of 99.99 %).

3.5 RAW management

RAW management is an activity described in detail in the Chapter B II.8.

3.5.1 HRAW management

3.5.1.1 *Procedure of RAW management in the “A” category (used sorbents)*

It starts by emptying and conditioning of "A" category RAW from the tank ZT20N-1. A smaller amount of sorbents with medium-level activity and fluids located in the tank ZT20N-2 (estimated total amount 18 m3) will be pumped into the tank ZT20N-1 via the existing connecting pipes. Similar procedure applies to the sorbents with low-level activity in the tank ZT20N-4 (appr. 5 m3), which will be pumped into the tank ZT20N-3. This way, the tanks ZT20N-2 and ZT20N-4 will be prepared for final cleaning.

RAW from the tank ZT20N-1 will be consecutively pumped for pre-conditioning into the "A" unit, which will be installed at the working place close to the storage tank (in the premises No. SK 236). The pump will be placed directly in the storage tank, with a double-walled extruding pump hose. A remote controlled manipulating arm carrying the pump will be installed into the circular entry opening of the tank ZT20N1. The manipulating arm will allow for any necessary movements of the pump inside the tank. RA sorbents will be gradually exhausted from the tank until the exhauster head reaches the bottom of the tank and any wastes that can be pumped are removed.

Upon conditioning and treatment of RA sorbents from the tank ZT20N-1 at the pre-conditioning facility, RA sorbents from the tank ZT20N-3 will be refilled, if possible, to the tank ZT20N-1 or will be directly pumped and conditioned through the drainage facility.

Pre-conditioning of RAW will be performed in the drainage tank (pre-conditioning unit for the waste of type "A" in the room No. SK 236), to which waste (RA sorbents) will be gradually pumped from the storage tanks. Conditioning includes draining and condensation in order to reach an optimum content of sludge dry residue in the waste. Separated fluid will be returned back into the storage tanks ZT20N-1 or ZT20N-3. Drained sorbents will be dosed by a screw conveyor from the pre-conditioning unit into prepared 200 dm3 metallic barrels (with a protective coating of the internal surface). The quantity of waste in the barrel will be continuously measured by a tensometric scale. Sorbents will be batched into the barrels in such a way that the amount of sludge dry residue will be between 50 and 60 kg, that is to say, if we presuppose a 55% content of sludge dry residue in the drained sorbent each barrel should be filled with 95 to 110 kg of sorbent.

The drained sorbents will have to be filled with service water in a volume of ca. 40 - 50 dm3. Either dissolved sediment phase (waste category "B") or water generated in sorbent conditioning shall be used as service water.

Next, a calculated amount of liquid waste of the "B" category, that is to say dissolved crystalline borates, will be filled into the barrels.

On the basis of approved methodology, representative waste samples will be extracted prior to the beginning of waste solidification itself. Samples will be transferred to the radio-chemical laboratory where the required radio-chemical analyses will be carried out. If analyses confirm that the waste can be disposed in NRR Mochovce the waste in barrels will be solidified.

Barrels with waste will be placed individually into a mobile solidification line where, under constant mixing, individual components of the matrix SIAL® will be added to them. The added amounts are checked by means of scales.

When filled the barrels will be closed with covers, designated with an identification label including a bar code and a warning sign for RAW and moved by means of a carriage to the working place for solidification of waste (room No. SK231/SK233). The parameters of the final product (firmness, capacity to dissolve) will be reviewed according to approved methods.

Barrels with the final product will be gradually transported from the temporary storage in BAPP to another destination for further treatment/storage as defined by employees of JAVYS. The barrels will be inserted by means of an electric chain hoist into closable ISO containers (maximum 40 barrels per container) and will be transported on a truck to the defined location within the JAVYS site. JAVYS a.s. is responsible for further loading and treatment of barrels with the final product into FCC containers.

3.5.1.2 *Procedure of RAW management in the "B" category (crystalline sediments and sludges)*

Sediments in the tanks are in form of a solid crystalline phase deposited on the bottom of the tanks or they are crystallized on other internal surfaces of the tanks (vertical walls, internal mountings). By means of dissolution sediments will be divided from the remaining non-soluble present sludges. Upon dissolving of sediments the liquid phase will be gradually pumped from the tanks ZT10N-4 to ZT10N-10 through the existing pipe lines to the tanks ZT10N-2 and ZT20N-3. A part of the dissolved sediments will be gradually refilled from the tank ZT10N-2into the facility for pre-conditioning of "A" waste where it will be deployed as service water for treatment of "A" category RAW. The other part of the dissolved sediments will be refilled through the existing pipe line to the facility for pre-conditioning of "B" category waste which will be placed in the building No. 809C (former cementation facility).

In the first step, by means of a sequence of chemical and mechanical procedures including preparation of reagents, mixing and separation, active fractions will be separated from the treated liquid and subsequently fixated into the SIAL® matrix, either on their own or in a mixture with active sludges/ionexes. A representative sample will be taken from the cleaned liquid phase in which remaining volume activity will be measured in the laboratory. If the value is lower than the limit for release to the environment the product will advance for further processing (can be performed out of the CZ).

After withdrawing the liquid phase with solved crystalline sediments the individual tanks will be cleaned from non-soluble sediments. Non-soluble sludges that remain on the bottom of the tanks will be extracted by means of a gear pump. The nose-piece on the sucking nose of the pump will be fixed to a remote controlled carriage which will be lowered to the bottom of the tank. Extracted sludges will be collected into 200-dm3 steel barrels MEVA placed in the corridor in front of the entry into the room with the cleaned tank.

On the basis of approved methodology, representative waste samples will be extracted prior to the beginning of waste solidification itself. Samples will be transferred to the radio-chemical laboratory where the required radio-chemical analyses will be carried out. If analyses confirm that the waste can be disposed in NRR Mochovce the waste in barrels will be solidified.

Pre-conditioned waste will be treated directly in the barrels by solidification into the inorganic SIAL® matrix pursuant to the approved technology. Barrels with waste will be placed individually into a mobile solidification line where, under constant mixing, individual components of the matrix will be added to them. Upon completion of this process, the barrels will be closed, designated with a label including a bar code and a warning sign for RAW and will be further treated like "A" category RAW.

Once the works are finished, the equipments will be decontaminated, dismantled, taken into parts, put into transport packages and removed from the premises of JAVYS. Removal of equipments will be announced to JAVYS employees at least 10 days in advance. Equipments will be carried away on trucks.

Upon dismantling and transportation of the used equipments the work stations (working surfaces) will be decontaminated to the limit values, that is to say, below the level of 1.0 Bq.cm-2. The choice of procedures will, apart from decontamination effectiveness, also allow for the quantity and treatability of secondary RAW.

4. Noise and vibrations

Noise and vibrations will be caused by machines, trucks and equipments such as pumps, compressors and the waste crusher. The proposed activities will be carried out prevailingly in closed premises. Common work tasks and transport (motor vehicles) will be carried out in open space.

Recycling of construction waste from demolition by means of crusher at the place of its generation will also produce noise and vibrations and may call for mitigation measures.. Demolition works and recycling will be, however, only of a short duration.

5. Radiation and other physical fields

The most significant physical field is radioactive radiation. Outputs of this kind are mainly due to decontamination and fragmentation of installations and buildings of the PC and to management of primary and secondary RAW and historical RAW.

The total radiological inventory to be decommissioned during the 2nd Stage is located in the controlled zone of the V1 NPP. The following table provides data on the summarised activity inventory contained in the individual buildings. This table shows the total activities of building structures and equipments in all affected buildings together with the respective masses of the materials.

Tab. No. 16. Total radiological inventory of V1 NPP, mass and activity as of January 1, 2010

Building No.		Activated components	Contaminated civil structures	Contaminated installations	Sum
800:V1	activity (GBq)	261,700,000	37.88	11,730	261,700,000
	mass [ton]	1,576	138,600	9,440	149,600
801:V1	activity (GBq)	0	1,266	6,609	7,875
	mass [ton]	0	74,020	1,815	75,840
802:V1	Activity [MBq]	0	0.93	143.3	144.2
	mass [ton]	0	508.7	50.81	559.5
803:V1 (part in the CZ)	Activity [MBq]	0	23.88	66.76	90.63
	mass [ton]	0	677.9	158.7	836.7
804:V1	Activity [MBq]	0	116.9	16.43	133.4
	mass [ton]	0	6,295	8.3	6,304
C809:V1 (C350, C804)	Activity [MBq]	0	116.8	51.24	168.0
	mass [ton]	0	4,472	73.26	4,545

Tab. No. 16. Total radiological inventory of V1 NPP, mass and activity as of January 1, 2010

Building No.		Activated components	Contaminated civil structures	Contaminated installations	Sum
800a,b:V1	activity (GBq)	0	4.773	0	4.773
	mass [ton]	0	176.1	0	176.1
Sum	**activity (GBq)**	**261,700,000**	**44.22**	**11,730**	**261,700,000**
	mass [ton]	**1,576**	**229,600**	**11,560**	**242,800**

Source: Impact assessment report "Construction of a new large-capacity F&D facility" JAVYS, 2013

5.1 Outputs into the atmosphere

Works such as cutting of activated materials inside the reactor building, decontamination of components and objects, fragmentation and decontamination in the F&D facility, waste conditioning and treatment[8] will cause generation of radioactive gases and aerosols. These work processes will be performed in the CZ where any gaseous discharges will be filtered prior to their release into the atmosphere.

The following table summarises the anticipated max. activities of discharges into the atmosphere according to the individual work processes.

Tab. No. 17. Anticipated max. activities of discharges into the atmosphere according to the individual work processes

Type of work	Total radioactivity (Bq)
Dismantling and fragmentation of large components of the PC	1.06E+9
Dismantling and fragmentation of contaminated components	8.42E+6
Fragmentation and decontamination in the new F&D facility	negligible
Decontamination of building structures (walls and floors, soils)	negligible
Total	**1.14E+9**

5.2 Outputs into the hydrosphere

The following table provides the total anticipated activities of radioactive liquid discharges attributed to the basic activities of the 2nd Stage of decommissioning.

[8] Outputs from RAW conditioning and treatment in TSU RAO facility have been assessed by separate EIA process

Tab. No. 18. Anticipated max. activities of discharges into the hydrosphere according to the individual work processes

Activities	Total radioactivity (Bq)
Dismantling and fragmentation of large components of the PC	4.25E+07
Dismantling and decontamination of components in situ	3.94E+06
Fragmentation and decontamination in the new F&D facility	negligible
Total	**4.64e+07**

The following table summarises the maximum anticipated doses to the public caused by transport of RAW to NRR Mochovce.

Tab. No. 19. Max. radiation doses to the public along the transport routes

	Collective dose (Sv)	Max. individual dose (Sv)
Common transport of RAW	7.55E-02	4.68E-06

More detailed calculations are provided in the specific Annex 14.

6. Malodour and other outputs

The proposed activity ought not to represent a significant heat load to the surroundings of the NPP Bohunice and no outputs of malodorous substances are expected during the 2nd stage of decommissioning either.

By decommissioning of cooling towers major part of heat discharge into the atmosphere has been eliminated. Presently, the only waste heat is the waste heat into the water recipient.

7. Additional data

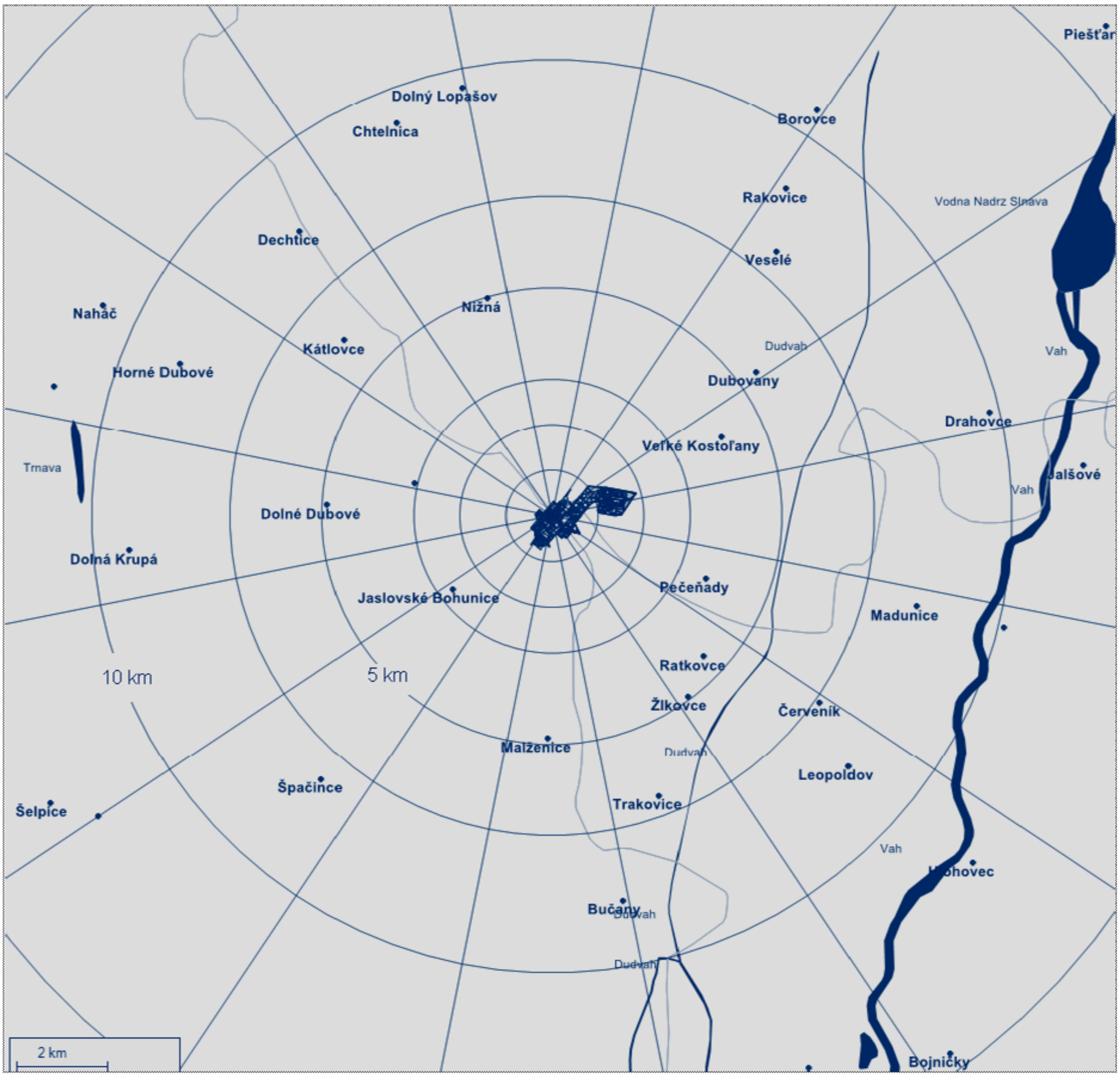
More detailed data and information can be found in JAVYS specific projects focused on preparation and implementation of 2nd stage of NPP V1 decommissioning. (see http://www.javys.sk/sk/bidsf/projekty-bidsf)

C. COMPLEX CHARACTERISTICS AND ASSESSMENT OF ENVIRONMENTAL IMPACTS INCLUDING HEALTH

I. Definition of borders of the affected area

The affected area has been defined as the territory within a radius of approximately 5 km of Bohunice V1. The broader context has been examined in greater entities suitable for characterisation of the individual parts of environment. The following graphics depict the area within 5 and 10 km of the V1 NPP. Annex 11 provides fotodocumentation of area of NPP V1, surounding area of NPP V1 and some installations.

Graph No. 68. Affected area within a radius of 5 and 10 km of Jaslovské Bohunice V1



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

1. Geomorphological conditions

From the point of view of geomorphological division of Slovakia the assessed area is situated in the Danube Basin, region of Danube pahorkatina Upland, sub-region of Trnavská pahorkatina Upland, part Trnavská tabuľa Table. (Mazúr, Lukniš, 1980).

From morphostructural point of view, the territory represents little differentiated, effaced table upland caused by movements along the Carpathian direction (SW - NE). The assessed area forms part of a transition and a table bench whose effaced boundary runs approximately in the direction Špačince - Jaslovské Bohunice - Veselé. It is assumed that the tectonics of the NW - SE direction has divided the transition bench into complexes of blocks elevated to two distinct levels with relative differences of height of 10 m in average. All of them have the shape of low, broad, flat, slightly towards SE inclined backs that smoothly result in a table. Near to Nižná the shallow Graben-nižnianska Depression is situated. It has a rectangle shape elongated in the NW - SE direction and its immersion in respect to the surrounding blocks does not exceed 10 m. The territory around Nižná shows a distinct rectangular net texture of valleys and dells, which testifies its tectonic predisposition. The table bench is built of a table with minimal inclination, or more precisely its remnants divided by local streams. The remnants of the table show shallow furrows in form of dells, wide shallow immersions or closed depressions of various origins. It is assumed that the NW - SE tectonics has caused a division of the table and its elevation into two levels of different height. The rectangular block between the valleys of Blava and Manivier, elongated in the direction of tectonic lines, experienced A relatively higher elevation (by 10 m). The table bench is on its SE rim delimited by a 15 - 20 m high base of an edge slope at the contact with the Dolnovážska flood plain. The distinct edge slope has been at some places notably lowered due to exogene processes.

2. Geological conditions

2.1 <u>Geological composition</u>

The affected area is situated in the North-West part of the Danube Basin in the Blatnianska priehlbina Depression. The geology of the area is represented by units of the Mesozoic Era (Triassic), the Tertiary Period (Paleogene - Eocene, Neogene - Miocene and Pliocene) and the Quartenary Period (Pleistocene and Holocene) (Maglay et al., 2002).

2.1.1 Pre-Neogene Substratum

In the substratum of the Danube Basin (in the area of interest) two basic zones can be distinguished: the northern and the southern zone. The two zones show different erosion levels before the creation of the basin fill. The northern zone of the Blatnianska priehlbina Depression, in which the affected area is situated, is characterised by sediments of Central-Carpathian Paleogene. These are Middle to Upper Eocene sandy marly claystones, less sandstones and seldomly conglomerates. More often Triassic complexes of Hronicum occur, which, in the direct subbase of Neogene, are composed of dolomitic limestones, dolomites and occasionally Lower Triassic clastic rocks.

2.1.2 Neogene

The stratum underlying Quaternary is composed of the youngest representative of Neogene sediments - the Kolárovské formation, dated to the Romanian (Piacenzian) (Krčmár, 1988). According to exploration results (Kováč et al., 1991), this sandy-gravel complex is uninterrupted in the whole territory and reaches a thickness of 15 - 30 m.

2.1.3 Quaternary

In the affected area only two Quaternary formations crop out - eolian sediments and fluvial sediments. The terrain surface is almost horizontal, divided by watercourses that flow in rather deep channels of different width. At the confluence of the individual streams these channels reach relatively large dimensions (Senčáková, 2002).

Eolian sediments of Middle to Upper Pleistocene (Older Riss to Würm) build the cover of the affected area. These are loess and loess loams that constitute a so called pseudo-terrace imbeded on subbase gravels. The loess layer is between 6 and 20 m thick, 18 m in average. In series of loess horizons, occurrence of relict (fossil) soils is common.

Loess sediments are brown with different shades. The mineralogical composition of loess is made up mainly of quartz (37-83%), feldspar, mica, carbonates and glauconite.

Fluvial sediments are represented by deposits of the Váh River, mainly gravels, to a lower extent by thin grained sediments that create layers in the gravels. Gravel base runs in a depth of 18 to 26 m below the terrain. From the point of view of petrographic composition the pebble material is represented by granitoides, metamorphites, volcanites, vein quartz, vein calcite, hornstones, quartzites, arcoses, siliceous sandstones, calcareous sandstones and limestones from several sources (Masina, Lexa, 2002).

Fluvial plain Holocene sediments, that is to say Quaternary gravels, are clearly divided into an upper layer of thinner sediments, normally without skeleton, a flood formation and a lower sandy-gravel channel formation rich in pore groundwater. (Krajňáková, 2003).

2.2 Engineer-geological characteristics

From the point of view of engineer-geological structure the affected area belongs to a region of tectonic sags in the zone of Inner-Carpathian lowlands (Danube Basin). According to occurrence and extent of the Quaternary cover formations, on the surface of the affected area 2 types of engineer-geological zones can be discerned (Vlčko, 1988):

- a zone of loess sediments with prevailing fine grained rocks (up to a depth of 5 m)
- a zone of fluvial deposits with alternating gravel and fine grained rocks (up to a depth of 5 m).

2.3 Deposits of raw materials

According to the Record of protected deposit areas of the Hlavný banský úrad (HBÚ, Central Mining Authority, 2013) the protected area Veľké Kostoľany is situated in the affected area (underground reservoir of natural gas).

In its proximity, to the South-West, the protected deposit area Boleráz (mining of brick loams) is situated and to the North-West, there is the protected deposit area Dechtice I. (limestone), II. (dolomitic sands) and III. (high percentage limestone).

Pursuant to the Record of mining areas of HBÚ (2013a), mining areas Bohunice, Bohunice I. and Veľké Kostoľany (exploitation of natural gas) lie here. Proximate mining areas are Boleráz (mining of brick loams), Dechtice (mining of limestone) and Dechtice I. (mining of dolomitic sands).

2.4 Geodynamic Features

The affected area is located nearby Dobrovodská depression, a seismically active area in the past, situated in the Brezovské Carpathians (cc. 16 - 18 km). Dobrovodská depression is situated in the zone of seismic activity in the penninsko-vahická suture characterised by shear zones and reverse fault displacements in the ENE - WSW direction. This zone generates seismic events that release in brittle fault deformations. Apart from this suture zone, which constitutes the most significant zone of seismic activity, other fault structures occur in wider surroundings that could potentially generate earthquakes. One of them runs in the direction SW - NE and SSW - NNE, through Trnava towards Piešťany directly through Malženice. All described fault structures were active in Neogene and evidenced also in Quaternary. Along the faults in the given directions, identified by geologists and geophysicists, faults in the NW - SE direction, discerned by geomorphological methods, were also characteristic of Quaternary. It is assumed that one of such faults runs through the valley of the creek Blava (through Malženice) along which in Pleistocene a block cropped out that is delimited on the other side by a fault line that runs through the Manivier Valley.

The most active exogene geomorphological processes in the assessed area are water erosion, eolian and groundwater processes.

In the past, a particular study on the "Geological history, tectonic development and seismicity of Jaslovské Bohunice" (06/1970) was elaborated. According to the study, a seismic hazard of 6 to 6.5° on the MSK scale was calculated for Jaslovské Bohunice, which corresponds to a value of 4.2 on the Richter scale. The terrain of this region is flat with a maximum inclination of 1°, which constitutes favourable conditions that exclude secondary effects of earthquakes, in particular the risk of gravity collapses. It was established that in a time frame of 200 years an earthquake in the built-up area in Jaslovské Bohunice would most probably reach a value of M = 4.2 on the Richter scale (6.5° MCS). The most probable earthquake in a time frame of 100 years is expected to reach M = 3.5 and within 50 years M = 3.0. Consequently, the conclusion was drawn that in the given area an earthquake is an unusual phenomenon and according to the analysis there are no seismic issues such as would hinder the utilisation of the area for construction of a nuclear plant.

2.5 Level of contamination of geological environment

The most significant potential area source of contamination of geological environment is represented by consequences of intensive application of agrochemicals in large-scale land farming.

With respect to radon contamination of the geological environment the assessed area counts among areas with low to middle radon risk.

2.5.1 Contamination of geological environment with radionuclides

So far, the major large-scale area source of contamination of geological environment in the area of NEC Bohunice remains the A1 NPP site. Among several point, line and small-scale area sources building 41 has been the object with highest contamination potential, owing to the contaminated geological environment of its surroundings. Since 2010 results of groundwater monitoring have shown renewed occurrence of a potential source in the area of the buildings 44/20 and 44/10 (boreholes: JB-32, JB-14A, JB-14 a JB-14B). Measurement results from 2011 show that the geological environment of the surroundings of these buildings still has adverse effects on groundwater in this area. Moreover, already in the I. quarter of 2011 adverse conditions were detected in the surroundings of the borehole JB-35 (area of the main production building of A1 NPP).

According to monitoring results from 2012, the intensity of the source in the given area has decreased. The adverse radiation situation of groundwater at the site has been, however, targeted by redevelopment measures (rescue pumping) by which contaminated groundwater is removed from the geological environment and spreading of rest contamination to the surroundings of the site is impeded. The effectiveness of rescue pumping in relation to the defined complex source at the site of A1 NPP reached more than 86% at the end of 2012.

3. Soil conditions

3.1 Basic characteristics

According to the Act No. 220/2004 Coll. on protection and exploitation of agricultural land, as amended, soils in the affected area pertain to the soil valuation ecological unit BPEJ 7 (VÚPOP - Research Institute of Pedology and Nature Protection, 2013).

In the immediate surroundings of the site, soils of BPEJ 0139002, 0139202 and 0147202 occur to the North, soils of BPEJ 0144202 to the West, 0139002 soils to the South and 0143002, 0138202 and 0143002 soils to the East.

In the surroundings of the affected area, medium heavy, typical and brown chernozem (type of chernosol) on loess prevail. To the North-West and West, medium heavy regosols and eroded luvisols built on loess and medium heavy typical luvisols occur, and to the East regosols and chernosols eroded in complexes on loess. Soils in the affected area are prevailingly loamy, deep (60 cm and more) and without skeleton.

3.2 Level of disposition to mechanical and chemical degradation

Considering the relief type, no significant water erosion phenomena are expected in the area of interest. The predominantly flatland terrain (Dudváh flood plain, flood plain of the stream Blava, Trnavská tabuľa Table) does not show any water erosion signs. On the contrary, on slopy terrain (cad. ter. Radošovce), water erosion of characteristic low intensity can occur. When water levels are high, soils in the flatland terrain of the Dudváh flood plain are under threat of being underflooded and leached.

The wind erosion can be classified as relatively high and high since the relief under consideration is open and predominantly flat, with large-scale agricultural utilisation and without planted wind barriers that would partially eliminate this undesirable phenomenon. This phenomenon manifests itself in the non-vegetation period.

As far as the soils of the affected area are concerned, it can be stated that the soils in the area of interest are very resistant against mechanical and chemical degradation. The soils show acidification caused by long-distance transfer from emission sources in the wider surroundings, in particular from industrial sites in Trnava, Leopoldov, Hlohovec, Piešťany and from transport. The acidification results mainly from immission condensation of SO_2, NO_x or fluorine.

3.3 Quality and contamination level of soils

Contaminants coming from pesticides and industrial fertilizers have been diminished mainly due to the significant reduction of their application as a result of aggravated economic situation of the cooperative farms in the area of interest. Mass stock raising has been closed down or reduced, hence primarily reducing the risk of pollution and deterioration of environment.

Neither are there in the affected area any extensive localities with anthropogenic or economic activities that might lead to contamination of agricultural land.

On the basis of geochemical monitoring of soils in Slovakia (Čurlík, Šefčík, 1999) it can be stated that none of the monitored heavy metal elements has exceeded the limit values established by the former Regulation of the Ministry of Agriculture of SR on allowed values of harmful substances in soils and on organisations authorised to monitor factual values of such substances (Act No. 531/1994-529, note: these limits are no more valid).

3.4 Contamination of soils by radionuclides

As part of the radiation control of NEC Bohunice, activity of soils in the surroundings of the site is monitored as well. Soils are sampled once a year. Samples are divided into two groups: first, from grass plots taken in spring and second, from arable land taken in autumn. The measured parameter is mass activity of natural radionuclides (uranium decay series - ^{226}Ra, thorium decay series - ^{232}Th and isotope ^{40}K) and mass activity of ^{137}Cs or eventually of other artificial radionuclides. INSITU gamma spectroscopy is carried out twice a year, in spring and in autumn. Measurements are made in the proximity of dosimetric stations. The INSITU measurements include also measuring of dose rates at the given location and taking soil samples. Monitoring results confirm that content values of natural and artificial radionuclides in the soil are similar to the average values for the whole region, without noticeable anomalies caused by operation of NEC Bohunice.

4. Climatic conditions

According to the climatic classification of SHMU (Slovak Hydrometeorological Institute), the area of interest belongs to the area A3 - warm, moderately dry climate with warm winter.

4.1 Precipitation

Precipitations are characterised by its considerable variability in the individual years. From the point of view of long term average values, the annual precipitation average reaches about 533 mm (years 1960 - 1990). Most of the total precipitations fall in the summer months and are often combined with storms. The annual cloud amount is 59%, the number of sunny days per year 55.7 and of cloudy days 117.3. The terrain configuration does not predetermine the occurrence of long lasting inversions. Occurrence of inversions is closely connected to occurrence of fog with an average of 34.4 days a year. In winter, they result in a higher risk of frost cover. The average number of days with snow cover per year was in the given time frame (1960 - 1990) 41 days. The average height of snow cover was 7.0 cm.

The following table shows values of average monthly precipitations in the years 2007 - 2010.

Tab. No. 20. Average monthly precipitations in the years 2007 - 2010 in mm (weather station Jaslovské Bohunice)

Year / Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2007	54.8	40.5	59.3	0.3	58.6	30.4	36.7	51.4	128.6	37.8	42.8	25.1
2008	27.1	21.1	42.1	35.2	49.9	81.3	132.0	48.7	51.6	24.9	31.1	38.4
2009	31.0	60.1	58.9	7.8	58.1	121.5	61.0	49.8	9.5	52.3	50.2	69.1
2010	65.1	31.5	20.7	64.8	163.8	88.8	91.2	121.4	96.3	26.4	60.9	39.4

Source: Annual reports on climatological observations at meteorological stations on the territory of SR in the years 2007 - 2010, SHMU

4.2 Temperature

With an average annual temperature of 9.8°C, the assessed area belongs to the warmest regions of Slovakia. Extreme air temperatures in the assessed area can be assumed at -28°C (absolute minimum) and 38°C (absolute maximum).

The following table shows values of average monthly temperatures in the years 2007 - 2010.

Tab. No. 21. Average monthly temperatures in the years 2007 - 2010 in °C (weather station Jaslovské Bohunice)

Year / Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2007	3.9	4.5	7.5	12.4	17.0	20.6	21.8	21.1	13.3	8.8	3.3	-0.4
2008	1.8	3.1	5.3	10.7	15.2	19.7	20.2	19.8	14.6	10.9	6.6	2.6

Tab. No. 21. Average monthly temperatures in the years 2007 - 2010 in °C (weather station Jaslovské Bohunice)

Year / Month	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
2009	-2.7	0.4	5.1	14.6	15.8	17.6	21.2	20.8	17.4	9.6	6.0	0.5
2010	-3.4	0.0	5.3	10.4	1407	18.8	22.0	19.4	14.0	7.7	7.6	-2.8

Source: Annual reports on climatological observations at meteorological stations on the territory of SR in the years 2007 - 2010, SHMU

4.3 Wind conditions

In the area of interest, north-western winds with high average speed prevail. Windlessness occurs seldom.

The following tables shows values of average wind speed and the relative frequency of wind directions in the years 2007 - 2010.

Tab. No. 22. Average wind speed in the years 2007 - 2010 in m.s-1 (weather station Jaslovské Bohunice)

Year / Month	N	NE	E	SE	S	SW	W	NW
2007	4.0	3.2	3.5	4.6	3.4	3.1	5.2	5.3
2008	4.0	3.0	3.9	5.2	3.3	2.8	5.0	5.2
2009	4.4	3.2	4.0	5.2	3.8	2.5	3.8	5.4
2010	4.6	3.2	3.5	5.6	3.7	2.5	4.3	5.7

Source: Annual reports on climatological observations at meteorological stations on the territory of SR in the years 2007 - 2010, SHMU

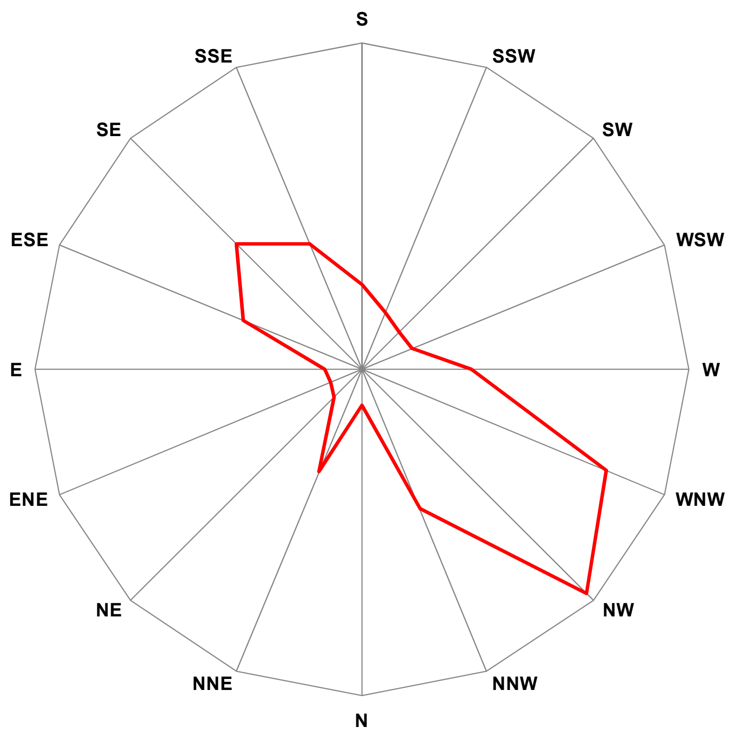
Tab. No. 23. Relative frequency of wind directions in % in the years 2007 - 2010 in mm (weather station Jaslovské Bohunice)

Year / Month	N	NE	E	SE	S	SW	W	NW	CALM
2007	17.9	6.8	4.6	14.9	6.8	5.1	14.1	25.1	4.8
2008	18.6	5.5	6.6	18.9	6.0	4.6	12.5	22.6	4.8
2009	23.1	13.2	3.5	15.0	7.4	3.0	5.2	24.8	4.7
2010	20.5	10.6	6.6	17.2	7.0	3.8	7.8	23.9	2.6

Source: Annual reports on climatological observations at meteorological stations on the territory of SR in the years 2007 - 2010, SHMU

Graphical expression of wind directions, frequency of wind directions and their duration by means of a wind rose for Jaslovské Bohunice.

Graph No. 69. Wind rose Jaslovské Bohunice (source JAVYS, a.s. 2013)



Wind Direction	Hours per year	%
S	418	4,8
SSW	301	3,4
SW	258	2,9
WSW	267	3,0
W	537	6,1
WNW	1293	14,7
NW	1554	17,7
NNW	739	8,4
N	176	2,0
NNE	542	6,2
NE	189	2,2
ENE	164	1,9
E	180	2,0
ESE	626	7,1
SE	872	9,9
SSE	668	7,6

5. Air

5.1 Emissions

Primary sources of air pollution in the affected area are, in particular, the energy industry and communal energetics (central and block boiler plants). A significant mobile source of air pollution is road traffic with steadily growing intensity.

In the territory, there are no major sources of air pollution, apart from NEC Jaslovské Bohunice. Emission amounts from stationary sources in the districts Hlohovec, Piešťany and Trnava in the years 2007 to 2011 are shown by the following table No. 17.

As major sources of air pollution can be considered (according to National Emission Information System - NEIS, 2013):

- In the Hlohovec district: E.ON Elektrárne s.r.o., ENVIRAL, a.s., BEKAERT Hlohovec, a.s., Faurecia Slovakia s.r.o., ZENTIVA a.s.
- In the Piešťany district: Bytový podnik Piešťany, s. r. o., STAKOTRA MANUFACTURING, s.r.o., Bodet & Horst mattress ticking Verwaltungs, Trnavská vodárenská spoločnosť, a.s., Technical Textiles, s.r.o
- In the Trnava district: Amylum Slovakia spol. s .r.o., Johns Manville Slovakia, a.s., Zlieváreň Trnava s.r.o., PCA Slovakia, s.r.o., SWEDWOOD SLOVAKIA, OZ Jasná.

Tab. No. 24. Emission amounts from stationary sources in the districts Hlohovec, Piešťany and Trnava in the years 2007 to 2011

District	Year	Emissions of polluting substances ($t.year^{-1}$)				
		Solid pollutants	SO2	NO2	CO	TOC
Hlohovec	2007	8.92	2.267	52.912	35.984	43.633
	2008	10.74	2.979	82.105	42.902	80.736
	2009	12.476	5.506	89.429	36.116	52.376
	2010	12.007	5.685	100.137	39.125	93.614
	2011	22.874	5.926	379.763	133.246	67.53
Piešťany	2007	4.645	0.815	40.32	16.39	20.09
	2008	5.412	0.647	37.251	15.555	27.825
	2009	4.446	0.27	31.103	13.409	18.514
	2010	5.186	0.322	33.513	14.781	17.631
	2011	4.920	0.25	31.016	15.999	31.098
Trnava	2007	76.099	101.684	391.655	957.109	584.927
	2008	76.777	134.79	438.134	759.908	532.173
	2009	60.275	71.127	290.146	177.637	439.057
	2010	73.971	75.267	297.751	114.107	331.911
	2011	82.126	96.638	308.766	123.774	319.628

Source: NEIS, 2013

Sources of air pollution operated by JAVYS, a.s.:

State Nuclear and Decommissioning Company, a.s. - JAVYS, a.s. operates small, middle-size and major sources of air pollution.

As "major sources of air pollution" have been classified:

- Start-up and back-up boiler plant (SBBP) - building No. 441.

In the category of "middle-size sources of air pollution", the company operates:

- Boiler LOOS - building No. 441.
- Gas infrared heaters in the department for production of fibre-concrete containers in Trnava,
- Gas boiler plant - building No. 740-IX.1, owned by the Slovakia Nuclear Energy Company, a.s. (JESS, a.s.).

- Diesel generators - building No. 585:V1.

In the category of "small sources of air pollution", the company operates:

- Diesel generator near the ISFSF - building No. 840 - not in continuous operation, merely its operability is controlled. In the year 2012, 1,600 l (1.344 t) of diesel were burnt to that end during 24 hours of test operation.
- Diesel generator at the premises of the FCC container production in the building SO-200 - not in continuous operation; for operability tests 10 l of diesel were consumed in the year 2012 and during load tests 95 l of diesel.
- Production of fibre-concrete mixture (FCM) -In the year 2012, 247 fibre-concrete containers were produced, that is to say 1,062.1 t of FCM, which represents air pollution with solid pollutants amounting to 0.02124 t.

gas equipments - JUNKERS type ZS 12-2 LH AE 23, IMMERGAS typ EOLO 27 Maior, SAHARA plus G, KING 35 a 55 V, LIEBER typ KN 30 P

Incineration plant of RAW - building No. 808 - the national authorities do not classify BRWTC as a source of air pollution.

The following tables No. 18 and 19 provide emission amounts of pollutants into the air in the year 2011.

Tab. No. 25. Fuel consumption and emission amounts for the year 2012 in respect to the individual sources of pollution

SOURCE	Fuel	Polluting substance (t)				
	Natural gas (m^3)	Solid pollutants	SO_2	NO_X	CO	C_{org}
SBBP	26 697	2,03	0,24	44,64	14,96	1,90
Boiler LOOS	11 443	0,87	0,10	16,96	6,85	1,14
Gas infrared heaters	77 994	5,93	0,71	115,59	46,68	7,78
Gas boiler plant	126 320	9,60	1,15	187,20	75,60	12,60
Gas equipment	15 676	1,19	0,14	23,23	9,38	1,56
	Mineral oil (t)					
Dieselgenerator ISFS	1,344	1,908	0,026	6,720	1,075	0,153
Dieselgenerator 585d:V1	0,252	0,358	0,005	1,260	0,202	0,028

Source: JAVYS, a.s.

Tab. No. 26. Amounts of polluting substances discharged from the incineration plant of the BRWTC in the years 2007 to 2012

Polluting substance	Year 2012 (t)	Year 2011 (t)	Year 2010 (t)	Year 2009 (t)	Year 2008 (t)	Year 2007 (t)
HCl	23.84	0.00054	0.00105	0.002	0.001	0.002
HF	0.82	0.000113	0.00896	0.011	0.006	0.002
Hg+Tl+Cd	0.054	0.000034	0.000035	0.00002	0.0009	0.003
As+Ni+Cr+Co	0.29	0.00033	0.00043	0.0003	0.004	0.012
Pb+Cu+Mn	0.24	0.000205	0.000157	0.00008	0.0006	0.002
SO2	107	0.00405	0.00611	0.005	0.011	0.347
NOX	62.93	0.67666	0.85275	1.17	0.989	3.593
CO	17.17	0.05793	0.07838	0.093	0.168	0.726
Solid pollutants	3.55	0.00561	0.00523	0.004	0.02	0.036
Corg	11	0.01247	0.01446	0.018	0.029	0.045
Operating hours	2,671	4,851	5,342	6,143	7,574	6,037

Source: JAVYS, a.s. Report on Environment in 2012

Control of keeping the emission limits is provided by means of a permanent monitoring system at the incineration plant of BRWTC and by periodical measurements at the SBBP and the middle-size sources of pollution. For the period from 2009 to 2013, adherence to the emission limits is documented by measurement reports.

5.2 Immissions

The Trnava region counts among the regions of SR with the lowest environmental load regarding air pollution. Thanks to its wind conditions, the territory is sufficiently aerated and polluting substances get easily dispersed.

According to requirements set by Act No. 137/2010 Coll. air quality is assessed by SHMU. On the basis of measurement results from the year 2010 and according to the § 9 para. 3 Act No. 137/2010 Coll. on Air, as amended, SHMU, being the authorised organisation, has suggested 19 air quality management areas in 8 zones and 2 agglomerations for the year 2011. The qualified areas extend on a surface of 2,932 km^2. In 2011, 1,469,072 inhabitants lived on this territory, which made for 27% of the entire population of SR (5,404,322).

The whole territory of Trnava region is included in the zone for sulfur dioxide, nitrogen dioxide and nitrogen oxides, PM10 particles, PM2.5 particles, benzene and carbon monoxide.

In 2011, there were 19 air quality management areas in Slovakia, 14 of which referred to PM10, 1 to PM10 and NO_2 and 4 areas to PM10 and PM2.5. In the past years as well as in 2011, two air quality management areas referring to the pollutant PM10 were established in the Trnava region zone - the municipalities of Senica and Trnava. The same air quality management areas were proposed for the year 2012.

The major air quality issue in Slovakia, just like in most European countries, nowadays represents air pollution by solid particles (PM10).

5.3 Air quality in the Trnava region zone

In 2011, the 24-hour limit value of PM10 established regarding health protection of persons was exceeded 59 times at the measuring station Trnava - Kollárova. The strongest increase of exceeding values in comparison to 2010 was detected at the rural station Toloľníky. The daily limit value of PM10, increased by a margin of tolerance, was exceeded at the station Trnava - Kollárova. The other polluting substances have not exceeded their limit or target values.

The zone of Trnava region belongs to:

- 1. group in respect of the pollutant PM10 - zones in which the level of pollution by one substance or several polluting substances is higher than the limit value or the limit value increased by a margin of tolerance, if applicable. In case of ozone, the zones and agglomerations in which ozone concentration is higher than the target value for ozone.
- 3. group in respect to sulfur dioxide, nitrogen dioxide, carbon monoxide, benzene, PM2.5 - zones in which the air pollution level is below the limit or target values. In case of ozone, the zones and agglomerations in which ozone concentration is lower than the long-term target value for ozone.

The affected area does not classify as an air quality management area.

6. Hydrological conditions

6.1 Surface water

The area of interest belongs to the Váh River partial drainage area and the main drainage area of the Čierna Voda River with its affluent, the Dudváh River. The channel of the Váh River is parallel to the partially artificial channel of the Dudváh River. The two rivers flow in parallel from North to South. The Dudváh River drains the affected area under immediate influence of the NEC Bohunice site. Right-side affluents of Dudváh that drain the affected area are the streams Chtelnička, Blava, Krupiansky potok and the artificial canal Manivier (built for the necessities of NEC Bohunice).

There are no natural lakes in the area of interest. The closest artificial water storage is the water reservoir on the stream Dubovský potok approx. 6 km to the West of NEC Bohunice. In the wider surroundings, on some affluents of the Dudváh River water reservoirs have been constructed: Chtelnica on Chtelnička stream, Dolné Dubové, Dolná Krupá and Sĺňava near the town of Piešťany.

The nearest water reservoir in the wider surroundings of the affected area is situated near the Dechtice village in a distance of 1.5 km, consisting of a complex of Dechtické ponds. These ponds are exploited for irrigating, flood protection and fish breeding.

The water reservoir Sĺňava is exploited as a superficial water source for the common site of JAVYS, a.s. and SE-EBO in Jaslovské Bohunice. The water is pumped using the pumping station in Pečeňady (held by SE, a.s. - V2 NPP plant) and it is used for the production of service and demineralised water.

6.2 Groundwater

The dominant groundwater source in the affected area, from the water management point of view, are the Quaternary sediments of the Váh alluvium, which, in some areas, are hydraulically interconnected with Upper Pliocene sandy gravels and sands. Fluvial sediments of the connected Váh and Dudváh flood plain are built by approx. 10 to 12 m thick layers of gravels and sandy gravels. They are usually covered by a 1 to 3 m thick layer of alluvial loams that represents a protective - covering layer of the Quaternary groundwater body. The underlying bed of the Quaternary fluvial sediments is built by impermeable Neogene clays (except the Upper Pleistocene gravels mentioned above that occur only in the north-eastern part of the area). Filtration coefficient of fluvial gravels lies between 2.10^{4} $m.s^{-1}$ and 1.10^{-3} $m.s^{-1}$. The Váh alluvium crops out in a stripe of approx. 4 km running from North to South in the eastern part of the area in question.

Due to a relatively thick layer of the covering very little permeable loess sediments there is only little infiltration of atmospheric precipitation to the water-bearing gravel bed. Moreover, these gravels are characterised by their many times lower permeability than the Holocene gravels of the Váh alluvium, which results in a significantly slower circulation of groundwater in these areas. Groundwater levels are strongly lowered here, they are filled partially by transfer of precipitations and partially by hidden transfer of surface water in the area of streams running from the slopes of the Biele Karpaty Mts. The prevailing direction of groundwater streams in terrace gravel beds is NNW - SSE, less NW - SE. It can be stated that they get gradually - indirectly - drained by the Dudváh and Váh Rivers.

The original mineralisation of groundwater in the entire area of interest is typically fluviogene - it can be described as of magnesium-calcium-bicarbonate type. However, due to agricultural activity, it is strongly anthropogenicly influenced (Rapant et al. 1996).

Groundwater of the area in question is characterised in particular by phreatic surface immersed in sandy-gravel alluvial collectors. The only significant water spring in the wider surroundings is the spring of karst-fissure water in the municipality of Dechtice. It is one of the most substantial natural groundwater springs in Slovakia - the diffused spring has a yield of approx. 425 $l.s^{-1}$. Its area of infiltration is, however, situated out of the analysed area, namely on the dolomitic slopes of the Biele Karpaty Mts. The quality of groundwater (basically of the Ca-Mg-HCO_3 type) has been up to now very high. Approx. 175 $l.s^{-1}$ is exploited as a source of residential drinking water for the municipality of Trnava.

The level of groundwater in the locality of Bohunice lies in a depth of 16 to 20 m. Monitoring of groundwater (activity and hydraulic regime) has been carried out by means of an extensive net of existing and newly constructed monitoring boreholes (143). The main goal of the monitoring system is to secure the protection of groundwater resources against diffusion of radioactive substances.

6.3 Springs and spring areas

In the wider surroundings of the affected area there is a natural water spring in Dechtice near Dobrá Voda (water source Dobrá Voda - Dechtice). Yield of the source is 60 $l.s^{-1}$. This source supplies the Trnava group water distribution line. The majority of municipalities in the affected area are supplied with drinking water from the water source Veľké Orvište in the Piešťany District. The exploitation of the water source Rakovice - Borovce (yield 120 $l.s^{-1}$) is due to an increased level of manganese (0.9 - 1.09 $mg.l^{-1}$) dependent on the construction of a water treatment plant.

The company JAVYS a.s. owns the wells HB-1 to HB-4 situated near the road leading from the JAVYS a.s. site to the municipality Jaslovské Bohunice, which have not been exploited since 2002 though.

Apart from the mentioned water sources, there are not any significant thermal springs areas in the affected area.

6.4 Areas protected under water management considerations, zones of hygiene protection

Areas protected under water management considerations are situated predominantly in the surroundings of significant sources of groundwater connected to the local water distribution network. Such sources can be found in the wider area. There are no such sources in the affected area.

6.5 Contamination level of groundwater and surface waters

6.5.1 Surface water

Surface water in the assessed area is contaminated in the first place through agricultural activity, namely by humus flush, fertilizers, pesticides, including sewage discharged from fields and gardens as a result of intensive agricultural production, in particular on animal farms etc. (mainly as consequence of past activities).

All municipalities, except one, are provided with a sewage system and are connected to a sewage treatment plant. The number of households, municipal facilities and state and private establishments that accumulate wastewater and other sewage water in cesspits or septic tanks, emptied in irregular intervals into contractual sewage treatment plants, has fallen considerably in the given area. Wells are used as free sources of irrigating water for gardens and private plots.

As far as the requirements on the quality of surface water pursuant to the Appendix No. 1 of the Regulation of the Government of SR No. 269/2010 Coll., part A (general indicators) are concerned, in 2010 almost all locations of surface water monitoring in the affected area or its proximity failed to fulfil the requirements regarding several indicators:

- V350500D (Šteruský potok) - EK (conductivity), CHSKCr, N-NO_2, N-NO_3, Ptotal, Ntotal, Ca
- V359500D (Dubovský potok) - N-NO_2, N-NO_3
- V645505D (Krupský potok) - N-NO_2, N-NO_3, Ca
- V653500D (Trnávka) - N-NO_2, N-NO_3
- V363000D (Horná Blava) - N-NO_2
- V327015D (Dubová) - N-NO_2,N-NH_4, Pcelk.

The other major polluter of surface water in the affected area is NEC Bohunice. Rainwater from the entire site is drained by the open channel Manivier which flows, after passing the municipality Žlkovce, into the unregulated Dudváh River. Dudváh serves as a source of irrigation water.

All service water and sewage wastewater produced in the NEC Bohunice site is collected by the pipe collector Socoman. Socoman discharges water on gravity principle into the discharge channel of the hydroelectric power plant Madunice.

6.5.2 Groundwater

In respect to groundwater quality, the second major groundwater pollutant, after sewage water, in the wider surroundings is agricultural activity. Groundwater contains high level of nitrates (10 - 50 $mg.l^{-1}$, at some places up to 200 $mg.l^{-1}$) that are in practice generally represented in groundwater of the middle and south-western part of the sandy-gravel Romanian (Piacenzian) formation. In comparison with the groundwater of the fluvial sediments in the SE part of the affected area, the level of secondary pollution of water is somewhat lower. The overall mineralisation of groundwater of the sandy-gravel Romanian (Piacenzian) formation is on average 611.2 $mg.l^{-1}$ and the values of S1 and S2 are 9.45 and 4.85 respectively while groundwater of the fluvial sediments in the SE part has a mineralisation value of 689.6 $mg.l^{-1}$ and the S1 and S2 values of 15.45 and 6.15. Similarly, it can be stated that the chemical composition of groundwater in Quaternary sediments is also caused by inorganic or organic pollutants of various origins transported to the geological environment by infiltrating surface and rainwater or direct influx.

The quality of groundwater in the affected area and its surroundings was in 2010 monitored at several boreholes of the state monitoring network in Quaternary and pre-Quaternary formations of groundwater. The groundwater at the Radošovce locality meets the required quality indicators set by the Regulation of the Government SR No. 269/2010 Coll. while the quality of groundwater at the monitoring borehole Drahovce does not meet these requirements.

6.5.3 Radioactive contamination

So far, the major large-scale area source of contamination of groundwater in the area of NEC Bohunice remains the A1 NPP site. Maximum volume activity of groundwater was detected in the IV. quarter of 2011 in the surroundings of the buildings 44/20 and 44/10 JAVVYS, a.s., , where maximum volume activity of tritium was measured in November 2011: 4 752 Bq.dm^{-3}. The given value is at the same time the highest value measured within the entire JAVYS, a.s. site over the year 2011.

As part of decommissioning of A1 NPP, activities have been carried out to gradually eliminate sources of rock contamination and later also of water contamination. Among several point, line and small-scale area sources building No. 41 has been the object with highest contamination potential.

The radiation situation of groundwater at the A1 site in the proximity of buildings 41, 44/41, 44/20 has been addressed by realisation of redevelopment measures (rescue pumping since 2000) designed to eliminate contaminated groundwater from the geological environment, hence preventing rest contamination from spreading to the surroundings of the site.

Apart, within the JAVYS, a.s. site a deteriorated radiation situation at the V1 NPP site, in particular in the proximity of the build. 800 (borehole JB-43) has been registered since 2000. The source of groundwater contamination in the examined area is due to leakages of technological units, in particular in the build. 800 V1 NPP. The contamination affects the groundwater of the I. water-bearing layer. The monitoring results of the groundwater of the II. water-bearing layer (the V1 NPP and V2 NPP sites) have shown that these waters can be considered as not contaminated.

According to results of monitoring carried out in the whole network of monitored objects in the territory in the III. quarter of 2012, the other contamination direction of the surroundings of NEC Bohunice is practically identical with the direction of groundwater streams. Maximum values of volume activity of tritium in the area close behind the NPP site (the first part of the contamination cloud originating from A1 NPP)has reached values of up to 99 Bq.dm-3 (borehole JB-12) and in the front of this part of the cloud (borehole JB-44) <12 Bq.dm-3. Close behind the V1 NPP (originating probably from the area of building 800) volumeactivity has been of up to 154 Bq.dm-3 (borehole JB-3). In the second part of the cloud originating from A1 NPP, located due to natural streaming and dispersion in the line of the boreholes JB-45 → JB-46, maximum volume activities have been at the level of 227 Bq.dm^{-3} (borehole JB-46).

Tritium contamination transported into the municipal zones is low (in Malženice up to 36 Bq.dm^{-3}, in Žlkovce up to 46 Bq.dm-3 and at the border of the municipality Jaslovské Bohunice up to 230 Bq.dm^{-3}).

Groundwater in the remaining part of the monitored territory is not radioactively contaminated (< 10 Bq.m^{-3}) apart from the groundwater in the proximity of Dudváh (result of the historical infiltration of discharged waters from Dudváh to groundwater: borehole TKS-1 - activities of up to 15 Bq.dm^{-3}, TKS-2 - activities of up to 12 Bq.dm^{-3} - however, the level of volume activities has been decreasing in comparison to the historically measured results down to the level of the natural background) and the area of the close surroundings of SOCOMAN, in particular near to its discharge opening into the Drahovský channel (activities of up to 390 $Bq.m^{-3}$ - building SK (effectively surface water), and up to 65 $Bq.dm^{-3}$ - groundwater from the borehole SK-6 in the III. quarter of the year).

A significant fact that can be observed in course of the long-term development of volume activities of tritium in the area of the closest municipalities around the NEC Bohunice site is a considerable improvement of the radiation situation in comparison with the previous years. The long-term performance of correction measures at the A1 NPP site (rescue pumping of groundwater) has led to a division of the main contamination cloud originating from the main source - the A1 NPP site - into two parts. In the first part, closer to the site, a diffusion of contamination into other territories in the direction of groundwater flows has been slowed down or stopped and it can be assumed that the head of this cloud will gradually shift towards the source - the A1 NPP site. In the second part, which is no more affected by rescue pumping, a gradual decrease of volume activities of tritium down to the level of the natural background is expected due to natural flows, dispersion and radioactive decay. A further significant improvement of the radiation situation has been registered in the area ahead of the municipalities Malženice and Žlkovce where a decrease of volume activities of tritium down to the background level has been measured. Thanks to limited discharges of wastewater into the Manivier recipient and sealing-off of the SOCOMAN channel the situation in the municipality Žlkovce itself has improved as well. A similar positive development is expected in the area of the south-eastern border of the municipality Jaslovské Bohunice in future.

6.5.4 Water discharges from the site

Pollution of waste water discharged from the nuclear facilities is strictly limited and controlled. The limits are derived from potential impacts on the environment and population and fixed for the authorised operation of the nuclear facilities. Yearly amounts of fluid discharges, monitored parameters, monitoring mode and submission of reports are determined by the Public Health Authority of SR (UVZ SR) in respect to each provider.

In course of operation of nuclear facilities wastewater contaminated with radionuclides is generated. Depending on its features, it is either processed as fluid radioactive waste using technologies for processing and adjustment of RAW or it is cleaned on special equipment until a level is reached that allows for discharge into surface water. By means of multiple control schemes it is secured that the limits established in UVZ SR decisions are maintained (tank revision before discharge, authorisation procedure before discharge, continuous monitoring of discharged wastewater by two measurement devices).

At JAVYS, a.s. wastewater is discharged by the following pipe collector systems:

- rainwater is led into the Dudváh recipient, with volume activity of water discharged in branches A and B being monitored continually,
- sewage water is led into the sewerage plant - BIOKLAR (mechanical and biological processing),
- pipe collector SOCOMAN enters into the Váh recipient.

Activity of radionuclides in wastewater discharged into the recipients Váh and Dudváh are provided in the following tables.

Tab. No. 27. Activity of radionuclides in wastewater (including water from rescue pumping at the A1 site) discharged into the Váh recipient in the year 2012

V1 NPP (ISFS)				RWPTT + A1 NPP			
FCP (MBq)	Tritium (GBq)	% of the FCP* limit	% of the 3H* limit	FCP (MBq)	Tritium (GBq)	% of the FCP limit	% of the ^{3}H limit
17.182	8.053	0.13	0.40	23.041	228.90	0.19	2.29

Source: JAVYS, Comprehensive Report, Radiatoin Protection 2012

Tab. No. 28. Activity of radionuclides in wastewater discharged into the recipient Dudváh in the year 2012

V1 NPP (ISFS)				RWPTT + A1 NPP			
FCP (MBq)	Tritium (GBq)	% of the FCP limit	% of the 3H limit	FCP (MBq)	Tritium (GBq)	% of the FCP limit	% of the ^{3}H limit
0	0	0	0	0.162	0.693	0.135	0.002

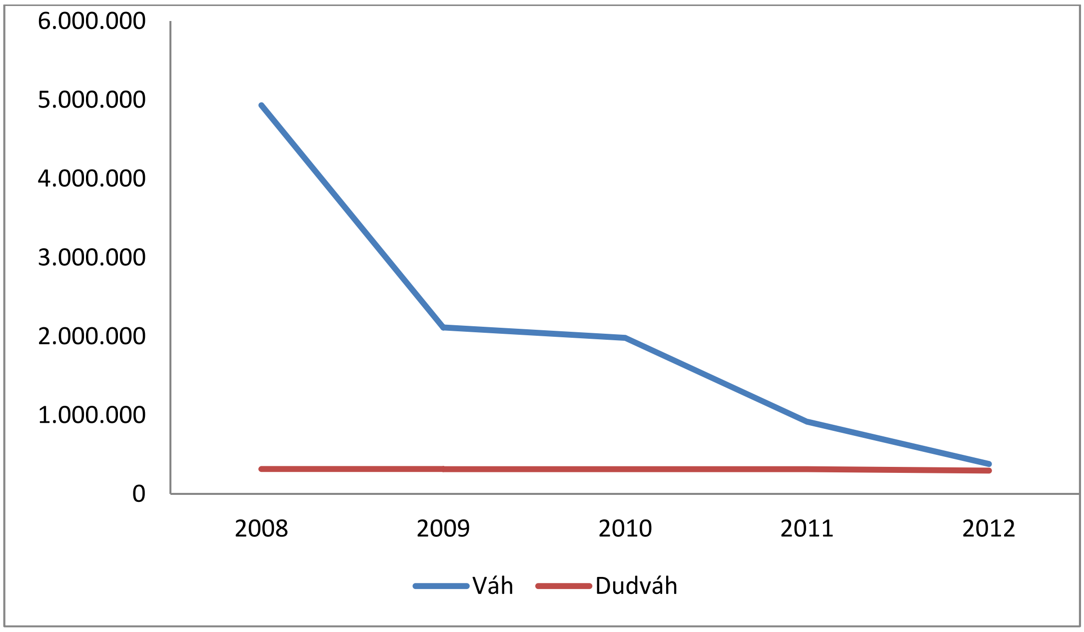
Source: JAVYS, Comprehensive Report, Radiation Protection 2012

From the point of view of water management neither limits set for monitoring of polluting substances in wastewater nor limits for volume activity of radionuclides in discharged water have been exceeded.

In connection with the altered operation of V1 NPP, a decreasing tendency in respect to cooling water consumption and the amount of discharged wastewater can be observed. Considering the leakproofness of tanks, leakage monitoring probes have not shown any changes that would hint at leakage of fluids.

Water discharged from the JAVYS, a.s. site is monitored as to the volume activity of FCP and ^{3}H as well as of other chemical pollution parameters pursuant to the requirements established by resolutions in respect to JAVYS, a.s.

Graph No. 70. Overview of amounts of discharged wastewater from JAVYS, a.s. into the Váh and Dudváh recipients in the years 2008 - 2012 in m^3



Source: JAVYS, a.s.

7. *Fauna and flora, protected rare and endangered species and biotopes, significant animal migration corridors*

7.1 Flora, vegetation and biotopes

The assessed area is situated, from the point of view of phytogeography, on the Trnavská pahorkatina Upland and belongs to the region of Pannonian flora (Pannonicum), Eupannonian xero-thermal flora (Eupannonicum) division, Trnavská pahorkatina district (Futák, 1980).

Potential natural vegetation

Potential natural vegetation in the area of interest that would evolve under the current climatic, edaphic and hydrological conditions if man stopped interfering with natural processes is represented by the following (Michalko et al., 1986):

- Floodplain lowland forests - Ulmenion
- Floodplain upland and highland forests - Almenion glutinoso-incanae,
- Pannonian oak-hornbeam forests - Querco robori-Carpinenion betuli,
- Oak-Quercus cerris forests - Quercetum petraeae-cerris,
- Oak xerophillic Pontic-Pannonian forests - Aceri-Quercion. .

Actual vegetation (characteristics of biotopes)

The actual vegetation is best characterised by existing biotopes. According to a catalogue of biotopes by Ružičková et al. (1996) the following biotopes occur in the area of interest:

Fields - occupy a major part of the affected area. Segetal vegetation develops on fields.

Wood species of anthropogenic origin - growths of trees and bushes intentionally planted by man. Growths of tress and bushes in built-up areas and growths along the roads can be attributed to this biotope.

Gardens at family houses - these are man-made and maintained spaces with growths of wood, herbaceous and grass species with focus being laid on their aesthetics. The variety of species is rich. Fruit tree varieties are the most common species, while foreign, mainly coniferous and evergreen species occur quite often as well. Original tree species and their cultivars are also represented.

Groups of trees, groves - these are represented by in-line tree vegetation along field roads and field margins in the affected area. This is an important biotope since it offers a refuge for game and other mammals, some bird species and invertebrates.

Riverine herbaceous vegetation along the banks of flowing waters - rims the banks of streams and partially also of the Manivier channel.

Ruderal biotopes - are concentrated along the access roads and at field margins.

No protected and rare species or biotopes have been found in the affected area.

7.2 Fauna

According to zoogeographical classification the affected area belongs to the Inner-Carpathian depressed area, South Slovak division, floodplain Danube district (Čepelák, 1980), steppe province of the Pannonian section.

The affected area belongs to a zoogeographical region characterised by occurrence of steppe animal species. Steppe species characteristic of this area are, among the invertebrates, e.g. Ascalaphid owlfly (*Libelloides macaronius*).

In agrocenoses, covering the major part of the affected area, only remnants of the original epigeic and edaphic mesofauna and microfauna are represented today, reduced by agriculturalist interference. In comparison with the original biocenoses, variety of animals is poor, while species of wide ecological valence are represented, which reflects the low species diversity. Spectrum of species inhabiting agrocenoses is represented by common animal species that occur in different ecological conditions and geographic areas. Species representation, dominance of individual species and the entire structure of soil invertebrate communities in agrocenoses depends to a high degree on the cultivated crop and the used fertiliser (mainly stable dung). Therefore, representation of soil fauna species can vary considerably in the individual agricultural years. In the affected area, poor communities of soil invertebrates occur, with representation of common and resistant species. With view to the landscape structure and mosaic, these communities are only secondary.

Represented amphibians are Common toad (*Bufo bufo*), Common spadefoot (*Pelobates fuscus*). Among reptiles, it is Sand lizard (*Lacerta agilis*) and Grass snake (*Natrix natrix*).

Fish variety in streams is poor, the most common species being Gudgeon (*Gobio gobio*), Stone loach (*Barbatula barbatula*) and Spirlin (*Alburnoides bipunctatus*).

The most abundant representatives of fauna are birds with 250 species discerned so far in the given territory, 110 of which are nest-building species (Energia, 2007). According to biotope fixation the avifauna is divided into three groups: birds of agricultural steppe (Perdix - *Perdix perdix*, Common quail - *Coturnix coturnix*, Common pheasant - *Phasianus colchicus*, Common kestrel - *Falco tinnunculus*, Rook - *Corvus frugilegus*, Carrion crow - *Corvus corone corone*, Common magpie - *Pica pica*, Jackdaw - *Corvus monedula*, Skylark - *Alauda arvensis*), birds of lowland groves (Great tit - *Parus major*, Blue tit - *Parus caeruleus*, Eurasian nuthatch - *Sitta europaea*, Eurasian bullfinch - *Pyrrhula pyrrhula*, Goldfinch - *Carduelis carduelis*) and, as a result of construction of ponds and water reservoirs, also water and swamp birds (Eurasian coot - *Fulica atra*, Water rail - *Rallus aquaticus*, Black-headed gull - *Chroicocephalus ridibundus*, Wild duck - *Anas platyrhynchos*). During the migration period, some seldom and remarkable bird species land on the water surface to take rest or migrate over the territory.

Mammals represented in the affected area are small species like Eastern European hedgehog (*Erinacerus concolor)*, Common vole (*Microtus arvalis*), European mole (*Talpa europaea*), House mouse (*Mus musculus*), Brown rat (*Rattus norvegicus*), Water rat (Rattus terrestris), European ground squirrel (*Spermophilus citellus*), Least weasel (*Mustela nivalis*), Common noctule (*Nyctalus noctula*), Serotine bat (*Eptesicus serotinus*) and others. Among game animals we can find European hare (*Lepus europaeus*), Common rabbit (*Oryctolagus cuniculus*) and Roe deer (Capreolus capreolus).

7.3 Significant animal migration corridors

In the affected area there are no significant migration corridors. Among significant migration corridors in the wider area count:

- a hydric bio-corridor of supra-regional importance: the river Váh and the bordering bank growths
- a terrestrial bio-corridor of supra-regional importance: Malé Karpaty Mts. (mountain crest).

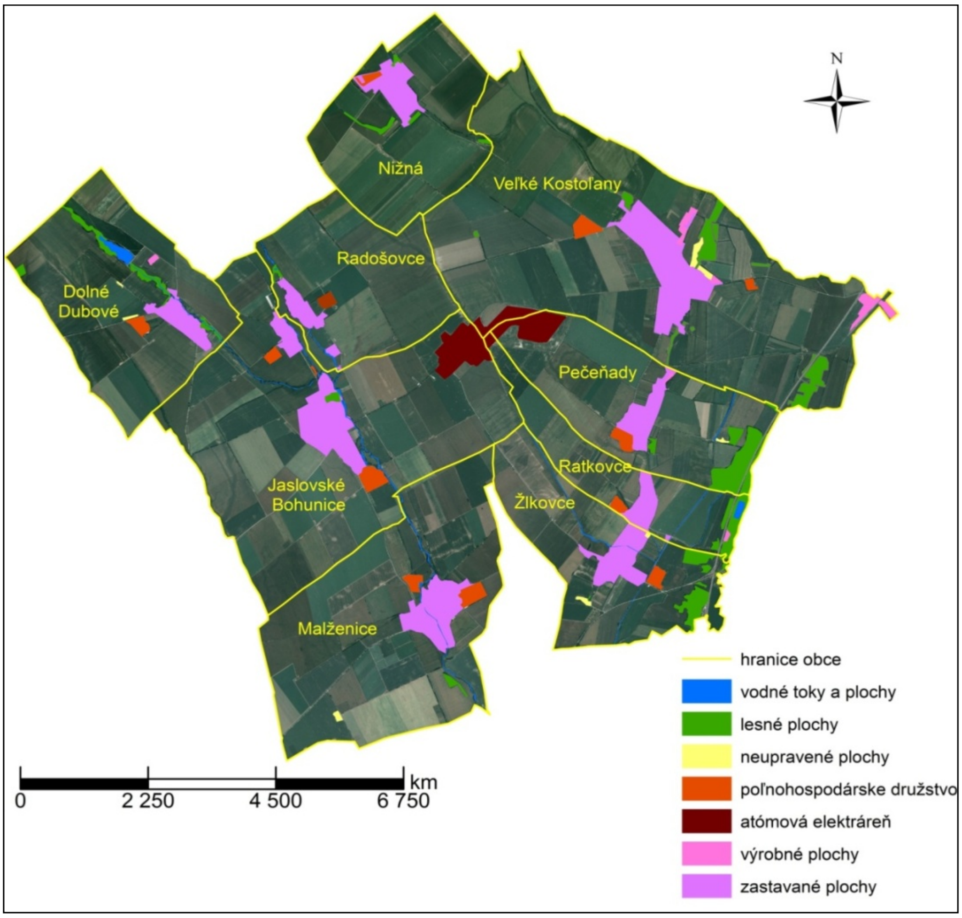
8. Landscape

8.1 Contemporary landscape structure

The landscape structure of the affected area constitutes its space-functional utilisation. Arable land dominates the landscape structure of the affected municipalities, followed by residential built-up area of rural character .

On arable land, groves occur rather frequently and naturally seeded wood species sporadically. Most of the water streams are rimmed by bank growths and non-forest wood species. Other structural elements typical of the landscape in the assessed area are agricultural cooperatives, private gardens and elements of technical infrastructure.

Graph No. 71. Map of the current landscape utilisation in the affected area, based on aerial images



8.2 Scenery

Owing to little diversified relief, absence of forest growths and little representation of non-forest wood vegetation it can be stated that the natural surroundings do not markedly contribute to a varied landscape appearance, resulting in a very low variability of the landscape mosaic. The scenery is determined in the first place by large fields, at places interrupted by vegetation elements, municipalities' outlines and traffic lines. The scenery is disrupted by high voltage flagpoles and a dense net of electric lines. The most visible object is the nuclear power plant site, in particular the cooling towers for service water, which, due to their size, are visible from all cardinal directions.

8.3 Landscape stability

The overall ecological stability of the affected area is low to very low. The examined landscape dominated by agricultural utilisation of the soil, with a lack of non-forest wood vegetation, occurrence of non-native plant species and adverse socio-economic elements and phenomena, has a low coefficient of ecological stability.

In the affected area several structural landscape elements can be found whose preservation or enhancement would help in improving the overall ecological stability of the area. Such elements are, among others, water streams flowing through the assessed area, such as the stream Dubovský potok in the municipalities Dolné Dubové and Jaslovské Bohunice with a line of trees all along its flow and bank growths dominated by willow, alder and poplar. Further, there is the water reservoir Dolné Dubové, constructed on this stream for irrigation purposes, with its adjacent remnants of floodplain forests, the stream Vítek in the municipality Nižná and the water reservoir for irrigation purposes in the borough Bohunice of Jaslovské Bohunice.

Among the elements that impede ecological stability there are linear barrier elements in this area. These are mainly high voltage cables and partially also road communications.

8.4 Landscape protection

The affected area belongs to the I. category of nature and landscape protection according to the Act of the National Council of SR No. 543/2002 Coll. on protection of nature and landscape, as amended. (note: information on protected areas and protected areas pursuant to special provisions is provided in the Chapter 9).

On the assessed territory itself there are not any wetlands of national or regional significance (NNP SR, 2013b). The closest regionally significant wetlands are Rajtarské (c. t. Hlohovec), Štrkoviská (c. t. Horné Zelenice), Gazdovský pasienok (c. t. Dolné Zelenice), water reservoir Boleráz (c. t. Boleráz), Sĺňava (c. t. Piešťany, Ratnovce, Sokolovce), water reservoir Chtelnica and natural reserve Výtek (c. t. Chtelnica) and Priesaky nad Sĺňavou (c. t. Drahovce, Ratnovce and Sokolovce).

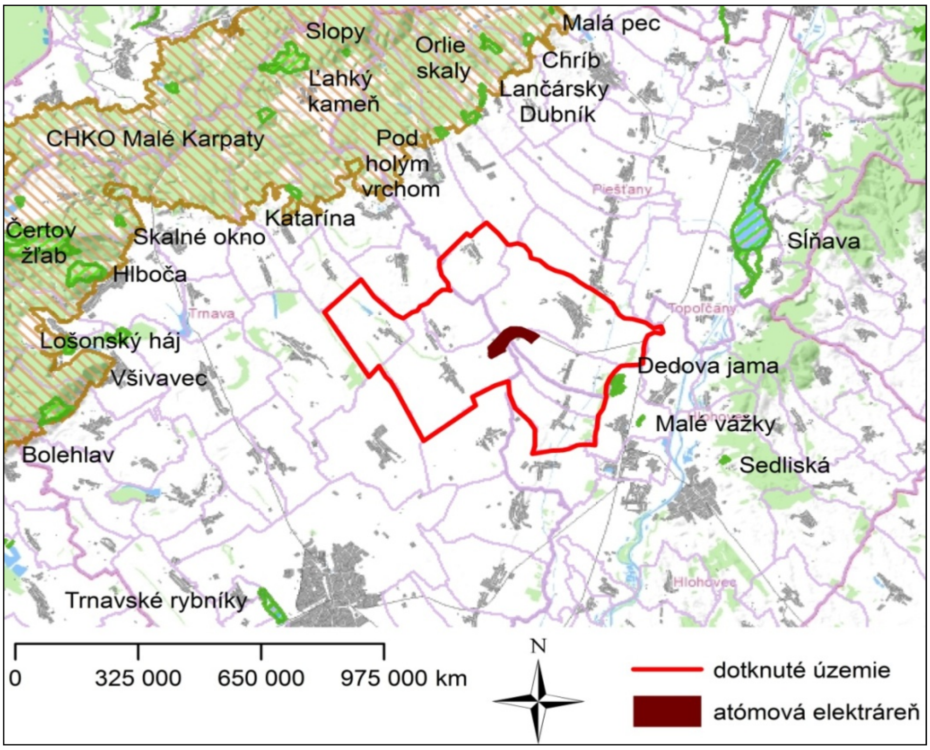
Locally significant wetlands, directly in the affected area, are the gravel deposit Ratkovce (in c. t. Ratkovce) and the water reservoir Dolné Dubové (in c. t. Dolné Dubové). In the immediate proximity of the affected area there are the wetlands Vinišovka Baková, Kňazová - Lazy and water areas of the derivational channel (c. t. Drahovce), wet meadows near the water reservoir Chtelnica (c. t. Chtelnica) and the gravel deposit Zelenice (c. t. Dolné Zelenice).

9. Protected areas pursuant to special provisions and their protective zones

In the proximity of the affected municipalities there are no protected areas among the territorially defined localities determined by the Act of the NC SR No. 543/2002 Coll. on protection of nature and landscape, as amended, with a surface bigger than 1,000 ha (NNP SR, 2013). The nearest large-scale protected locality is the Little Carpathians Protected Landscape Area (CHKO Malé Karpaty). The area spreads to the West of the affected municipalities, in the air distance of approximately 12 km. This locality is the only large-scale protected landscape area of vineyard character with prevalence of deciduous forests of beech, ash, maple and lime.

Several protected sites (CHA), nature reserves (PR) and nature monuments (PP), belonging to the III, IV and V category of protection can be found in the wider surroundings of the affected area. Protected localities closest to the assessed area are CHA Dedova jama, CHA Malé Vážky and PR Sedliská. In a distance of approx. 13 km to the West of the affected area, there are other protected areas: PP Čertov žľab, NPR Dolina Hlboče, NPR Driny and a little more to the West there are NPR Záruby, PR Čierna skala and CHA Všivavec. 7 km to the North of the affected are the following protected localities are listed: PR Katarína, PR Černec, PR Chríb, PR Lančársky Dubník, PR Orlie skaly, PR Pod holým vrchom, PP Malá Pec and CHA Sĺňava. 13 km to the South, there is CHA Trnavské rybníky and a little more to the South CHA Vlčkovský háj.

Graph No. 72. Protected areas in the proximity of the affected area (processed according to Ministry of Environment SR and CEI Slovak Environmental Agency, 2013)

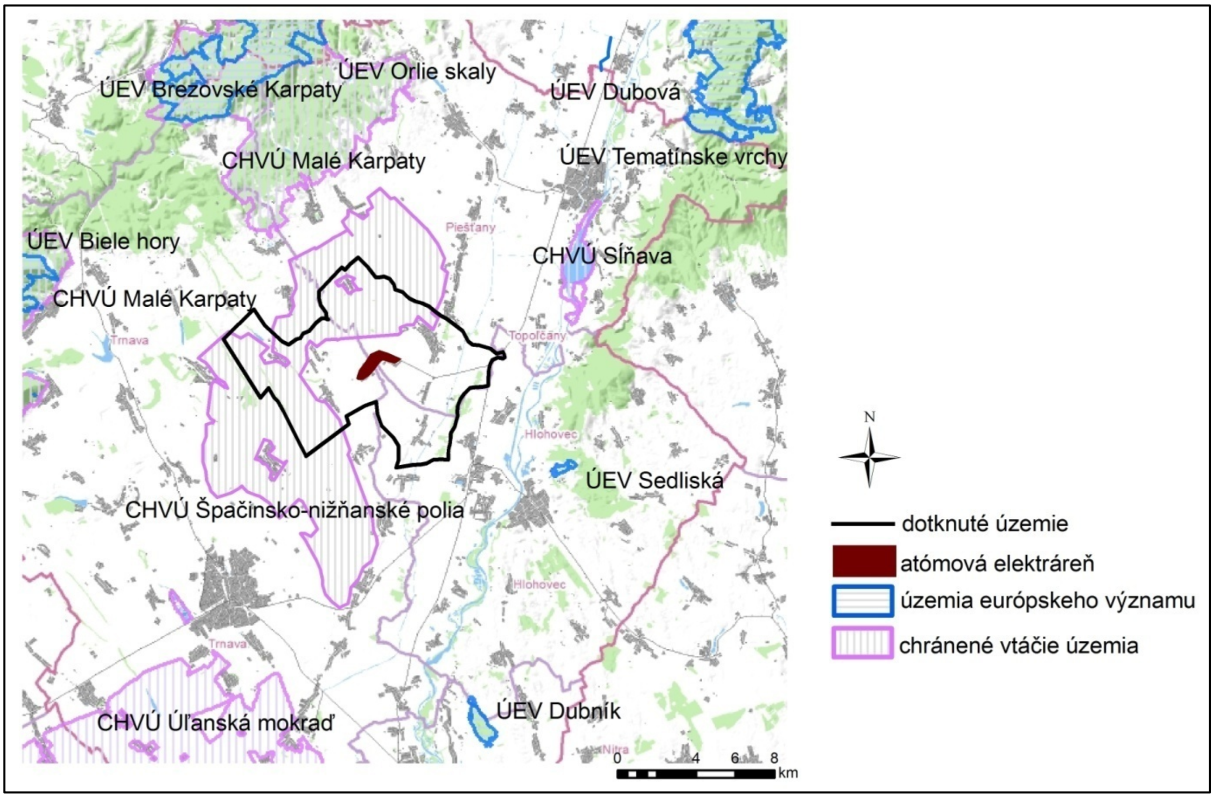


Approximately 13 km to the South-East of the assessed area there are the following sites of Community importance:

- SKUEV0175 Sedliská with a surface of 46.09 ha
- SKUEV0074 Dubník
- SKUEV0278 Brezovské Karpaty
- SKUEV0277 Nad vinicami (National Nature Protection - NNP SR , 2013a).

To the West and in the wider surroundings of the affected area, some of the areas protected under the European network of protected areas NATURA 2000 can be found. The special area of conservation SKCHVU054 Spačinsko-nižnianské polia (NNP SR, 2013a) extends from West into the assessed area. It was declared by Regulation of the Ministry of Environment SR No. 27/2011 Coll. on securing a favourable state of habitat of the migratory bird and bird of European importance, the Saker falcon (*Falco cherrug*). The overall surface of this special area of conservation is 5533.53 ha. In the proximity of the assessed area, 7 km airline distance to the North-East, there is another special area of conservation SKCHVU026 Síňava. Approximately 14 km airline distance in the South-West direction of the affected area there are the Trnavské rybníky Ponds which were by Resolution No. 345/2006 Coll. removed from the list of areas protected under NATURA 2000.

Graph No. 73. Localities included in the NATURA 2000 network in the proximity of the affected area (processed according to Ministry of Environment SR and CEI Slovak Environmental Agency, 2013)



In the affected area there are no trees protected under the Act of the National Council of SR No. 543/2002 Coll. on protection of nature and landscape, as amended.

In the affected area there are no areas protected under water management considerations pursuant to the Act 364/2004 Coll., as amended.

10. Territorial system of ecological stability

The general ASSESSMENT REPORT OF the territorial system of ecological stability (TSES) classifies the affected area with its surroundings as a territory with low ecological stability. This is primarily due to intensive exploitation of the territory for agricultural purposes, high percentage of arable land and built-up territory on the one hand and low percentage of wood growths on the other (Aurex, 1999).

From the point of view of regions, the following regional bio-corridors (RBk) can be discerned:

- Dudváh
- Blava.

Regional bio-corridor - RBk Dudváh - this bio-corridor runs to the East of the affected area. It is represented by remnants of bank growths with original wood composition consisting of willow, alder, ash and poplar. Significant are the water stream and its bank growths.

Regional bio-corridor Blava - RBk Blava - it is along the majority of its flow of natural character and is lined by woody plants. The section of the stream Blava from its source to the borders of the district Trnava was suggested in older documentation of TSES (Jančurová a kol., 1993) as a zoological locality of biodiversity protection and therefore its legislative protection in the category nature monument was proposed, but it has never been proclaimed as such.

In the affected area several structural landscape elements can be found whose preservation or enhancement would help in improving the overall ecological stability of the area. Such elements are, among others, water streams flowing through the assessed area, such as the stream Dubovský potok in the municipalities Dolné Dubové and Jaslovské Bohunice with a line of trees all along its flow and bank growths dominated by willow, alder and poplar. Further, there is the water reservoir Dolné Dubové, constructed on this stream for irrigation purposes, with its adjacent remnants of floodplain forests, the stream Vítek in the municipality Nižná and the water reservoir for irrigation purposes in the borough Bohunice of Jaslovské Bohunice.

In the affected area itself there are several existing and proposed TSES elements. In the cadastral territory of the municipality Veľké Kostoľany (Čuperka, Kováč, 2009), there are the NBk Váh River (on the connected Váh and Dudváh flood plain), RBk stream Výtok (Chtelnička), LBc the wood growth Urbársky háj and LBc Háj.

According to the municipal plan of the municipality Žlkovce (Drgoňová, 2011), in the affected area, there are RBk Horný Dudváh, LBk Rakytovský kanál, LBk Pečeňadský kanál, LBk Manivier, LBk Vanigovský kanál, open wood growth RBc Háje - Mlynské (locality of biodiversity protection), LBc of the irrigation pumping station Žlkovce.

The stream Výtek, running through the municipality Nižná, constitutes together with the adjacent bank growths an RBk (Lukáčová, 2005).

In the cadastral territories of the municipality Jaslovské Bohunice there are LBc Panské diely, LBc Meanders of the stream Dubovský potok, LBc Radošovce (grove near the flood gate), LBc Radošovce (new meadows along the stream Blava), LBc Park pri kaštieli (Park at the manor house), LBc Ostrov na Blave (Isle on the Blava stream), LBc Urbár Špačinského (Odnoga, 2007,). Bio-corridors in the territory are: LbK Blava, LBk Dubovský potok and LBk Zlín.

Proposed TSES are: the corridor connecting the Urbársky háj grove with the wood growth in the c. t. Červeník of the municipality Veľké Kostoľany as bio-corridor of local significance (LBk) and a locality behind the gardens at the Manivier stream in the municipality Žlkovce as a local bio-centre (LBc).

11. Population

11.1 Demographic data

According to the census of inhabitants, houses and apartments (carried out in May 2011), in the affected area, 9,161 inhabitants lived in 9 municipalities that belong to three districts: Hlohovec, Piešťany and Trnava, all in the Trnava region. From the total number of inhabitants, men and women form equal parts (4,581 men and 4,580 women), which is unusual for Slovakia.

Regarding the age structure, 16.4% inhabitants are in pre-productive age (0 - 14 years), 63.2% in productive age (men 15 - 59, women 15 - 54) and 20.3% in post-productive age.

Among the represented nationalities, Slovak nationality prevails strongly (with 95.31%) and among the represented religions the Roman Catholic Church is most represented (86.78%).

Economic activity of residents of the affected municipalities is comparable with the situation in other regions of SR. As of July 2013, the Trnava region had an unemployment rate of 9.52 %, which was the second lowest unemployment rate among the regions of SR and 4,5 % below the national average (13.99 %). In the Hlohovec district, the unemployment rate in July 2013 was at 9.58%, in the Piešťany district at 8.70% and in the Trnava district at 7.68% (www.upsvar.sk/statistics).

Tab. No. 29. Number of inhabitants in affected municipalities

Municipality	District	Total	Man	Women
Ratkovce	Hlohovec	326	173	153
Žlkovce		630	321	309
Nižná	Piešťany	536	263	273
Pečeňady		509	251	258
Veľké Kostoľany		2698	1362	1336
Dolné Dubové	Trnava	645	319	326
Jaslovské Bohunice		2011	1015	996
Malženice		1377	669	708
Radošovce:		429	208	221

Source: SO SR, 2012

11.2 Health status of the population

Owing to lack of recent studies on health status of the population in the individual municipalities, the assessment is based on an evaluation of the health status of the population of SR and larger territorial units/districts to which the municipalities in question belong.

From the point of view of public health, in the affected area a slightly higher mortality of men in working age can be observed than in the other Slovak regions. Regarding the causes of death, in the area prevail, just like in the whole territory of SR, cardiovascular diseases, cancer, gastrointestinal diseases and diseases of respiratory tract, which reflects the national and European reality regarding public health and life expectancy.

Mean life expectancy at birth in the affected area has been 67 years for men and 75 years for women, which is comparable to the Slovak average.

Report on health status of the population of SR for the years 2009 - 2011 (, 2012) provides data on demographic development, and development of mortality and morbidity in Slovak republic. Among the most common causes of death are cardiovascular diseases, cancer, personal accidents, diseases of respiratory tract and gastrointestinal diseases.

Apart, the following parameters can be pointed out:

- In the years 2008 - 2010 a positive development of natality in Slovak Republic was registered (in 2009, 61,217 children and in the year 2012, 60,410 children were born), while in the examined time frame spontaneous and artificial abortions were decreasing; the average number of all deaths and premature deaths owing to cardiovascular diseases dropped in the years 2009 - 2011 by 3.4% compared to 2006-2008.
- Occurrence of malignant tumours within the population has been increasing,
- The number of diabetics has been growing, with yearly more than 22,000 new diabetes cases diagnosed,
- Still a high number of persons is registered who suffer from hypertension, obesity and smoking.

Based on prognostic data it can be assumed that the number of diseases and deaths due to non-infectious diseases will grow. Non-infectious diseases have made for 90% of deaths in Slovakia. The report hence reveals the necessity of better prevention and education in the given sphere in order to change the attitude of inhabitants in respect to their own health.

In the affected area, several studies on the state of health and oncologic diseases of the population have been carried out by Slovak and foreign specialists. The most comprehensive study on occurrence of cancer in the Trnava District, using data for Nitra and Levice Districts as reference territories, has been the study „Nuclear power plants in Jaslovské Bohunice and cancer“ (Ján Korec, Mária Letkovičová, Viktor Príkazský, Vladimír Príkazský, Katarína Smatanová, Zdeněk Šmejkal) based on data from the years 1968 to 1990 and modelling the development until 2000. This study arrives at the conclusion that, in the surroundings of NPP, neither a higher occurrence of oncologic diseases nor an increased growth has been established. Mortality has been the same throughout the whole Trnava District and no extraordinary situation in the region has been registered.

Occurrence of oncologic diseases is above the Slovak average in districts of the Bratislava, Nitra, Trenčín and Trnava Regions. In the recent years most people died of cancer in the Nitra Region - according to the report on the study by Peter Gschwendt from NCZI, published in 2011. The further you go to the West, not only in Slovakia, the more cancer there is," says MUDr. Vladimír Bella from the Oncologic Institute sv. Alžbety in Bratislava on behalf of the published data. Increased occurrence of cancer in West Slovakia is, in his opinion, due to a higher number of bigger cities where western lifestyle prevails.

The highest number of oncologic patients in relation to the number of inhabitants is registered in the western part of the country. Physician Pavol Dubinský from the East-Slovakian Oncologic Institute considers higher life expectancy of the local population in West Slovakia to be also a factor for an increased occurrence of cancer. According to him, cancer risk rises significantly with the age. A phenomenon is the highest mortality in the South. Oncologists name in particular the unhealthy eating habits of people living in the South. They hold that the southern part of Slovakia shows a high occurrence of colon cancer since the local population is used to consume many unhealthy meals such as ducks and uses too many spices. The South of Slovakia copies the situation in Hungary where apart from this a high occurrence of lung, head and neck cancer is registered.

In November and December of 2011, a study on the health status of the inhabitants of SR was carried out in 36 districts with a seat of RÚVZ (Regional Authority for Public Health). (Assessment EHES -European Health Examination Survey). A preliminary analysis of the results of the national study on the health status of adult population has confirmed a high proportion of inhabitants with cardiovascular disease risk.

11.3 <u>Municipalities</u>

The surface of the affected area is 61.306 km^2.

According to data provided on 31 December 2011, the cadastral territories of the individual municipalities in the affected area had the following surface areas (SO SR, 2013):

Ratkovce	445.3 ha,
Radošovce	728.0 ha,
Malženice	148.5 ha,
Pečeňady	857.3 ha,
Veľké Kostoľany	243.9 ha,

Žlkovce	793.9 ha,
Dolné Dubové	100.4 ha,
Nižná	805.0 ha,
Jaslovské Bohunice	2,008.3 ha.

These settlements have, from the point of view of functional assessment, mainly residential-agricultural character, apart from Jaslovské Bohunice, which is a municipality with combined function (residential-agricultural-industrial).

The settlement structure in the area of interest is made up mainly of family houses of rural type with house breeder facilities and parcels for vegetable and fruit growing and eventually decorative front gardens. Residential areas are complemented by agricultural complexes, cooperatives, animal production farms, storehouses, maintenance buildings and complexes of affiliated production. These objects constitute independent production sites at the margins of residential settlements. Further, there are sites belonging to local entrepreneurs. Objects of industrial production are situated in Jaslovské Bohunice - the NEC Bohunice site.

11.4 Industrial production

Industrial production focuses on production of electric and heat energy from nuclear fuel (A1 NPP, V1 NPP and V2 NPP). Industrial activity on the JAVYS, a.s. site is primarily oriented at liquidation of the nuclear power plant A1 NPP, manipulation with RAW and decommissioning of the nuclear power plant V1 NPP. Near the municipality of Malženice a steam-gas power plant with an installed capacity of 430 MW and an annual output of 3 bn kWh of electric energy is in operation.

In the other municipalities of the assessed area industrial production is merely of additional character.

11.5 Agricultural production

Apart from the production of electric energy and activities of JAVYS, a.s., agriculture represents the third most important branch of production.

Agricultural production comprises plant and animal production. Farming on arable land dominates within the plant production. Cultivation of dense-sown cereals with high yields and low production costs prevails. Another profitable crop is alimentary wheat. In view of possible utilisation of waste heat, favourable conditions are given also for cultivation of vegetables, for example in form of greenhouse farming. The areas in question are situated along the heat energy distribution lines leading from Jaslovské Bohunice. Wine-growing is of lesser importance, with significantly less vineyards being cultivated recently, which has been the overall tendency in Slovakia. Partially, fruit growing is also represented. Permanent grass growths have a small share of the whole territory.

Animal production specialises mainly in pig farming and only to a lower extent in cattle farming, in particular for meat and milk. Connected with the animal production are branches of food industry, such as dairying, meat processing etc.

11.6 Transport

Road transport consists of the road of I. category Trnava - Leopoldov (I/61), the road of II. category Trnava – Malženice – Pečeňady – Veľké Kostoľany (II/504), the road of II. category Trnava – Dolné Dubové – Dechtice (II/560) and roads of III. category: Malženice – Jaslovské Bohunice - Kátlovce, Špačince – Jaslovské Bohunice – JZ Bohunice, Žlkovce – JZ Bohunice. These roads are connected to municipal and local roads.

To secure personnel and goods transport, a road and rail connection from the NEC Bohunice site to the public transport net was built. Within the JAVYS, a.s. site there are only inner-plant roads.

NEC Bohunice is connected to the railway network by an independent factory railway. It is 8.1 km long and is connected to the railway line in the direction Piešťany - Trnava - Bratislava, joining it in the railway station Veľké Kostoľany.

In the wider surroundings of NEC Bohunice there is an airport in Piešťany, an Aeroclub airport in Boleráz and an airport used for agricultural purposes in Trnava. The NEC Bohunice site has been declared no-flight zone LZP29 (radius 2,000 m , height 1,500 m).

11.7 Technical infrastructure

In the affected area there is a dense network of electric above-ground and cable lines (in particular above-ground very high voltage and high voltage lines). Apart from these power distribution lines of national and regional significance there are also electric distribution lines outside the built-up municipal areas. Electric distribution lines and telecommunication networks have been placed partially underground.

The second group of power lines is constituted of heat energy distribution lines (above-ground pipelines DN 500) that transmit heat energy from the NEC Bohunice site to surrounding municipalities where it is used for heating buildings (Trnava, Hlohovec).The third group of power lines represent product lines. These are gas pipelines of international, national and regional significance, oil pipelines and other product lines.

Municipalities are connected to the group water distribution line Veľké Orvište with other supplementary water sources. This water distribution line supplies also the NEC Bohunice site.

Except for the municipality Nižná, all affected municipalities are provided with a sewage system.

11.8 Services and recreation

Service infrastructure is on a level typical for rural municipalities. The following types of infrastructure can be discerned:

- Administrative facilities - these are town halls in the individual municipalities, post offices.
- Healthcare service facilities.
- Educational facilities - represented by basic schools (except the municipality of Radošovce) and kindergartens in the individual municipalities.
- Cultural-educational facilities - providing services that meet inhabitants' personal development needs; in the assessed area these are culture houses and libraries.
- Physical training and sport facilities - establishments for sport and relax purposes.
- Retail, board and lodging facilities - retail trade net for various types of goods, e.g. food, other consumer goods, fuels, restaurants, accommodation facilities etc.

The municipalities are of little recreational significance. The potential of the area as a recreational resort is very small (there are not any natural or socio-economic conditions for development of recreational facilities).

12. Cultural and historical sites and remarkable places

On the territory of the affected municipalities, there are several cultural-historical sites connected mainly to sacral objects situated in the area (churches, chapels etc.). They are situated, as a rule, in the built-up area of the individual municipalities.

Ordered according to their belonging to the individual municipalities, these are:

12.1 Ratkovce

- Roman Catholic Church, originally baroque, built in 1756, rebuilt in the years 1843 and 1896.

12.2 Žlkovce

- classicistic Church of Our Lady of the Seven Sorrows, the patroness of Slovakia, built in the year 1811, in the 19th century reconstructed twice in Empire style (in the years 1843 and 1887).
- sculpture of Virgin Mary, creation of which is dated back to 1656, renovated in 1901.
- sculpture of Saint Florian from the year 1862.

12.3 Nižná

- Church of King Stephen - built in the year 1682 in the place of the former Chapel Adamom Onorym.
- bell tower - built in the year 1788, originally with three bells, owing to requisition of church bells only one bell has been preserved.

12.4 Pečeňady

- Church of the Most Holy Heart of Jesus.
- Cloister of the Congregation of the Merciful Sisters of the Holy Cross from the year 1899.
- classicistic manor house from the year 1825.

12.5 Veľké Kostoľany

- Church of Saint Vitus from the late 12th cent., several times rebuilt in the past.

12.6 Dolné Dubové

- Cloister of Saint Catherine.

12.7 Jaslovské Bohunice

- Late baroque Manor House from the end of the 18th cent., rebuilt in the late 19th cent. in Neo-Romanian style, featuring a historical park with an area of 4.5 ha reconstructed in 1998, including the historical English park.
- Roman Catholic church from the years 1817 - 1836, built in the place of an older church from the year 1494.
- Filial Church of Saint Martin, Bishop, situated in the municipality of Paderovce from the year 1848.

12.8 Malženice

- Roman Catholic Church, originally Romanian, brick construction of the middle 13th cent. and early 14th cent., enlarged in the early 17th cent., rebuilt to include three naves and renaissance vaults.

12.9 Radošovce:

- Parish Church of the Birth of Virgin Mary.

13. Archaeological sites

In the affected area there are no archaeological sites.

14. Palaeontological and significant geological sites

In the affected area there are no palaeontological or significant geological sites.

15. Characteristics of the existing sources of environment pollution (e.g. noise, vibrations, radiation) and their impacts on the environment

Among the major sources of environment pollution within the area of interest, which adversely influence environment as well as the quality of life of the inhabitants and cause environmental issues, there belong:

- NPP Bohunice, which produces RAW in all three states of matter potentially causing contamination of air, surface water and groundwater, soil and rock environment, as well as common emissions, wastewater and conventional waste.
- Industrial, energetic (non-nuclear), agricultural sites and plants and other economic activities producing emissions, wastewater, sludge, conventional wastes etc. potentially causing contamination of the individual environmental units
- Transport and technical infrastructure causing noise, air pollutants, barrier effect to migration of animals etc.
- Operation of civil facilities, services of local importance, housing structures and other objects that produce emissions, waste etc. on a lower scale.

NEC Bohunice is considered as the major source of environmental pollution.

15.1 Radioactivity[9]

Radiation monitoring is in the SR carried out by SHMU that fulfils obligations under bilateral treaties with Austria and Hungary. Their fulfilment is regularly verified by the Treaty Partners.

To this end the following activities are carried out:

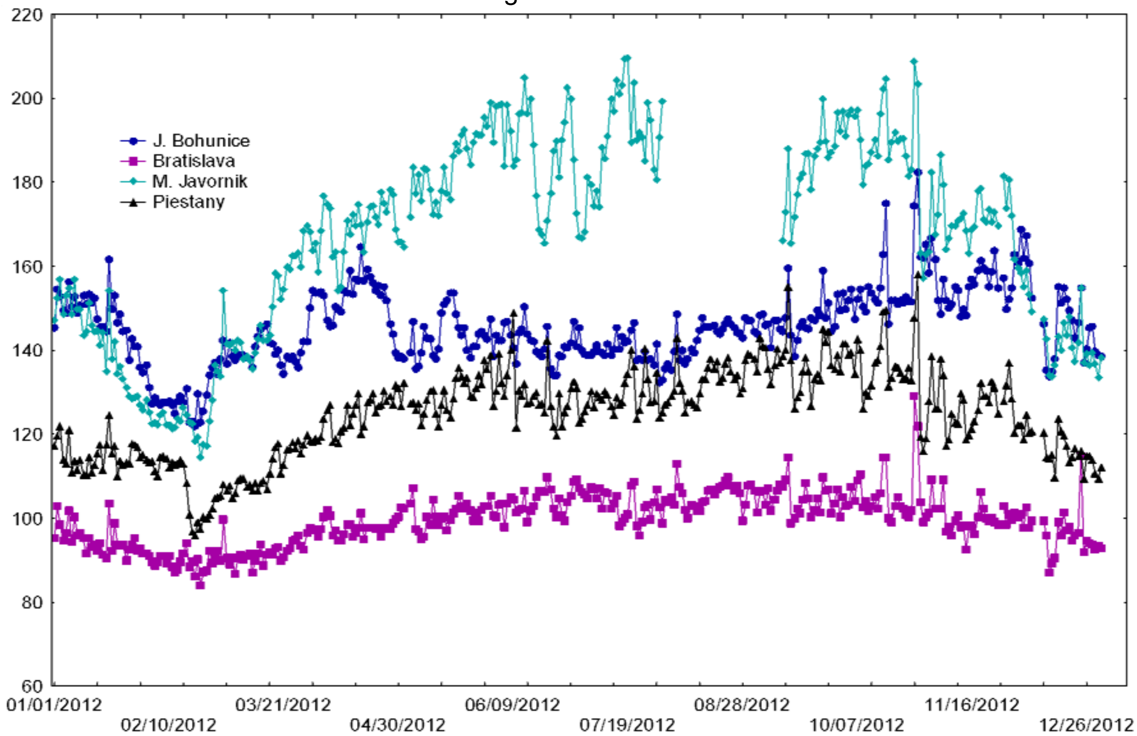
- Monitoring of ambient dose equivalent rate of gamma radiation (since 1991).
- Monitoring of volume activity of aerosols (since 2001 the automatic measuring station AMS-02 has been in operation in Jaslovské Bohunice).

[9] Total atmospheric radioactivity is composed of natural and induced radioactivity. Natural radioactivity denotes spontaneous decay of radionuclides. Naturally radioactive substances get released into the atmosphere mainly from rocks. Besides, they also emerge when atmospheric atoms get struck by neutrons produced by cosmic ray bombardment. Induced radioactivity refers to decay of nuclei triggered by forced addition of energy in such a manner that nuclei become unstable and decompose, emitting alpha, beta or gamma radiation (radiation). If decay results in radioactive products a decay chain emerges. A decay chain refers to a sequence of radioactive decays of nuclei. The chain ends when the radioactive nuclei reach, after a series of decays, a stable isotope. Artificial radionuclides get released into the atmosphere as a result of exploitation of atomic energy, in particular as products of nuclear arms tests in the atmosphere or in case of a nuclear power plant disaster. According to half-life we divide radioactivity into short-lived (half-lives of split seconds to days) and long-lived (half-lives of months to years). Only short-lived radioactivity is usually considered as natural radioactivity, which is represented in the ground layer of atmosphere mainly by radon isotopes and their decay products.

Monitoring results are published in form of annual reports (SHMU). One of the MS is the station No. 11 819 in Jaslovské Bohunice.

Explanatory note: Today, early warning systems measure the radiation absorbed dose rate on basis of which the ambient dose equivalent rate of gamma radiation in nSv/h is established. This is a parameter that comprises natural and artificial radionuclides without a possibility of qualitative distinction between the individual radionuclides. Absorbed dose (total ionising dose, TID) is defined as energy deposited by ionising radiation in inorganic matter per mass of this matter. The unit of absorbed dose is gray (Gy), 1 Gy = 1 J.kg^{-1}. Older unit of absorbed dose is rad (radiation absorbed dose), where 100 rad = 1 Gy.

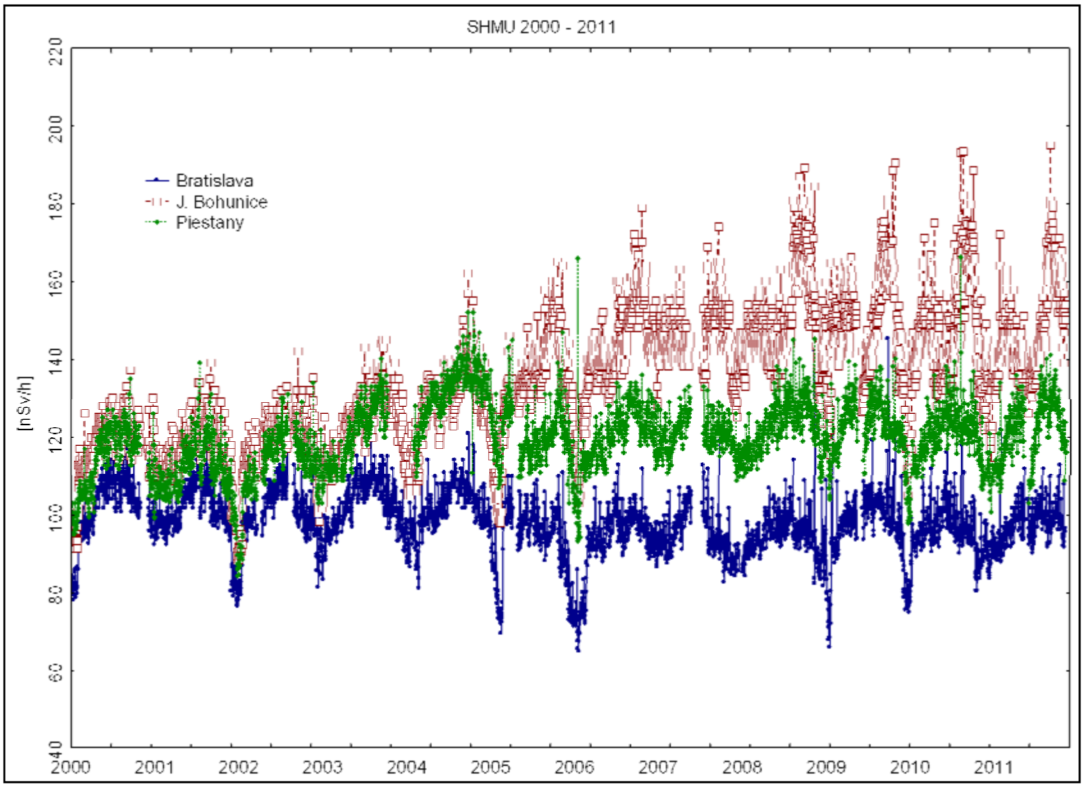
Graph No. 74. 24-hour averages (in nSv/h) of dose equivalent rate of gamma radiation measured at four MS in the Western Slovak Region in the individual months of 2012



Source: SHMU, Radiation monitoring, 2013

Results of measurements of gamma radiation dose equivalent rate over a period of 11 years (2000 to 2011) at three MS in the surroundings of the NEC Bohunice are represented by the following graphics.

Graph No. 75. Gamma radiation dose equivalent rate measured at the MS in Jaslovsé Bohunice, Bratislava and Piešťany in the years 2000 to 2011.

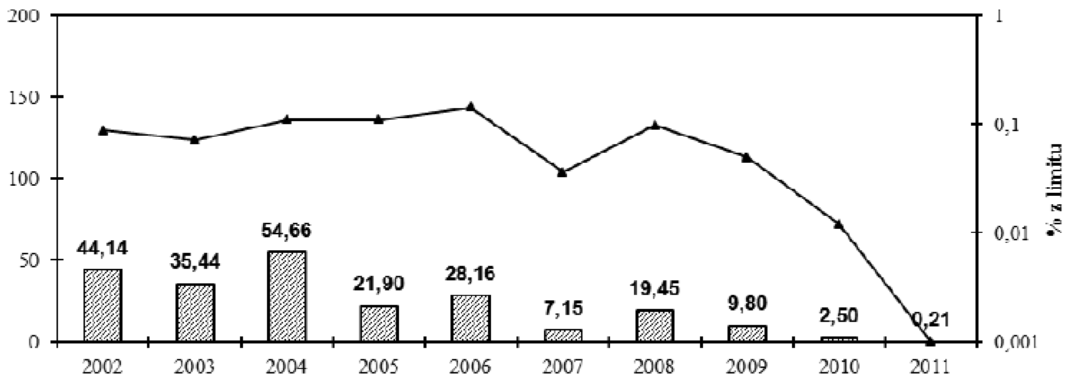


Source: SHMU, Radiation monitoring, 2013

15.1.1 Aerosols

Among artificial radionuclides only ^{137}Cs has reached values at the detection limit of the gamma-spectroscopy systems, while other artificial radionuclides have not been detected. The only natural radionuclide with detected volume activity has been the cosmogenic nuclide 7Be. With regard to the radiation load of the population, contamination of aerosols in the ground layer of the atmosphere by terrestrial radionuclides (^{238}U, ^{232}Th a ^{40}K) does not contribute significantly to the external exposure.

Graph No. 76. Emissions of alpha aerosols (^{238}Pu, $^{239+240}Pu$, ^{241}Am) in the last 10 years (kBq)



Source: Annual report for the year 2011 (Výročná správa za rok 2011), Javys, a.s.

15.1.2 Radiation load measured at NEC Bohunice (Annual report for the year 2012, Javys a.s.)

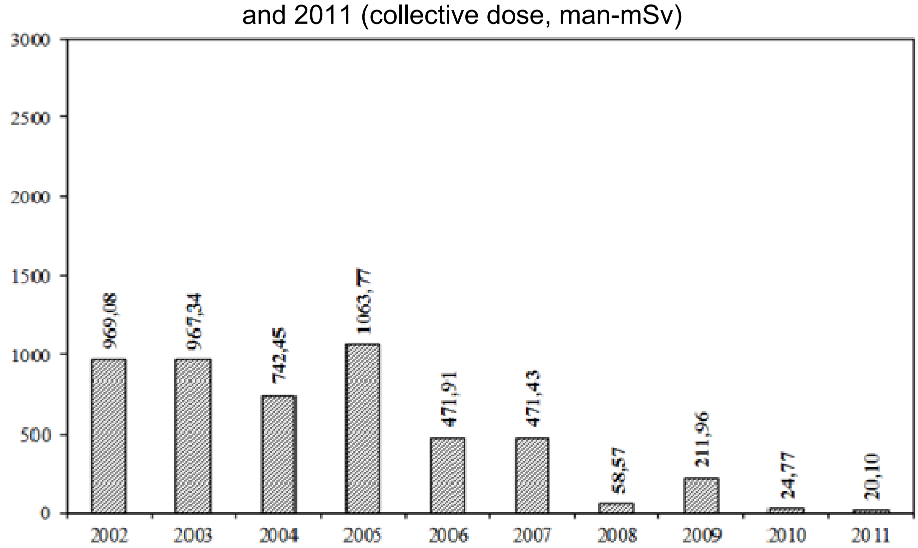
15.1.2.1 *Radiation load of the employees of NEC Bohunice*

In the controlled area of nuclear facilities of JAVYS radiation characteristics of working environment have been systematically monitored, received doses have been processed operatively and administratively and observance of radiation safety standards and the ALARA principle with regard to persons present within the controlled area has been inspected. Regulation and planning of exposure of persons in the year 2012 was in keeping with the provisions of Act No. 355/2007 Coll. and the internal rules of JAVYS. One of the strictly monitored parameters of radiation protection of persons working in the supervised area of the nuclear facility is the maximum individual effective dose that did not exceed the determined per-year limits (50 mSv).

In 2012, the maximum individual effective dose E (mSv) in employees of NPP (RWPTT, A1 NPP, ISFSF) represented a load of 10.171 mSv and 0.627 mSv in employees of V1 NPP. In the year 2012, the per-year irradiation limit was not exceeded in any monitored employee.

The following graphics show the radiation load in employees and suppliers of JAVYS - V1 NPP (expressed as collective dose) in the period between 2002 and 2011.

Graph No. 77. Radiation load in employees and suppliers of JAVYS - V1 NPP in the period between 2002 and 2011 (collective dose, man-mSv)

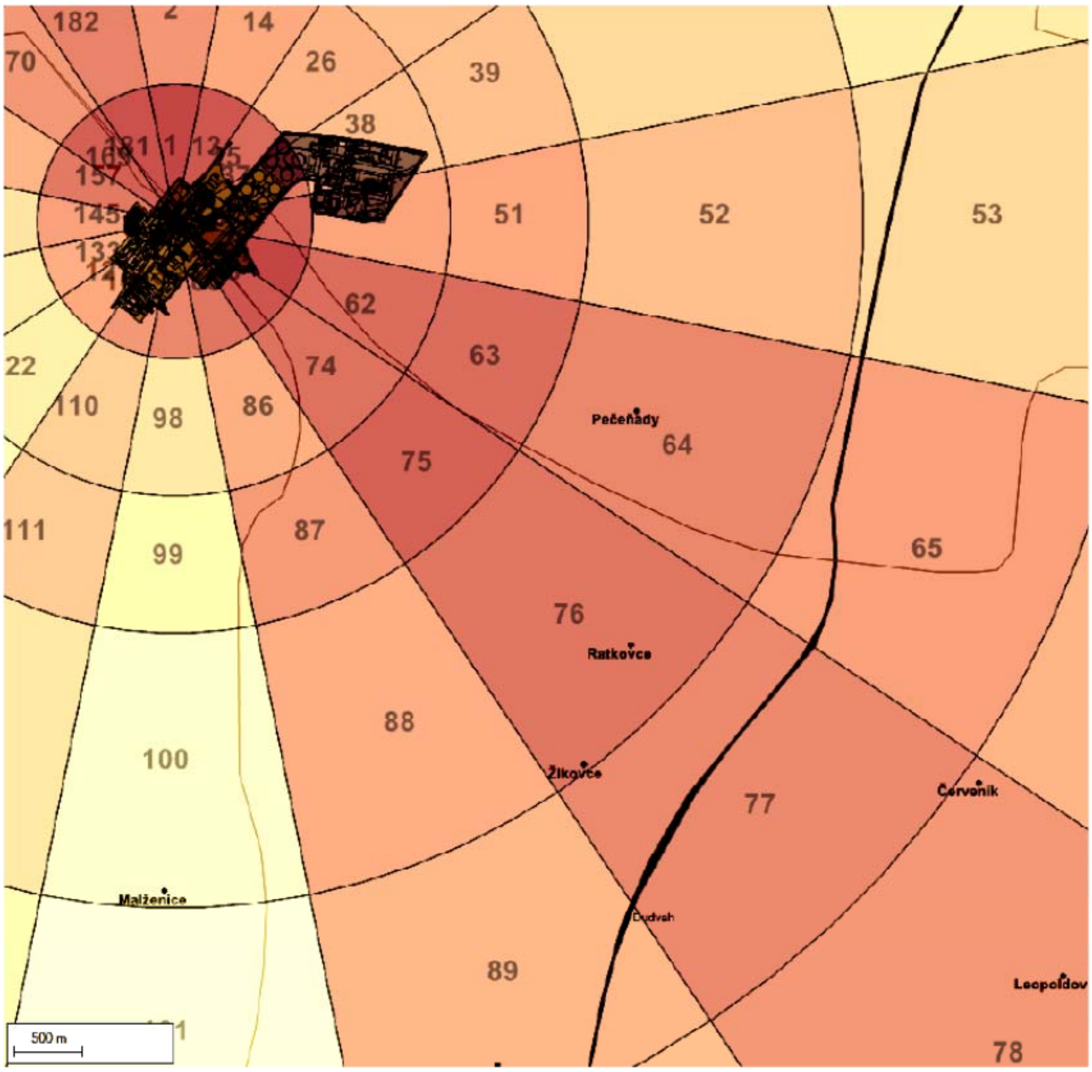


15.1.2.2 *Radiation load of the population*

JAVYS evaluates the operational impact of NPP on the radiation load of the population once a year, using a specialised software system running on a high-performance hardware. The system, approved by the national supervisory authority, applies internationally accepted models of diffusion of radioactive substances, allowing for local conditions and using recent statistical data. The system takes into account all gas and fluid discharges from the JAVYS nuclear facilities and the relevant meteorological conditions. The system provides data on the resulting irradiation of the population within a radius of 100 km, that is to say, it also evaluates the impact on the population living in the given zone in neighbouring countries (Austria, Hungary and Czech Republic).

The maximum calculated values of individual effective dose E in the year 2012 reached in the sector 76 in inhabited areas 0.13% and in uninhabited areas 0.21 % of the per-year irradiation limit established for an individual in the sector 1 - see the following graphics.

Graph No. 78. Sectors map of JAVYS surroundings for calculating the exposed population in the year 2012

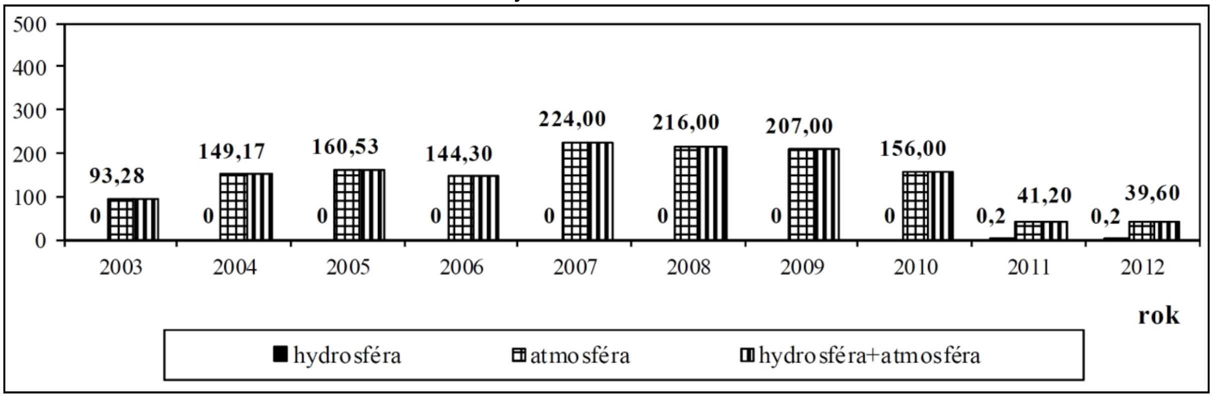


The per-year irradiation limit for a representative individual exposed to discharges of radioactive substances from the nuclear facilities JAVYS, a.s. is $0.32 \cdot 10^{-4}$ Sv. Based on records of discharges of radioactive substances from JAVYS, a.s. and the respective meteorological conditions, the following values were calculated for 2011:

- the highest individual effective dose in a representative individual in the inhabited area 76 Ratkovce, Žlkovce, to the South-East of the nuclear site, reached in the age group 2 - 12 years the value of $3.98 \, . \, 10^{-8}$ Sv (0.129% of the per-year limit),
- the highest individual effective dose in the uninhabited zone 1, to the North of the nuclear site, amounted to $6.63 \cdot 10^{-8}$ Sv (0.207% of the per-year limit).

The values of effective doses were in the year 2012 at the same level as in the previous years. In the year 2011, a percentage increase of the effective dose in comparison to the previous years was recorded, which is, however, due to lowering of the per-year limit of irradiation in a representative individual by the national supervisory authority with effect from 20 July 2011. The absolute values of the individual effective dose remained on a multiply lower level than the radiation load of the population caused by the natural background and medical diagnostic examinations.

Graph No. 79. Radiation load (nSv) of the population in the surroundings of the SE EBO and JAVYS sites in the years 2002 to 2012



15.1.2.3 *Assessment of radiation risks for inhabitants in connection to the contamination of groundwater*

On the basis of a complex analysis of measured monitoring results, also from the point of view of long-term development, and a model prognosis of the further development of the radiation situation, it can be stated that:

- The contamination of groundwater with tritium (originating from the sources of the A1 NPP and V1 NPP site) can neither in future exceed the value of 100 Bq.dm^{-3} in the first water-bearing layer in the area of the municipalities closest to the NEC Bohunice and 500 Bq.dm-3 around the centre line of the main contamination cloud (originating from A1 NPP). The given assumptions are however valid only if the following conditions are kept: the rescue pumping at the A1 NPP site is in permanent operation and there will be no unpredicted events that can affect the radiation situation of groundwater in the area in question.
- The long-term rescue pumping of groundwater carried out at the A1 NPP site (main source of tritium contamination), building 106 (borehole N-3) since the year 1999 will in long run cause a restriction of the diffusion of groundwater contamination out of the source site. The construction of the said system of rescue pumping has procured a significant active element of groundwater protection at the locality.
- The low contamination of groundwater with other artificial radionuclides cannot spread to a significant distance from the NPP site and hence cannot cause risks to quality of groundwater in the surrounding municipalities.
- In the past, the contamination of groundwater with tritium, owing to leakages of low active waters from the pipe collector SOCOMAN, exceeded locally the monitoring level of 100 Bq.dm^{-3} (area between the municipalities Žlkovce – Červeník), while, at present, it has dropped to the level of the natural background. Even in case of unpredicted events, exceeding of the level of 500 Bq.dm^{-3} in the area of SOCOMAN is not expected.

- The measured and predicted volume activities of tritium in the groundwater below the municipalities and in their proximity are low and, from the radio-biological point of view, their level cannot exceed 1/100 of the irradiation limit valid in respect to population according to § 15 Regulation of the Government SR No. 345/2006, that is to say, the possible effective dose due to ingestion cannot reach 10 μSv.year-1 in an individual of the critical group.

In conclusion, it can be claimed that the existing radioactive contamination of groundwater in the area of NEC Bohunice and their surroundings, even under the most conservative presumptions, cannot cause a health risk to any individual of the population such as would exceed the level of 1/100 of the irradiation limit valid in respect to population according to § 15 Regulation of the Government SR No. 345/2006, that is to say, the possible effective dose due to ingestion is less than 10 μSv.year-1 in an individual of the critical group. Any limit indicators of valid legal regulations and international recommendations are higher than the actual values. No regulatory protective measures are necessary in respect to the inhabitants living in the surroundings of the nuclear facilities at Jaslovské Bohunice. Nonetheless, a supply of water from the central water distribution line is secured to meet their needs.

16. Complex assessment of the present environmental issues

The following environmental issues are known in the area of interest at present:

- Activities connected to the operation of NEC Bohunice. These are previous and present activities of the nuclear power plant. By constructing these facilities not only a new technical complex has been established in the given territory but a new technical infrastructure which due to its economic and territorial significance exceeds the boundaries of the assessed area. In relation to its surroundings NEC Bohunice operates as a closed functional unit the inputs and outputs of which are provided by networks of communications, telecommunications, electric lines and product, water distribution and wastewater pipelines. These networks intersect the surrounding landscape at, below and above the terrain level and together with the nuclear facilities determine its usage. The environmental load of non-radioactive substances produced at the NEC Bohunice site does not cause a problematic situation in the affected area.

Among the most significant environmental aspects count:

- Radiation load on the environment
- Increase of heat potential owing to release of waste heat and water steam into the surroundings, in particular through the cooling towers into the atmosphere, by which the local micro-climate (temperature, air humidity, frost cover occurrence and similar) gets modified under certain climatic conditions (mainly inversion).
- Fields of increased heat potential in the assessed area apart from the NPP site due to heat energy distribution lines (and gas distribution lines), which are significant mainly in the winter period, but affect the area also during the vegetation period.
- Electromagnetic fields or fields of changed electromagnetic radiation below the very high voltage and high voltage distribution lines.

What is relevant to current situation from the point of view of a synthetic assessment of the present environmental issues in this territory is the assessment of impacts of NEC Bohunice on the radiation situation in the examined area. The radiation situation in the assessed area and its broader surroundings has been monitored in long term in a broader perspective, comprising evaluation of radioactivity changes practically in all units of the natural environment, including biota and men. This monitoring is evaluated regularly four times a year and comprehensively once a year in order to prove adherence to the set limits defined by the state supervisory authority UVZ SR.

Limited discharges into the atmosphere from V1 NPP were in 2012 assessed as very low, far below the defined limit values.

Discharges to the atmosphere from the ventilation stacks of RWPTT and A1 NPP were in the year 2012 at a low level, showing no extraordinary events, far below the defined limit values.

Based on the said above, we can hence state that the discharges from JAVYS, a.s. into the atmosphere were in the year 2012 far below the authorised limits defined by the CA - UVZ SR (the highest values of the yearly limit were reached by 90Sr among aerosols, build. 808, with 0.898% of the yearly limit).

The locality A1 NPP shows the environmental issue of groundwater contamination with tritium. The situation has been monitored and rescue pumping has been carried out according to the geological project "Monitoring and protection of groundwater at the nuclear-energetic facility Jaslovské Bohunice, p. No. 2625". MžP SR approved, by decision No. R-AR 05/2013, the final report including a risk analysis of the polluted area and the target values of groundwater contamination after the rescue pumping: tritium - max. 100 $Bq.dm^{-3}$ (at the border of the JAVYS a.s. site) and the volume activity of tritium at the reference point (borehole N-3) during the operation of rescue pumping max. 26 $Bq.dm^{-3}$ (that is to say, rescue pumping will be continued until this value is reached in water samples at this borehole). In order to carry out geological activities it is necessary to continue the monitoring of the locality according to approved monitoring programmes, continue the rescue pumping at the source area of the A1 NPP site and update the risk analysis of the polluted area once in 6 years.

Other activities influencing the affected area

- Current environmental issues of the affected area connected to the long-term intensive utilization of the territory for predominantly agricultural purposes. It is assumed that the soils have been damaged with long-lasting effects which show themselves in deteriorated physical-mechanical features of the soils, compression of the soils and local risks of water and wind erosion. Groundwater pollution as a result of agricultural activities was proved in the past, becoming apparent in an increase of nitrites, nitrates, phosphates and ammonium ions. It is assumed that this pollution has a falling tendency. The influence of intensive agricultural use has also manifested itself in the biotic environmental unit. Owing to interventions into the terrain and alterations of vegetation the biodiversity has changed significantly, resulting in reduced and corrupted natural plant and animal communities. In the past, bank growths were eliminated by straightening and regulation of water streams, which had a clearly adverse effect on the stability of ecosystems.
- The quality of environment is also adversely affected by unregulated landfills which can be found at settlements or their proximity.
- Among adverse elements that influence the quality of life of the local population count also:
    - Anthropisation of the territory leading to a low level of ecological stability,
    - Noise load and air pollution by particles originating from road transport,

- Quality of surface water and groundwater in relation to agricultural production and the landfills location.

17. Overall quality of environment

In order to assess the overall quality of environment it is necessary to evaluate the vulnerability of the individual environmental sectors and their corresponding carrying capacity.

17.1 Vulnerability of relief

Although the relief dynamics is influenced by surface and line water erosion processes and occasionally also by Eolian processes, the vertical and horizontal segmentation of relief in the area of interest is relatively low. The values of other attributes that belong to the basic assessment criteria of relief vulnerability, such as inclination and intensity of superficial and underground processes, are low. Thus, the assessed area can be characterised as little vulnerable.

17.2 Vulnerability of rock environment

We characterise the vulnerability of rock environment as its responsiveness to instant changes of conditions caused by geodynamic factors and anthropogenic activity.

Based on the occurrence of the most significant factors we have discerned the following levels of vulnerability of rock environment in the assessed area:

1. Critically to highly vulnerable territory - represents a territory with potential occurrence of the two assessed geodynamic factors, that is to say, occurrence of Würm shifting loess in the proximity of structures of seismic activity
2. Medium vulnerable territory - locations with occurrence of one of the examined vulnerability factors, that is to say, of active tectonic zones or more remote loess with a high coefficient of shifting capacity
3. Territory with little vulnerable to stable rock environment - this represents the remaining areas in which none of the examined critical factors has been found.

In general, the major part of the affected area can be classified as moderately to little vulnerable territory.

17.3 Vulnerability of soils

Vulnerability of soils represents, under environmental perspective, the disposition of soil to anthropogenic influences, but at the same time also the resistance of soil to degrading antropogenic activities.

Based on the characteristics of soil-substrate complexes we have established the following levels of soil vulnerability:

1. Moderately to little vulnerable soils, which are: chernitza, gleyic medium heavy, without water erosion risk and with moderate risk of wind erosion; chernitza, typical carbonate, medium heavy to heavy, without water erosion risk and with moderate risk of wind erosion; chernozem, typical, medium heavy, with medium to strong water erosion and strong wind erosion
2. Medium vulnerable soils, which are: chernozem, eroded, medium heavy, with strong water and wind erosion; chernozem, typical and brown on loess, medium heavy, with high risk of water and wind erosion
3. Highly vulnerable soils, which are: chernozem, typical and brown, medium heavy, with strong risk of water and wind erosion on slightly segmented upland.

Under this aspect, the area can be classified as medium vulnerable.

17.4 Vulnerability of air

The vulnerability of air can be interpreted as the risk of exceeding the primary immission limits (impact on health of persons), secondary immission limits (critical levels - impact on fauna, flora and materials) and deposition limits (critical loads - secondary impact on water, soil and flora). The affected area is not situated in a special air protection area. There is a feasible assumption of further decrease of air pollution. At present, there is no risk of exceeding primary and secondary immission limits or deposition limits as defined by national legislation on air protection. Meteorological conditions for dispersion of pollutants are very good in the locality in question. Under this aspect, the area can be classified as little vulnerable.

17.5 Vulnerability of surface water and groundwater

Among the surface streams, the river Dudváh is the most affected by the proposed activity. Other surface waters that can also be affected by the proposed activity are the stream Blava, flowing from the Biele Karpaty Mts., from the municipalities Dobrá Voda and Dechtice, in the North-West. Considering that its waters originate to a significant extent from the substantial karst-fissure collectors, this stream is enriched by rare communities and as such can become endangered. From this local point of view the vulnerability of surface streams is medium to high.
The vulnerability of groundwater depends on the lithologic composition of Quaternary sediments or exposed Neogene sediments, but also on the present level of contamination. The most vulnerable groundwater in the area of interest from this point of view is the groundwater of the Quaternary fluvial sediments of the Dolnovážska flood plain, which is hydraulically connected with the surface streams Váh and Dudváh. Groundwater at the NPP site, in particular in the area of A1 NPP, shows high vulnerability, mainly due to the proven contamination with tritium.

A major part of the area of interest spreads on sands and gravels, covered with a 10 to 20 m thick layer of loess due to which we have classified the territory as little to medium vulnerable, locally high vulnerable.

17.6 Vulnerability of flora, fauna and their biotopes

Vegetation is most vulnerable in the proximity of road communications owing to exhaust gases from car traffic, further as a result of usage of agrochemicals in agriculture and sewage waste of the local settlements. Forest vegetation suffers from uncontrolled tree felling.

Vulnerability of various groups of animals results from the change of biotopes. This refers in the first place to the elimination of the original locations of the species which is in the majority of the cases irreversible. Effects of meliorations in the area of interest have been significant over the last decades, leading to visible changes of the wetlands.

When assessing the vulnerability of biotopes we presume that a biotope is the more responsive to changes, meaning more vulnerable, the more it is bound to specific conditions of environment. Therefore, the biotopes of the stream Blava belong to the category of medium vulnerable.

The overall vulnerability of biotopes is medium, locally high.

17.7 Vulnerability of welfare and quality of life of persons

Factors that help to establish the vulnerability of welfare and quality of life are closely connected to the individual phenomena of environment (e.g. noise level, emissions, malodour, vibrations, barrier effect, visual quality of scenery and similar), and also to the quality of settlements in respect to the infrastructure. The vulnerability of this kind can be also interpreted by means of economic and social factors in the municipalities. An independent group of indicators is represented by subjective feelings of security, rest, protection or, on the contrary, danger to an individual or a group of people, provoked by the existence of preconditions for possible breakdowns (e.g. a breakdown of a production facility).

Vulnerability of the factors defining the quality of environment can be assessed as a sum of the vulnerabilities of the environmental units, in particular air, water and soil. Since these appear to be minimum to low, we classify the vulnerability as low. Into the same category falls the vulnerability of factors defining the quality of settlements. In this respect, the affected municipalities show good conditions due to a positive situation of residential construction, connection to water distribution, sewage system and gas line networks.

The economic and social situation is at present determined mainly by unemployment. The unemployment rate in the Trnava district is presently under the Slovak average.

In total, the vulnerability is hence qualified as low to medium.

17.8 Total vulnerability of affected area

Final total vulnerability of affected area was evaluated by synthesis of vulnerability of individual parts of environment. For the assessment the following scale was used:

1. Low vulnerability
2. Medium vulnerability
3. High vulnerability

The following table provides the levels of vulnerability and the resulting total vulnerability as the avarage of input values.

Tab. No. 30. Evaluation of vulnerability for individual parts of environment and total vulnerabilty

Environmental issues	Level of vulnerability	Verbal expression of level of vulnerability
Rock environment	2	Medium
Relief	1	Low
Surface water	2 (3*)	Medium
Ground water	2 (3*)	Medium
Soil	2	Medium
Air	1	Low
Biotops	2	Medium
Wellfare and quality of life	2	Medium
Total vulnerability	**1,7**	Medium

(*): local level of vulnerability

By considering of all parcial levels of vulnerability the total vulnerability for affected area was evaluated as medium level vulnerability.

18. Assessment of the assumed development of the area in case of no activity

If the proposed activity would not be carried out there would be no impacts on the affected area and its inhabitants. The aim of V1 NPP decommissioning, which started in April 2007 by adopting the Final Statement of MžP SR, is to return the V1 NPP site into a state which does not represent any threats to the health of people or any other security risks. The only possible scenario after the completion of the 1st Stage of V1 NPP decommissioning, other than the proposed activity, would be the interruption of the decommissioning process. A repeated commissioning of the reactor is not envisaged, nor is it possible.

In case of no activity the status corresponding to the zero alternative would persist, which would mean that the licence holder could finish the activities permitted for the 1. stage of decommissioning. The environmental impacts of maintenance of the nuclear facility would be according to assumptions of previously issued reports on environmental impacts. If the process of V1 NPP decommissioning would be stopped the adverse environmental impacts and the risks connected with them would persist. This would mean that the issue of low and medium active RAW, which were produced during V1 NPP operation, would remain unsolved and its solution would be shifted into the future without a clear time frame being defined. It is necessary to underline that the decommissioning process is ongoing and has started by dismantling and demolition of unnecessary equipments, systems and buildings and workforce, premises and technologies are at disposal. In case this process would be interrupted unused buildings and facilities would remain in the area, some of which would represent a source of radiation risks. The territory would remain blocked to any usage and would require institutional supervision, while there would be no possibility to use the territory as "brownfield" and the existing infrastructures for other industrial purposes.

Interrupting the decommissioning process after the completion of the 1st Stage would imply leaving those facilities which under the perspective of radiation loads constitute the biggest issue without any solving approach and shifting a possible solution of this issue into the future.

As far as employment rates are concerned, a significant decrease of workforce demand would occur in near future.

19. Concordance of the planned activity with the valid land planning documentation

The proposed activity is in concordance with the respective land planning documentation and the conceptual and strategic documents of SR and JAVYS. The most significant related strategic documents are:

- Accession Treaty of the Slovak Republic to the EU, Protocol No. 9
- Concept of Termination of V1 NPP Operation, JAVYS, 2005
- Conceptual Plan for V1 NPP Decommissioning, JAVYS, 2006
- A Strategy for Bohunice V1 Decommissioning, JAVYS, 2012
- A Strategy for the Final Stage of Peaceful Exploitation of Nuclear Energy in SR, Ministry of Economy SR, 2012.

III. Evaluation of anticipated impacts of the proposed activity on the environment, including health

1. Impacts on the population

1.1 <u>Number of citizens in affected area</u>

In accordance with the decree No 533/2006 Coll. on details and protection of inhabitants against effects of hazardous substances, a 5 km radius has been considered as affected area for the assessment of potential impacts on the natural and anthropogenic components of the environment and population. The municipalities situated within a circular area of 5 km diameter from the centre of the V1 NPP, to be considered as affected population, are as follows:

- Jaslovské Bohunice, Malženice, Radošovce and Dolné Dubové within the Trnava District;
- Žlkovce and Ratkovce in the Hlohovec District;
- Veľké Kostoľany, Nižná and Pečeňady in the Piešťany District.

According to previously presented data, the total population of the affected area is 9.161 inhabitants. The urban areas closest to the Proponent's site are the urban areas of Jaslovské Bohunice (2.011 inhabitants) and Radošovce (429 inhabitants) municipalities, at a distance in both cases of approximately 2 km.

The activities of 2nd Stage of V1 NPP decommissioning induce both positive and adverse impacts, as well as direct and indirect impacts on the population. In general, consideration may be given to the following environmental aspects: standards of living, investment and cost, residentail areas, nuisance, population density, migratory movements, lifestyle, and the local, provincial and national economy and energy consumption.

1.1 Social and economic context

According to the Environmental and Social Policy of EBRD in respect to assessment and management of environmental and social aspects PR1 (Performance Requirements) the assessment of the proposed activity shall also allow for a social dimension by providing for sustainable development, namely as to the following aspects:

working standards and conditions (including health protection and safety)

impacts on the society such as public health and safety of inhabitants

equality of genders

impacts on the native population and the cultural heritage

forced resettling

accessibility of basic services

Tab. No. 31. Identification of impacts on social aspects

Social aspects	Identification of the impact	Reasons
Working standards and conditions (including health protection and safety)*	Yes	The proposed activity represents health and safety risks, but the employer is obliged to respect the existing national legal requirements to protection of workers' health and creation of safe conditions in the working environment. SR has harmonised its legislation in this sphere with the requirements of EU directives. As to the legal provisions, administration, management and control, the working standards and conditions in the NPP in question have already been provided for and implemented in the long term.
Impacts on the population such as public health and safety of inhabitants	Yes	The proposed activity bears a risk of influencing health and safety of the affected population, but must be regulated and implemented in such a way as to fulfil the approved limits established in the first place for purposes of public health protection and minimisation of non-standard situations. As to the legal provisions, administration, management and complex monitoring, the impacts on the population in the affected area have already been managed, supervised, evaluated and published in the long term and will be managed in the same way also during the 2nd stage of decommissioning.

Tab. No. 31. Identification of impacts on social aspects

Social aspects	Identification of the impact	Reasons
Equality of genders	No	The proposed activity has no relation whatsoever with gender-based discrimination.
Impacts on the native population and the cultural heritage	No	In case of SR and the affected area this aspect is not relevant in any way. The proposed activity will in no way affect the ethnic composition of the population or the cultural heritage in the affected area.
Forced resettling	No	Resettling of inhabitants is not required by the proposed activity since it consists in decommissioning of a NPP without any occupation of additional land. Neither occurrence of emergency situations can result in a necessity to resettle inhabitants.
Accessibility of basic services	No	The proposed activity will in no way affect the present or future accessibility of basic services since it is of a limited and short-term character and compared to other activities in the area it is insignificant in terms of accessibility of basic services.

*Standards on employment and working conditions established in collective bargaining agreements or according to labour law and labour-legal provisions.

The impact in the social sphere can be defined as an adverse impact of small scale and short duration. From the point of view of cumulative impact in this sphere it is insignificant.

The positive impacts on the population include economic benefits, especially a short-term increase in employment associated with decommissioning activities and in long-term perspective it is creation of conditions for new industrial development of affected area and employment in future.

The potentially major adverse impacts of the respective activity on the affected population include nuisances (e.g. related to increase of traffic load in heavy vehicles, as well as noise and vibrations associated with traffic and dismantling, fragmentation works and mechanical construction waste recycling), and also adverse significant socio-economic effects that may result from the ending of plant operations on levels of employment (lower employment because number of workers at the installation will be smaller than during the operational phase and will gradually decrease), economic benefits (reduction in income from taxes in the municipal area) and impact on the needs of auxiliary industries (problems associated with a downturn in the sectors supplying the installation).

1.2 Health and safety

Human health impacts are related to health risk connected to certain decommissioning activities. Human health risks for 2nd Stage of V1 NPP decommissioning are expected to be dominated by occupational injuries to workers engaged in activities such as construction, maintenance, and excavation.

In general, consideration may be given to the following risks as the most important factors associated with health risks:

- Exposure to ionizing radiation,
- Exposure to hazardous (toxic) products (e.g. aerosols containing lead, asbestos),

- Exposure to high concentrations of dust,
- Exposure to common pollutants,
- Falls, contact with electricity and other risks typical of construction works,
- Exposure to high noise levels.

Impacts on human health include radiological and non-radiological health effects both on those who are involved in or exposed to decommissioning activities.

1.3 Radiological health risks

The radiological impacts will be due to changes to the installation, as a result both of the activities involved in decontamination and dismantling operations and of the overall duration of the decommissioning process. The health risk, expressed in terms of radiation dose, corresponds firstly to the standard execution of the decommissioning process, and secondly to the effects of possible non-standard situations (accidents).

Radioactive materials are present in the reactor and support facilities after operations cease and the fuel has been removed from the reactor core. Exposure to these radioactive materials during decommissioning may have consequences for workers. Members of the public may be also potentially exposed to radioactive materials that are released to the environment during the decommissioning process. All decommissioning activities have been assessed to determine their potential for radiation exposures that may result in health effects to workers and the public.

In assessing the radiological safety of dismantling, consideration needs to be given to three important routes of exposure: inhalation, ingestion and external irradiation. The most important route of exposure for the workers involved in dismantling will probably be external irradiation. The ingestion and inhalation routes must be minimised through application of the protection techniques normally used in these activities (surveillance and control of radiological conditions, filtration, containment, use of confined areas with controlled ventilation, protecting clothing and breathing apparatus).

Inhalation is likely to be the dominant route of exposure for the public, since external irradiation due to radioactive materials deposited on surfaces and ingestion should both be minimised as exposure routes during dismantling.

Application of the IAEA Safety Transport Regulations[10] as enacted in the Slovak Republic, will ensure that inhalation and ingestion are eliminated as routes of exposure for the public and workers in standard transport operations, leaving external irradiation as the dominant route of exposition.

For purposes of drafting the present EIA Report, a specific methodology of dose calculation for each of the exposure routes considered has been applied, taking into account contrasted literature[11]. The results obtained have been compared with the individual dose limits established in the applicable standards.

Radiological health risks are specifically focused on workers activity, but risks to the public have been also established and documented, though it may be expected that these will be considerably lower than those existing during the operational phase of the of the V1 NPP.

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[10] International Atomic Energy Agency (2012). Regulations for the safe transport of radioactive material: specific safety requirements. 2012 Edition. Vienna.

[11] U.S. Nuclear Regulatory Commission (1983). Radiological Assessment. A Textbook on Environmental Dose Analysis. NUREG/CR-3332 ORNL-5968. Washington, D.C.

As reference levels12 for this indicator, the collective dose for the public and dose limits for workers according to recommendations of the International Commission on Radiological Protection have been applied in order to assess stochastic health effects such as development of cancer or genetic effects. General radiation protection criteria pursuant to the Act No 470/2000 Coll. of December 5th, 2000 and the Regulation of the Health Ministry of SR No. 12/2001 of December 13th, 2000 on requirements for securing radiation protection have been applied as well. According to the aforementioned regulations, dose limits to workers and public are as follows:

- Annual dose limit to workers 100 mSv/5 yrs. (max. 50 mSv/yr),
- Annual dose to the public: 1 mSv/yr,
- Dose constrain to the inhabitant living near nuclear installation: 0,25mSv/yr.

Considering the fact that in the affected area other nuclear installations are in place the total radiation impact on inhabitants have to be assessed in context of cumulative impact, in order to know that the sum of contributions from all installations in place will not exceed the limit values. To reach the aim of max. human health protection such limit values have been established for following installations: V1 NPP, V2 NPP and A1 NPP + TSÚ RAW + ISFS.

From governemental decree of SR No 345/2006 Coll. follows that it is allowed to discharge the radioactive compouds (RAC) into air and surface water if it is ensured that effective dose in related critical group of inhabitants will not exceed 250 microSv/year as a consequense of this discharge.Yearly limit value of exposition due to discharges of RAC from NEC Bohunice for one person from inhabitants was 250 microSv in 2010 (operation of JAVYS and SE – EBO V2). From year 2011 JAVYS evaluates impact of V1 NPP, and A1 NPP + TSÚ RAW + ISFS on environment separatelly and respects its limit value of 32microSv/year.

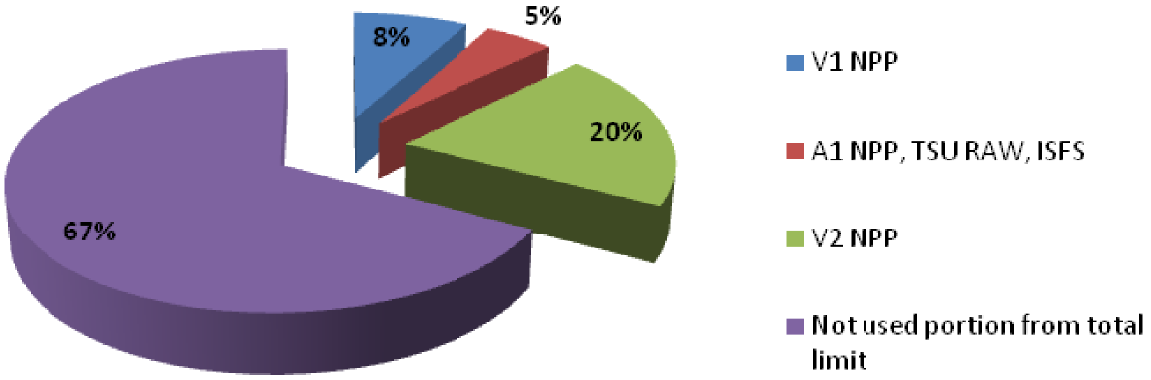
Currently the limit values for effective dose of representative person from inhabitants caused by RAC from individual nuclear instalations in Bohunice established by competent authority (UVZ SR) are as follows:

- For V1 NPP – 20 μSv/year (JAVYS, a.s.)
- For A1 NPP, TSÚ RAO a ISFS – 12 μSv/year, (JAVYS, a.s.)
- For V2 NPP – 50 μSv/year (SE, a.s., EBO nuclear plant)

Portions of limit values established for individual nuclear installations in Bohunice from total limit value (250 microSv/year) allowed by legal provission of GD SR No. 345/2006 Coll. are presented on the following graph.

12 ICRP (2007). Recommendations of the International Commission on Radiological Protection. ICRP Publication 103. Annals of the ICRP 26, Ann. ICRP 1 (3).

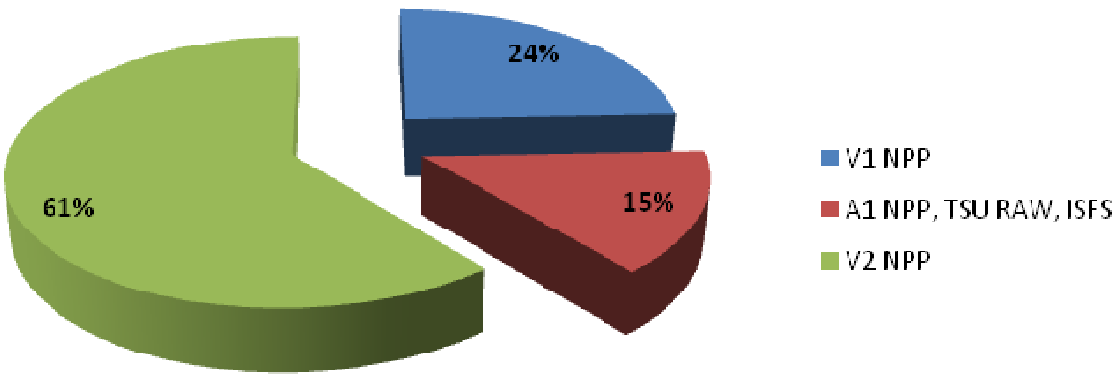
Graph No. 80. Portions of NEC Bohunice individual limit values from total limit value 250 μSv/year



In 2012 JAVYS utiliesed its limit value at the level of 0.124% from limit values of 32microSv/year (considering the highiest effective doses od representative person in inhabited area – sector 76 Ratkovce SE from V1 NPP) for group 2-7 year. The highest values of individual effective doses in non-inhabited area represented the portion of 0.207% from limit value.

Taking in consideration the conservative assumption (discharges into atmosphere and hydrosphere from NEC Bohunice will reach max. values of limit values), the discharges from V1 NPP decommissioning will participate on total radiation load by the minorite portion of 24%. As it is shown on the following graph the dominating source of radiation load for inhabitants from RAC discharges into atmosphere and hydrosphere is operation of V2 NPP (max. possible contribution to radiation load for inhabitants is 61%).

Graph No. 81. Portions of individual nuclear installations in Bohunice on total radiation load for inhabitants - conservative assuption



Radiation measurements (content of radionuclides and surface contamination) will be performed by JAVYS and supervised by the Public Healthcare Authority – UVZ SR.

As far as possible health risks are concerned all activities carried out in an environment with sources of ionising radiation are subject to control and optimisation of radiation load pursuant to the Act No. 355/2007 Coll. and internal regulations already in the authorisation process as well as during implementation. For purposes of monitoring of radiation load to the employees and suppliers each person is provided with a film and operational electronic signal dosimeter. Monitoring of workers working with sources of ionising radiation comprises also monitoring of internal irradiation by means of whole-body measurement on a whole-body computer.

On the basis of the said above it can be stated that health risks of employees and suppliers working in the controlled zone of V1 NPP are very low since individual doses to workers are reduced by application of technical, administrative and organisational measures ALARA and are well bellow the set irradiation limits.

As mentioned before, radiological impacts could correspond not only to the standard execution of the decommissioning process, but also to the risk of possible radiological accidents.

The likelihood of a large offsite radiological release in a facility such as V1 NPP, that has permanently ceased operation, is considerably lower than the likelihood during the operation of the reactor since, after removing the nuclear fuel, any potential breakdown scenarios associated with reactor operation are no longer relevant. Considering separately design basis accidents (DBA) and severe accidents (beyond design basis), it is clear that DBA focus on reactor operation and are not applicable to plants undergoing decommissioning. The only severe accidents applicable to a decommissioned plant are those involving the spent fuel, for instance as a consequence of structural failures due to the action of external agents (e.g. earthquakes, flooding, and sabotage). These anticipated accidents have been assessed to establish the preventive and mitigation safety systems of the Interim Spent Fuel Storage (ISFS) facility.

During dismantling, there is a risk due to the residual radiological activity in areas, systems or components contaminated or activated. The presence of radioactive material means that the installation continues to present a risk of exposure for people and, more so, for workers who perform dismantling works.

The assessment of planned dismantling activities demonstrates that:

- Radiological doses to workers and members of the public are within the limits acceptable to the CNSC; and
- Releases of radioactive material into the environment fall within the allowable limits for normal operation.

Among the hazards that could be associated to significant radiological consequences for members of the public are fire, explosion, physical and external hazards.

Potential accidental scenarios related to those hazards could be radioactive material (non-fuel) handling accidents (drop and breaking of a waste container, producing radioactive airborne releases), dismantling related accidents (piping and equipment cutting, generating considerable amounts of airborne radioactive contamination), fire accidents with radioactive release or explosion accidents with radioactive release (oxyacetylene explosion occurring during the segmentation of components).

The highest value result in the safety risk analysis is 6.95E-03 mSv, corresponding to the dose calculated for an oxyacetylene explosion during the segmentation of the most contaminated component. The comparison of this value with the reference values shows clearly that radiological consequences of accidents on public members are low even in the worst anticipated scenario. However, preventive and mitigation measures will be adopted, not only for reducing risks to workers, but also for minimizing the potential impact on the population, both during planned activities and in case of accidental events.

1.4 Risks connected to free release of low radioactive materials

Low radioactive matarials, which will be released into environment after fulfilling the limit value and conditions for free release will, in particular consist of conrete – 81% portion. All this material will be used directly at place in JAVYS for fulfilling in the terain depression after buildings removal. Next 14 % portion of free release materials consists of iron and steal, which will be used as the secondary raw material in iron production. The minorite portion of 5% will be recovered or disposed of at suitable conventional waste treatment facilities. It can be assumed thet free release materials will not be source of significant radiological impact on inhabitants of SR.

1.5 Other non-radiological health risks

Apart from radiological health risks, typical health risks of concern in the context of decommissioning activities can be grouped into the following four categories: chemical, physical, ergonomic and biological. The risk of decommissioning activities on health from hazardous or conventional materials will be considered detectable if injury rate during decommissioning exceeds regulations of the Government of the Slovak Republic on the minimum requirements for ensuring occupational safety and health protection (Act No. 393/2006 Coll.). The risk of decommissioning activities on occupational health issues will be considered destabilizing if injury rate during decommissioning becomes rises to such a level that decommissioning activities must be halted in order to address worker safety.

1.5.1 Chemical health risks

Chemical risks derived from handling of hazardous materials (non radioactive and toxic) generated during demolition of V1 NPP buildings (e.g. aerosols containing lead or asbestos) could have a significant effect on the health of workers who carry out the proposed activities as well as indirect impacts on health of inhabitants living in the surroundings of the plant.

Inhalation and dermal contact with hazardous chemicals count among serious health risks. Ingestion is typically not a voluntary route of exposure but accidental ingestions (pipetting with mouth, siphoning gasoline, etc.) have been known to occur at the workplace. Solvents and particulates are the two contaminants of greatest concern. Some of the key chemicals of concern found in building materials, paints, light bulbs, light fixtures, switches, electrical components and high-voltage cables include asbestos, lead, polychlorobiphenyls (PCBs) and mercury. Other chemicals found during decommissioning activities in low concentrations include potassium, sodium chromate and nickel (found in the suppression chamber). Also, quartz and cristobalite silica were detected during concrete demolition. Fumes, often including lead and arsenic, and smoke from flame cutting and welding are significant sources of chemical exposure during decommissioning.

Decommissioning involves many activities that expose workers to chemical hazards. These are mainly:

- Chemical decontamination of the primary loop,
- Removal of reactor components,
- Decontamination of the piping walls,
- Removal of contaminated soil,
- Removal of radioactive structures,
- Removal of hydrocarbon fuel from storage,
- Removal of hazardous coatings,
- Removal of asbestos,
- Removal of chemical-containing systems, such as demineralizers and acid and caustic containing tanks,
- Removal of sodium and NaK residue.

The 2nd Stage of V1 NPP decommissioning can be considered, with regard to risks for public health from conventional pollutants and wastes, in essence as analogous to plant operation. These risks are related basically to small-scale pollution of non-radioactive nature, resulting from discharge of industrial and sanitary waste water into the environment, and to waste generation and management.

Emissions of conventional pollutants to the atmosphere will be performed according to conditions and relevant legal provisions of air protection legislation. The state of environment will, in essence, not change under this aspect.

Management of conventional wastewater (sewage and rain water) will be also performed according to legal requirements and will be similar to the management under standard operation, thus not representing a source of major impacts on the health of the affected population. Wastewater will be treated and discharged to the recipient in compliance with the conditions set in permissions and current legislation.

1.5.2 Physical health risks

The major sources of physical occupational risks during the decommissioning process involve the operation and use of construction and transportation equipment. Vehicles, grinders, saws, pneumatic drills, compressors, and torches are some of the more common equipment that can cause injury if improperly used. Heavy loads, which are often manipulated by cranes and loaders, must be steered and controlled to avoid injury. The majority of these hazards will be due to the activities of dismantling. Workplace designs and controls should be the first line of defence when preventing workplace injuries. Hard hats and other Personal Protective Equipment (PPE) are another important intervention and can serve as a secondary protective measure should workplace controls fail.

Many activities during decommissioning, for example, the use of cutting torches, have the potential to initiate fires. These activities, which are common during construction and demolition, should be identified in advance. It is required by law that precautions be taken to minimize the likelihood of fires and measures adopted to deal with non-standard situations (fire) should they occur.

Noise represents another physical hazard that will be significant during decommissioning. Noise will be generated prevailingly by equipments such as rivet busters, grinders, and fans. Although workplace controls and designs are the best methods for reducing noise, PPE (e.g., earplugs) can also be used to protect against hearing loss. If workers need to use PPE their ability to communicate effectively is reduced and safety may be compromised.

Electrical hazards are a significant concern during the proposed activities, especially if during decommissioning changes of electrical circuits and power supply will become necessary. All these activities, plus various other activities (cranes operating near power lines, excavation works near buried cables, etc.) count among activities causing threats to workers. Proper precautions will be taken in order to avoid injury.

1.5.3 Ergonomic health risks

The physiological and psychological demands of the proposed activity will create ergonomic hazards at the workplace. Discomfort and fatigue are two indicators of ergonomic stress that can lead to decreased performance, decreased safety, and increased chance of injury. The typical sources of ergonomic stress during decommissioning activities include mechanical vibrations, lifting and static work. Workplace designs, work shifts, and breaks should be planned accordingly to avoid ergonomic stress.

1.5.4 Biological health risks

Biological health risks include any virus, bacteria, fungus, parasite, or living organism that can cause a disease in human beings. Typical sanitation practices can help effectively avoid the emergence of diseases. Having clean, potable drinking water, marking no potable water, and providing cleansing areas are the most important elements of a sanitation system.

Given the age of part of the buildings and facilities of V1 NPP, there is an increased chance that workers will be exposed to molds and other biological organisms that grow in and on the buildings. Molds and fungus, when inhaled, can cause minor to serious pulmonary problems. Dermal contact could cause rash or irritation. Therefore, a thorough inspection of the facilities and their cleansing should be conducted and PPE should be used if biological agents are identified.

Impacts on the health of inhabitants have been qualified as short-term adverse impacts of medium extent.

1.6 Disturbance to well-being and quality of life

Perception of well-being and life quality belongs to subjective assessments and is different in each person. If safety concerns prevail among the affected population and they perceive the activity as hazardous in spite of observance of all limits and provisions designed to secure radiation safety their well-being and life quality will suffer. In general, activities in connection with the NPP decommissioning have been rather welcomed by the population (mainly in comparison with new construction or operation of a NPP). Nonetheless, in some cases, life quality can be affected by becoming aware of gradual employment reduction in the given facility and uncertainties as to the industrial usage of the territory in distant future.

In total, a long-term positive effect due to the elimination of risks connected to the presence of V1 NPP in the affected area, with implied increase of safety (elimination of risks), has been identified; short-term positive influence in connection to maintaining the employment rate and deployment of specialist work force in JAVYS during the 2nd Stage of decommissioning as well as creation of job opportunities for external suppliers, and an unspecified positive long-term effect in connection with creating of conditions for industrial development in this area in future, after its release for further industrial use.

1.7 Acceptance of the activity by the affected municipalities

According to written statements of the affected municipalities submitted on the PES and the course of the meetings of the Proponent with the representatives of the local self-governing entities, which were carried out in the framework of the implementation of the Stakeholder Engagement Plan under the Project B6.7, none of the affected municipalities has expressed its disagreement with the planned activity, while in some cases this was conditioned by requirements to carry out environmental impact assessment which have been reflected in the established Scope of assessment (MŽP SR).

The Proponent has provided, beyond the scope of the Act No. 24/2006 on environmental impact assessments, as amended, also for the possibility of the affected municipalities, authorities and the public to obtain information and consultation on two consultation days (one during the period for submission of comments on the PES and the other during the submission of comments on the Assessment Report). Apart from one inhabitant of an affected municipality who expressed his overall disagreement with the decommissioning of V1 NPP during the first consultation day (disagreement with the decision on V1 NPP decommissioning, the decommissioning concept, the immediate decommissioning alternative), the affected municipalities and other self-governing authorities have not expressed their disagreement with the proposed activity.

Information and consultation process is implemented according to requirements of Act. No. 24/2006 Coll. on EIA and according to Stakeholders engagement plan elaborated according to EBRD requirements in November 2012. More detailed information is provided at Annex 12.

2. Impacts on rock environment, mineral raw materials, geodynamic phenomena and geomorphological conditions

Direct impacts on the geological environment or indirect impacts in the form of contamination are due to the nature of the activity irrelevant for common operation. The potential risk of contamination as a result of non-standard operating conditions (e.g. leakage of liquid radioactive materials due to leaking equipment or pipelines, accidents during the filling of packages, barrels, FCCs, etc.) can be prevented by emergency measures for all operating premises (sealed joints between floors and walls, water-proof floors and walls up to a reasonable height, sloped areas conducting to the active sewer system, storage of hazardous substances in accordance with the Decree of the Ministry of Environment No. 100/2005 Coll. on details of management of hazardous substances, requirements to the emergency plan and procedure applicable in case of a sudden deterioration of water quality).

The risk of contamination of the geological environment in relation to transport can be prevented by observation of the legislative requirements to radiation control and transport.

The risk of certain contamination of the upper soil layers by leakage of hazardous substances from vehicles (e.g. oil, gasoline), removable by common remediation works, appears to be the most realistic risk.

Mineral deposits are not affected by the activity.

The respective area is not located within a territory with active exogenous geodynamic phenomena (landslides, increased water or wind erosion, etc.), and the respective activity, given its nature, cannot induce such phenomena at the affected location.

Due to its location and nature, the proposed activity does not have any impacts on the local geomorphologic conditions.

A positive impact will be induced by removing the source of current tritium contamination of groundwater and the surrounding rock environment. By removing the building No. 800, in which leakages due to leaks of the technological complex are presumed, contamination will be eliminated directly at its source. The remediation of this territory will be carried out in such a way as necessary to solve this issue at the V1 NPP site in complex.

An overall adverse short-term impact on the rock environment has been identified and assessed, as to its extent, as small. In view of the removal of the source of contamination of the rock environment a long-term positive impact has been identified, which can be assessed, as to its extent, as small since it affects only a local solution to a larger issue.

3. Impacts on climatic conditions

The activity will not affect the local micro-climate.

The assessed activity includes a process which constitutes a source of carbon dioxide (CO_2 is a greenhouse gas), however, these sources are not significant as to the amount of CO_2 emissions in relation to the overall emissions of greenhouse gases in the area. We assess the impact on the climatic conditions as a very small to negligible adverse impact.

4. Impacts on the air

Decommissioning activities have the potential to significantly affect the air quality of the affected area by emissions of non-radiological and radiological pollutants. The air polluting activities can be direct, such as demolition of buildings, or indirect, such as transportation of materials and workers to and from the site. These potential impacts are considered as detectable if they cause a destabilizing measurable increase in the concentration of one or more regulated air pollutants and can be directly attributed to the proposed activity. Besides using compliance with air quality standards under the relevant air protection legislation, impacts of the released gases can be assessed by comparison with the magnitude of potential releases during decommissioning with the magnitude of releases of the same or similar gases from other sources at the site or in its surroundings.

The potential conventional adverse impacts on air quality include:

- Degradation of air quality caused by emissions (e.g., NOx, CO, and hydrocarbons) from internal combustion engines;
- Increased particle loading of the atmosphere caused by the movement of vehicles and equipment, demolition of structures, dismantling of systems and operation of concrete batch plants;
- Alteration of other characteristics of the atmosphere (e.g., the ozone layer) by releases of gases used in plant systems (e.g., in fire suppression or refrigeration).

Regarding potential accidents, the most significant impact on the atmospheric air during decommissioning activities is expected in case of explosions and fire, failures of installations and ventilation and filtrating systems in particular. As a result of these accidents it is possible that some gas emissions and aerosols will be discharged, including radioactive emissions, which will depend on the type and scale of the accident. During decommissioning process different hazardous, toxic and explosive substances are used. Leakages, evaporations, spills and fires may occur. In case of earthquakes destruction of buildings is not expected so there is no risk of radioactive aerosols release. The impacts will be temporary and local until gaining of control over the accidents.

4.1 Radiological impacts

Potential radiological impacts on air quality are due to the gas emissions of waste air contaminated with radionuclides. It must be considered that many activities that take place during decommissioning (including decontamination of piping and surfaces in order to reduce the dose to nearby workers, removal of piping or other components, such as pumps and valves, and even larger components, such as heat exchangers) are similar to those that are carried out during normal operations and maintenance activities. However, some of these activities, such as removal of the reactor vessel or demolition of facilities, would be unique to the decommissioning process. Those activities would have the potential to result in exposures to workers who are close to contaminated structures or components, and to provide pathways for release of radioactive materials to the environment that are not present during standard operation.

It can be expected that there is increased leakage of these substances since the first stage of handling with radioactive materials during their retrieval from the places of their origin as well as during their shipment to the new storage sites. Dust, aerosols and gases arising in the process of dry fragmentation of materials and low pressure compaction of solid RAW will be exhausted and cleaned by the existing ventilation systems of V1 NPP.

Activities associated with the decontamination and dismantling of technological equipment and buildings will increase the humidity or dustiness of the environment (according to the decontamination method) and the content of radioactive aerosols in the air of working areas.

Majority of decommissioning activities will be carried out in the indoor spaces of the existing V1 NPP buildings. Since release of radioactivity during decommissioning activities carried out indoor can be expected the exhausts will be collected and controlled as to keeping the limits defined for emissions into the atmosphere. Exceeding these limits is not expected even in non-standard scenarios.

4.2 Impacts of non-radioactive character

In general, a nuclear power plant is not a significant emitter of conventional air pollutants such as NOx, SOx, CO_2 and solid particulates which could impair or significantly change the existing immission situation. According to this, non-radiological impacts of the 2nd Stage of V1 NPP decommissioning on air quality, due to gas emissions containing common pollutants, has been assessed as negligible.

The principal air quality impacts will arise from combustion engines emissions (from motor vehicles operated for movement on-site and transportation of people and materials to and from the site) and emissions of solid pollutants and PM_{10} from point and surface sources into the atmosphere or due to secondary dust.

Solid pollutants and PM_{10} will represent the most significant pollutant in the atmosphere, emerging from activities like demolition, fragmentation, landscaping and, in particular, from construction waste recycling by shredder. Considering the dispersion conditions, the existing immission situation and the overall vulnerability of the environment no significant deterioration of air quality is expected due to the activities of the 2nd stage of V1 NPP decommissioning.

The total impact on air has been assessed as adverse, short-term and, as to its extent, small impact.

All regulations of the Slovak legislation[13] on air quality in respect to demolition of buildings and other activities generating dust will be abided by. Moreover, specific mitigation measures will be adopted in order to reduce this adverse impact, in particular in respect to any such activities that present a major risk of increase of dust emissions into the air.

5. Impacts on water conditions

Potential impacts on water quality related to the proposed activity can be due to intended and accidental releases of non-radioactive pollutants and liquid RAW into surface water and groundwater. Water quality impacts during the 2nd Stage of V1 NPP decommissioning process can derive from demolition works and certain operational activities, such as sanitary sewer operations.

Impacts on hydrology and hydrogeology could be related, besides the quality of surface and groundwater, also to water sources, the hydrological regime, aquatic habitats.

Performance of the proposed activity will be accompanied by generation of sewage and rain water in volumes corresponding to the area and the number of employees. Before being discharged to the recipient (the Dudváh River for rain water and the Váh River for sewage water), sewage wastewater is treated at the mechanical and biological wastewater treatment plant of V1 NPP. Effectiveness of wastewater treatment is and will be monitored in order to ensure observation of permitted limits for content of polluting substances.

The recipient of technological wastewater is the Váh River. Wastewater is discharged into the Váh River after being treated at the treatment plant for active wastewater (building 41, 800) until the required activity level is reached and monitored as to the content of tritium. The potential risk of water contamination as a result of non-standard operating conditions will be prevented by the design of the operating premises (sealed joints between floors and walls, water-proof floors and walls up to a reasonable height, sloped areas conducting to the active sewer system) and by

[13] Act No. 137/2010 Coll. on Air; Act No. 318/2012 Coll. on Amendments and Supplements to the Act No. 137/2010 Coll.

procedures forming part of the approved operational regulations and the emergency plan.

Presently, it is concluded that underground water at the V1 NPP site is contaminated in the fiest water-bearing layer by tritium (area between the buildings 800 and 803) and it is also presumed that there are sewage system leakages and leakages from technological systems, tanks and the spent fuel storage pool in the building 800. In this sense, a positive impact on groundwater will be brought about thanks to demolition and removal of building 800..

As it may be seen from the presented assessments, the biggest exposure owing to radioactive discharges to the water of the 2nd Stage of V1 NPP decommissioning is expected at the beginning of decommissioning process. In later years, doses will decrease and will not exceed the limit value.

The impact of four radionuclides (Fe-55, Co-60, Cs-134 and Cs-137) dominates the annual radiation dose due to liquid discharges into the environmental water during the 2nd stge of decommissioning. The rate of other radionuclides in the annual radiation dose is insignificant. Trans-boundary impact is not expected.Radiological impact of discharges into the recipients during the 2nd stage of V1 NPP decommissioning is extremely low compared with the individual limit of the annual effective dose pursuant to safety regulations for NPPs.

In conclusion, a short-term adverse impact on surface water can be identified, which we consider as of small extent, and a long-term positive impact on groundwater, which we also assess as of small scope (local).

6. Impacts on soil

A direct impact due to occupation of land has not been identified.

It must be pointed out that the 2nd Stage of V1 NPP decommissioning will be located almost completely within the existing buildings of the plant, so that there are no requirements to occupation of land beyond the area of the site. The most important new facilities will be located in existing buildings, in particular as follows:

- New large capacity fragmentation and decontamination facility, in the V1 NPP Reactor Building,
- Existing fragmentation and decontamination facilities, as well as the new remelting (decontamination) facility, in the A1 NPP Turbine Hall.

The proposed activities will not affect directly the quality of soil in the affected area. What comes into question is only an indirect impact (through air, surface water and groundwater). It is presumed that this impact will be negligible if all set emission limits are satisfied. As far as potential impacts due to contamination by common polluting substances are concerned, it can be expected that, under standard operational conditions, the decommissioning technology will not represent a source of common polluting substances in an extent that would cause a risk of soil contamination. The potential risk of contamination as a result of non-standard operating conditions of common nature, such as transport (e.g. oil or gasoline leakage from motor vehicles into non-reinforced soil) can be solved by common remediation works.

An adverse impact owing to radioisotopes on soil in the vicinity was not detected during NPP V1 operation, and is not expected during decommissioning activities either.

In total, a short-term indirect adverse impact on the surrounding soil of a very small extent has been identified.

7. Impacts on flora, fauna and their biotopes

No relevant environmental impacts from decommissioning activities on plant and animal species in the surroundings of the V1 NPP site or their habitats are expected.

The V1 NPP site has been part of an industrial complex operating at the Jaslovské Bohunice location for decades. This nuclear complex is surrounded by a rural countryside with predominantly agricultural use. According to this, the expected occurrence of fauna and flora is related to species residing on the edge of human settlements with anticipated poor species diversity.

The impacts of the assessed activities on biodiversity are not direct, but mediated by abiotic components of natural environment.

Up to now, no impact of changed radiation situation on the biodiversity in the affected area has been registered. The proposed activity is especially aimed at removal of existing and potential sources of contamination of natural components of the environment by radioactive substances and at improvement of the overall radiation situation in the surroundings of V1 NPP. From this point of view, the impact of proposed activities on biodiversity is positive.

Regarding flora, the principal effects are likely to be due to the emission of particles during the works and subsequent deposition on the land and leaf surfaces. As to the fauna, effects on the habitats and/or behaviour of certain species may be caused owing to increased noise levels and also changes in flora (food plants). As mentioned above, the 2nd Stage of V1 NPP decommissioning will be located almost exclusively within the existing buildings of the plant so that the impact on biodiversity is considered as negligible.

8. Impacts on landscape

The proposed activity will partially influence the structure and usage of the landscape. By demolition of the decontaminated building structures some anthropogenic landscape elements will be physically eliminated and by the landscaping to follow the functional usage of the territory will be changed as well. Partially, also the scenery and visual perception of the conditioned terrain in the assessed territory will change. A so called „brownfield“ area will emerge, that is to say, an area which is not ideal from the point of view of a rational usage of the territory potential. The affected area will constitute a territory of reduced quality since possible future usage will be limited.

Nonetheless, the anticipated impact of the assessed activity on the structure and usage of the landscape and the scenery can be considered as positive and temporary until the released "brownfield" area changes into a space with new anthropogenic landscape elements. The temporary positive impact will cease also in case of no usage of the territory in the long term.

9. Impacts on protected areas and their protection zones

Considering the fact that in the affected area there are no protected trees or protected areas according to the Act No. 543/2002 Coll. on protection of nature and landscape, as amended, or any biotopes of national importance, biotopes of European importance or protected water management areas pursuant to the Act No. 364/2004 Coll. on waters, the assessed area will under this perspective have neither positive nor adverse impacts on the mentioned types of areas. Similarly, impacts on the Little Carpathians Protected Landscape Area, protected sites, nature reserves or nature monuments located in the broader surroundings of the affected area are not expected either.

The protected bird territory Špačinsko – nižnianske (SKCHVU054) spreads into the affected area. The site itself in which the proposed activities will be implemented is not situated in this protected bird territory. During implementation of the proposed activity no adverse impacts on the mentioned area of NATURA 2000 are expected. By changing the functional usage of the territory prerequisites for emergence of new biotopes are created which can be suited well for some bird species flying by from the protected bird area. Such influence can be assessed as positive and of small scale.

10. Impacts on the territorial system of ecological stability

The assessed activity is not expected to cause any significant change of the ecological stability of the affected area. The ecological stability is already by now on a low level and ecological balance is maintained by targeted human interference. The affected area is in the state of balance referred to as the so called tertiary homeostasis, in which the state of balance is formed by mutual action of natural processes and anthropogenic activity, while the influence of human activity is notably stronger.

Direct impacts on the elements of the territorial system of ecological stability of local and regional significance in the affected area are not expected. A more significant positive impact on the total ecological stability of the territory can be anticipated in form of a secondary change of the territory utilisation since the primary stress factor, which significantly contributes to reducing the level of ecological stability, will be eliminated.

11. Impacts on urban complex and land use

Land required for the implementation of the proposed activity makes up for only a part of the total area of the energetic complex. Therefore, no impacts of the proposed activity on land occupation and the urban complex are expected.

12. Impacts on cultural and historical landmarks

Considering the type and extent of the assessed activity no impacts of the proposed activity on cultural and historical landmarks are expected.

13. Impacts on archaeological localities

Considering the type and extent of the assessed activity no impacts of the proposed activity on archaeological localities are expected.

14. Impacts on palaeontological localities and significant geological sites

Considering the type and extent of the assessed activity no impacts of the proposed activity on palaeontological localities and significant geological sites are expected.

15. Impacts on intangible cultural values

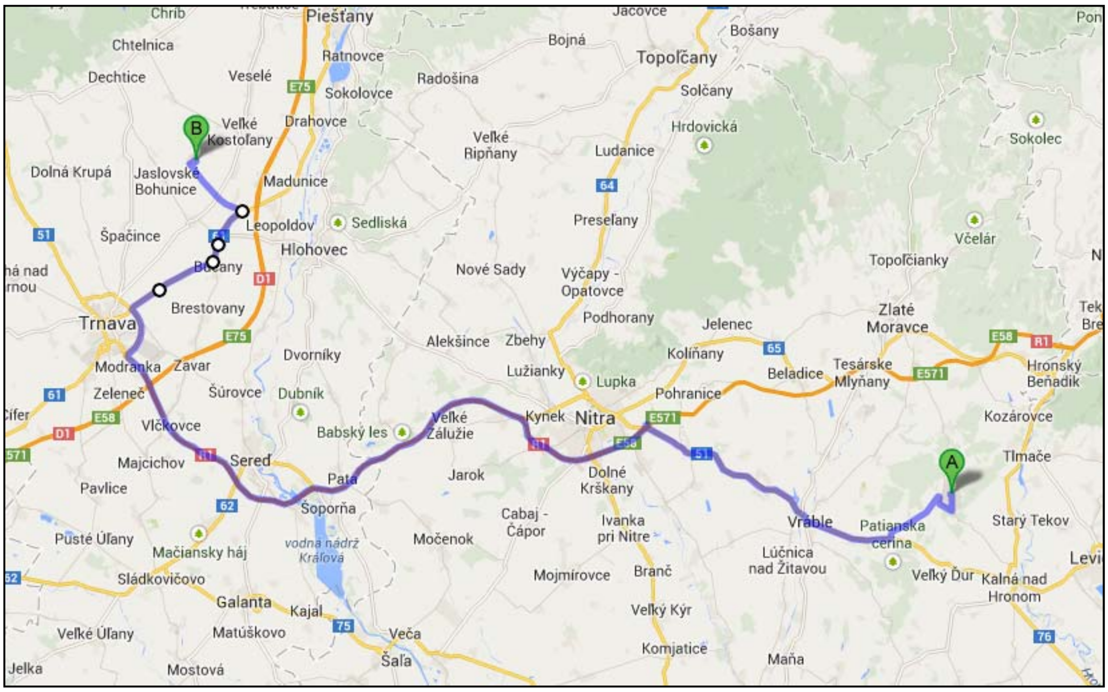
Considering the type and extent of the assessed activity no impacts of the proposed activity on intangible cultural values are expected.

16. Other impacts

16.1 Impacts on transport

Increased movement of transporting and constructing vehicles can be expected during the 2nd Stage of V1 NPP decommissioning, which will be significant mainly at the V1 NPP site and its immediate surroundings since the existing land communications are to be used. Increase of road transport in connection to the RAW transport in FCC will not be of significance for the anticipated number of expeditions is appr. 1,000 – 1,500 over 8 - 10 years, what means max. 16 transports per month. The transport route from Jaslovské Bohunice to Mochovce is shown on the following map.

Graph No. 82. RAW transport route from Jaslovské Bohunice to Mochovce



16.2 Impact of RAW transport on the inhabitants

Risks connected to transport of RAW to Mochovce have been assessed in an independent risk analysis in which the following results have been obtained.

The collective effective dose to which the public can be exposed through all standard transportations during the whole V1 NPP decommissioning process is provided in the following table.

Tab. No. 32. Collective dose during standard transport (manSv)

Truck crew	**Apart from the route**	**On the route**	**During stops**	**Total**
3.50E-02	9.55E-04	5.56E-03	3.41E-02	**7.55E-02**

In addition, maximum individual dose due to transport of RAW has been calculated maximum individual dose during transport amounts to 4.68E-06 Sv.

The following table summarises the anticipated emergency risks defined as consequences of emergency situations (dose or exposition) and their probability.

Tab. No. 33. Expected exposition values due to emergency situations manSv

Ground	**Inhaled**	**Resuspended**	**CLOUDSH**	**Total**
8.66E-09	1.61E-11	6.90E-11	5.06E-13	8.74E-09

On the basis of model calculations on INTERTRAN-2, the impact on inhabitants is determined by a calculated maximum dose of 4.68 microSv for the total transportation activity (over several years).

From the said above it follows that, after taking into consideration the internationally accepted limit dose, which is on the level of 1 mSV/year (1,000 microSV/year), the impact on the health of inhabitants can be considered as negligible.

16.3 Impacts on waste management

Adverse impacts on waste management (regarding conventional waste) are not expected in spite of generation of significant amounts of conventional waste since a significant part of this waste belongs to the category "other waste" with high potential of material recycling. Moreover, almost all reusable waste originating from buildings will be used at the place of its origin - on the site itself for backfilling, by which demand on natural materials from other areas will be reduced significantly. Requirements to disposal of waste are not notable. It is also of benefit that ferrous and non-ferrous metal waste will be used as secondary raw materials, which is in accordance with the principle of sustainable development in the sphere of waste management.

An adverse impact on waste management has not been identified.

17. Spatial fusion of impacts of the activity in the area

Anthropogenic load out of the proposed activity consists to a great extent in discharges of ionising radiation and of radioactive waste (RAW). Model calculations on spreading of this contamination have shown that the load, expressed as the effective dose to a representative member of population, caused by RA substances will be far below the set limit.

The set limits which express the maximum possible load to inhabitants in the surroundings of NPP due to cumulative impact (i.e. contributions of all radiation sources within NEC Bohunice - V1 NPP, V2 NPP, RWTC and ISFS) show that the load, expressed as the effective dose to a representative member of the public, caused by RA substances originating from V1 NPP decommissioning amounts to a rate of ca. 24 %. The proposed activity, hence does not, even under conservative approach to the assessment, constitute the major source of radiation load in the affected area, and, in short term (max. during 10 years of decommissioning), cannot influence the total radiation situation in a significant manner, while, in the long term, it can bring about its improvement.

The contribution to the total radiation is in comparison to the present state of the radiation situation in the given area on a very low level and in comparison to the operations of the neighbouring nuclear facility (V2) it is insignificant.

RAW will be released into the environment after reaching the release levels of activity.

The proposed activity has been assessed as to the anthropogenic load in regard to the zero alternative and the load to inhabitants caused by discharges from the 2nd stage of decommissioning and has been also assessed as cumulated radiation impact. The anticipated anthropogenic load on the territory by ionising radiation, expressed as effective dose is very low and fulfils the limit values with considerable margin. The strongest impact is anticipated within 100 m from the main source - DC 72 while the dominant contribution is effected by the operation of V2 NPP.

Another output, significant in respect to the radiation load, are RAW the majority of which remains stored under due supervision in the IS RAW at the Jaslovské Bohunice site and a small part shall be transported to the NRR Mochovce. A total transport volume of ca. 1,000 FCC is expected.

A new load on the territory will in short term (during 8 years) represent the transport of RAW to the NRR Mochovce, however, with a frequency of ca. 16 rides a month the load is not significant.

The storage of RAW as such, either in IS RAW or in the NRR Mochovce will still cause anthropogenic load although it will be considerably lower than the load of untreated RAW or the load that V1 NPP would cause if left in the state upon termination of the 1st Stage of decommissioning.

Regarding the spatial synthesis of positive effects of the proposed activity it needs to be pointed out that the most significant long-term benefit for the population living in the surroundings is the reduction of risks (increase of safety) connected to the existence of NPPs in the territory. Even though these risks have been smaller since V1 NPP shut-down they would remain in the locality as an unsolved long-term problem.

Elimination of the groundwater contamination source with tritium at the V1 NPP site also represents a positive impact on the environment.

A positive impact has been effected also by gradual reduction of water, energy and raw material consumption and, in particular, of pollutant emissions into the atmosphere and hydrosphere.

Socio-economic impacts will also manifest themselves in the territory and represent, considering the current situation with the V1 NPP operation terminated and the 1st Stage of decommissioning practically as well, at least partial and temporary preservation of employment, especially among workers with special qualifications, experience and routine in the given work sector. From long-term perspective, the usage of the territory for new industrial activities can be anticipated even if allowing for considerable uncertainties.

A significant positive impact is expected in the socio-economic context on national level because:

SR will fulfil its obligation towards the EU to which it committed itself in the framework of negotiations on the accession of the SR to the EU

SR will use finances from the Bohunice International Decommissioning Support Fund

18. Complex assessment of anticipated impacts in terms of their significance and their comparison with legal regulations in force

Based on the assessment of all outputs of the activity and under consideration of the condition of environment into which these outputs will be discharged it can be stated that they observe the valid legal provisions of SR and are in keeping with limit values established in the given sector by legal provisions.

In order to evaluate the extent of the individual impacts, a five-grade verbal and numeric scale has been applied:

- very high impact (5)
- high impact (4)
- medium impact (3)
- low impact (2)
- very low impact (1)

Significance of impacts has been assessed in respect to the vulnerability of the individual environmental units and their respective resilience/loading capacity. The most important criterion for the assessment of the impact significance have been the valid limit values, established by legal provisions or recommended by respected experts, and the present environmental capacity of the individual environmental units resulting thereof. In other spheres in which limit values are not applicable since they are not established by legal provisions, estimations and expert opinions and experience obtained in assessing similar activities have been used. Annex 17 provides the axamples from NPP decommissionig in other countries.

19. Adverse impacts from the point of view of their significance in respect to the individual environmental sections

19.1 Air

The impact of the activity on the quality of communal air is assessed as of little significance on the basis of the following reasons:

The activity is not a significant source of emissions of the basic polluting substances

Vulnerability of air is relatively low - set air protection limits are not exceeded, the affected area does not belong to a special air protection area

Gaseous RAW can be released into the environment only upon reaching the set activity release level

V1 NPP decommissioning is not the primary source of air pollution by RA substances in the affected area and it will not have a significant impact on the present state even in case of a cumulative effect

There will be no significant change of the present air quality in any parameter.

19.2 Soil and rock environment

The impact on soil is assessed as negligible due to the following reasons:

There will be no new occupation of land

Hygienic condition of the soil cannot be affected by the planned activity which is designed for relatively short period ca. 10 years

Outputs of the proposed activity will, under consideration of all technical and technological mitigation measures, not affect the present condition of soil and rock environment

The natural activity of soil and rock environment is, in comparison with the outputs from the proposed activity, so high that the contribution of the proposed activity can be considered as negligible

The activity does not generate emissions that would contribute to acidification of intoxication of soil

The activity represents a partial elimination of a contamination source of the rock environment

19.3 Fauna and flora

Insignificant impacts are anticipated in respect to:

Negligible outputs of the proposed activity which will practically not change the current condition of the environment

There will be no occupation of land, cutting of trees or destruction of biotopes

The planned activity does not produce emissions of typical polluting substances affecting flora (mainly SO_2).

19.4 Surface water and groundwater

Surface waters and groundwater in the affected area will not be, in comparison to the present state, adversely influenced by the planned technical and technological measures. Contamination by typical pollutants is excluded since it is prevented by protective measures; pollution of waters by discharges of RAW into hydrosphere is managed and supervised and, considering the present margin left to the limit values, a notable change of the situation is not expected. Impact on waters is assessed as of little significance.

19.5 Waste

The proposed activity will generate a relatively big amount of RAW and conventional waste. According to presumptions, it will be possible to release into the environment up to 90 % of the total waste generated in dismantling and fragmentation of V1 NPP, even with a high potential of its reuse, use as secondary raw material or other type of recycling. The impact of waste on the environment is assessed as of medium significance due to the following reasons:

Generation of a big amount of RAW and conventional waste with high potential of reuse and recycling

Treatment of wastes will ask for material and raw material input and generate outputs into the environment

Capacity of treatment, interrim storage and final storage of RAW to be generated has already been ensured

Only a small part of RAW requires conditioning and disposal at the National RAW Repository

No significant requirements to usage of capacities of existing facilities for recovery and disposal of conventional waste have been identified

19.6 Landscape

Impacts on landscape are assessed as insignificant for structure and utilisation of landscape, scenery and territorial system of ecological stability will not change; neither will the assessed activity affect cultural and historical monuments, structure of settlements, architecture, local traditions or existing economic activity.

Landscape protection will be not affected in the context of national or European interests.

19.7 Population

Adverse impacts on the population are assessed as of medium significance due to the following reasons:

Compared to the present situation, local emissions of radiation character into the atmosphere and hydrosphere can be expected during the 2nd Stage of decommissioning, however, within the set limits, and health risks to the affected inhabitants are not to be expected as a result from radiation exposure, even in non-standard situations in course of the implementation of the proposed activity

The total radiation load on the inhabitants cannot be significantly influenced by the proposed activity as it is not the dominant source of radioactive pollution of the environment in the affected area and its quotient, established under conservative assumptions, makes up for less than 1/3 of the total radiation load originating from NEC Bohunice

Model calculations executed for the worst case scenario allowing for break-downs during RAW transport to Mochovce have shown that the set limits would be kept with a considerable margin

Max. values of the effective dose due to dispersion of RAC originating from the proposed activity into the atmosphere and hydrosphere are significantly lower than 20 μSv/year (current limit value established for V1 NPP by competent healthecare authority - UVZ SR).

19.8 Positive impacts on population

The assessed activity is designed to eliminate the present environmental load which emerged upon V1 NPP close-down and performance of activities within the 1st Stage of decommissioning. The 2nd Stage represents a continuation of decommissioning activities aiming at removing this load from the area and enabling its further use. The significance of the positive impact consists in removal of hazards connected to the existence of the unused NPP and the untreated RAW in the area and some socio-economic relations. Positive impacts on the population are considered as of medium significance due to the following reasons:

- Quality of life will be increased in connection with increase of safety in the affected area
- In the horizon of 2014 – 2025, the employment rate will be partially maintained in JAVYS and demand for external work force will be created
- For works in the affected area, finances from European funds will be used
- Conditions for a new industrial activity in the affected area will be created, thus generating potential for employment increase in future.

20. Operational risks and their potential impact on the area

Requirements as to the safety are defined in the following legal provisions:

- Activities resulting in irradiation may be carried out only under fulfilment of the Act No. 355/2007 Coll. and only upon approval by ÚVZ SR. One of the conditions states that the premises in which the activities are executed is a so called controlled zone.
- Organisations may release radioactive substance from administrative control, whether as emissions of exhales into the atmosphere or discharge of radionuclides in wastewater, only upon a decision by ÚVZ SR, by which this authority grants the organisation a permission to release RA substances from administrative control. Any such decision by ÚVZ SR, either as approval of an activity causing irradiation or as a permission of release of RA substances from administrative control, will be granted to an organisation only upon examination by the ÚVZ SR of the ability of the organisation to observe requirements of nuclear safety (i.e. respective capacity of its equipments and personnel).
- From the point of view of nuclear safety, equipments will be assessed pursuant to the Regulation of ÚJD SR No. 430/2011 Coll. on requirements to nuclear safety. It is anticipated that the collector tank of the decontamination line will be classified as a facility in the safety category III.
- Projecting, mounting, commissioning and operation must take into account, apart from risks connected to nuclear and radiation safety, also the requirements of the Act No. 124/2006 Coll. on safety and health protection at work and on alternations and amendments to some Acts.
- In addition, the Proponent must assess and classify all supplied equipment components according to the Regulation No. 508/2009 Coll. on establishment of details for securing safety and health protection at work with technical equipments - pressing, heaving, electric and gas - and on definition of technical equipments considered as restricted technical equipments. Production, installation, maintenance and operation of equipments as well as documentation and instructions for operation and maintenance must be in full accordance with the legislation mentioned above.

JAVYS a.s. has presently at its disposal an Internal Emergency Plan (VHP) drawn up for the 1st Stage of V1 NPP decommissioning pursuant to the Regulation of ÚJD SR No. 55/2006 Coll. on details of emergency planning for cases of accident or breakdown, in which it has exactly defined the potential operational hazards. Principles of this VHP are with small modifications applicable also to the 2nd Stage of V1 NPP.

Potential operational hazards are described in the following paragraphs.

20.1 Fire - explosion

During the 2nd Stage of V1 NPP decommissioning oxygen - acetylene cutting and welding devices will be used. Similarly utilisation of propane heaters for heating some of the working areas cannot be excluded. Occurrence of flammable liquid rests (diverse oils, lubricants, mineral oil etc.) in some parts of technological systems also constitutes a risk of fire generation in course of dismantling and fragmentation by heat, but also some mechanical methods.

Neither can be excluded overheating of electrical circuits and development of fire resulting thereof.

20.2 Accidents due to usage of electric energy

The variety of decommissioning activities to be carried out during the 2nd Stage of V1 NPP decommissioning implies a big variety of applied dismantling and demolition techniques. Since many of these equipments will require electrical energy supply overloading of parts of electrical circuits cannot be excluded.

With the progressing works at the individual buildings interference into the existing electrical wiring at V1 NPP will be necessary. With such operations in course a risk of erroneously disconnected or, on the contrary, connected electrical circuits at V1 NPP cannot be excluded.

20.3 Biological and chemical - hazardous substances

Biological hazards due to viruses or bacteria are not relevant in the decommissioned V1 NPP buildings (which is the case in laboratories using ionising radiation for research purposes), but some biological organisms must be taken into consideration which, under certain circumstances, may cause relevant operational events, such as corruption of insulation of electric wires by rodents, subsequent fallouts of electric supply and air technical systems.

Usage of different chemical substances, mainly in decontamination activities and conditioning of waste represents a risk of their leakage into the environment in case of failure of preventive protective measures. However, this risk can be easily eliminated by technological procedures, organisation of work and technical measures.

20.4 Deficiencies and breakdowns of ventilation systems

The individual dismantling and demolition decommissioning activities will be performed in premises with different possibilities of natural and artificial ventilation. In particular in case of restricted space and usage of heat cutting methods and techniques or during grinding works risk of insufficient ventilation is significant (e.g. in pipe channels). A fall-out of power supply of air technical facilities also represents a relevant risk.

20.5 Organisation of works - human factor

A contribution of human factor in the emergence of operational events cannot be excluded. Pro-active measures reducing the influence of human factor consist in:

- Observance of working provisions and procedures,
- Execution of initial and repetitive trainings, including verification of their validity,
- Introduction of double checks of work procedures in certain spheres.

While radiation and nuclear safety is observed in the operational NPP in full extent, at times, the traditional industrial safety culture is not fully recognised (wearing of a protective hat out of the CZ and at the NPP site, no marking of slippery surfaces due to cleaning with a clear "No entry" sign, no supporting on the hand railing when walking on the stairs).

If work procedures under the given decommissioning activities are not elaborated in sufficient detail and with sufficient precision situations may occur which are not envisaged in the given work procedure.

20.6 Natural and other disasters

20.6.1 Earthquake

In course of V1 NPP reconstruction a seismic reinforcement of V1 NPP technological facilities was carried out up to 8° of the MSK-64 scale. According to the Report on the Environmental Impact Assessment of V1 NPP Decommissioning" elaborated in the framework of the Project B6.2, values of macro-seismical intensity of 6° to 7° of MSK-64 scale with a return period of 475 years have been calculated. Nonetheless, a possible earthquake in course of V1 NPP decommissioning represents a hazard in respect to the partially demolished high-rise buildings, tall construction machines, excavated construction pits etc.

20.6.2 Floods

V1 NPP buildings are not under a direct influence of static and dynamic effects of overflows and floods in the surrounding water streams and water reservoirs. Protection against floods caused by rainwater from the surrounding terrain in case of especially intensive precipitations is provided for by means of a draining channel excavated along the western side of the site where percolation of water from the surrounding area during rain storms was strongest. In objects inside NPP only premises below the terrain level are under threat when sewage system fails owing to strong rainfall. Rain sewage system which drains water from building roofs, communications, reinforced surfaces and drainage systems of the factory railway in the build-up area of NPP and the adjacent terrain has sufficient capacity to drain rain from a 100-year storm. In case of its local failure (obstruction of an outlet) water can run from adjacent surfaces and roofs, through untight entry doors and various mounting openings at or below the ground level, through entries into cable and pipe channels and by back-flow through sewage system inlets in case of overfilling or obstruction of the sewage collector, into one of the buildings from where it should be drained by industrial or sewage canalization. The degree to which a concrete object is under such risk depends on placement of technological equipment and electrical wiring on the lowest floors and the possibilities of drainage or emergency pumping of the flown-in water.

20.6.3 Airplane crash

Any air corridors (apart from the corridors A4 and W34) are spatially separated from the protected airspace P39. Air corridors A4 and W34 are situated spatially above the NEC complex. Air operation in the military training airspaces R89 and R90 is characterised by free movement of military airplanes without prescribed air corridors, except for starting and advancement operations, which are, though, in a distance of more than 4 km from the NPP locality.

20.6.4 Extreme temperatures of the surrounding environment

Expected extreme values (obtained from the neighbouring meteorological stations) of the most common meteorological features, air temperature and precipitations, in Jaslovské Bohunice area were in the last century as follows:

- Absolute maximum temperature 38.0 °C,
- Absolute minimum temperature -30,0 °C,
- Highest annual precipitation average 830 mm,
- Maximum height of snow cover 60 cm.

No serious risks connected to extreme temperatures at the NPP locality are expected during V1 NPP decommissioning.

20.6.5 Storm and adverse climatic conditions

Maximum wind force recorded in an observation period of 10 years reached the value of 32.6 m/s from the NW direction. In the Danube Basin, hurricanes and tornadoes do not occur and the Jaslovské Bohunice site classifies as II. wind region on the state territory with an ultimate wind pressure Wo of 0.45 kN.m^2.

A possible effect of storm activity (in particular in case of a lightning strike into V1 NPP electric distribution lines) is overloading of V1 NPP electrical circuits with a following disruption of energy supply of V1 NPP equipments and systems a contemporary failure of back-up supply systems start-up.

20.6.6 Explosions and fires in the surroundings

In a zone of 10 km from the JE V1 site, there are transport routes for substances which are of explosive and/or flammable character. These are the following pipelines:

- A transit gas pipeline from RF to Western Europe,
- VVTL gas pipeline from the distribution hub in Špačince to Nové Mesto nad Váhom,
- International gas pipeline „Brotherhood“ (RF-SR-CZ),
- Považský pipeline Bratislava – Trnava –Trenčín,
- Two parallel oil pipelines and product lines with the pumping station in Bučany crossing the Váh River between Hlohovec and Leopoldov.

Analyses of a possible explosion show that in case of a complete rupture of the transit pipeline (DN 1200, 1400) with a following gas explosion on two burst pipes a territory up to 1.8 km would be under threat depending on the speed of valve closure and the momentary amount of transported gas. Damages on the DN 500 pipe would put under threat a territory of ca. 0.4 km. A fire on the oil pipeline would in case of a respective wind direction cause occurrence of smoke at the site. A transfer of fire over the fields is not considered as probable.

Explosion and fire risks in the surroundings of the V1 NPP site have been, on the basis of the executed analyses, assessed as not relevant in respect to operational events.

Apart from the mentioned pipelines, a new steam-gas power plant is in operation in the cadastral territory of Malženice. This risk is not relevant from the point of view of the planned activities and operational events since the construction of the plant was subject to permissions by the responsible authorities, including the obligation to demonstrate that nuclear safety of NEC Bohunice will not be impeded.

20.6.7 Corruption of physical protection of the plant

During the operation of a NPP it may occur that a person wilfully commits an act against the nuclear facility, causing a direct or indirect threat to life and health of people or to the environment. Such an act can be committed by an alert message claiming danger in the guarded area, a threat in the premises important in terms of safety, or the intruder can enter the NPP site in order to obstruct its safety.

20.6.8 Terrorist attack

Possible types of terrorist attacks range from an air missile attack, an airplane or helicopter airdrop to a sabotage action by a small group of attackers. The plant is equipped for attacks of such extent with defence forces - BS (security service) and ZJ PZ (response group of police force).

20.6.9 Accident at another NPP

A radiation event at A1 NPP, RWTC, ISFS, V2 and SE-EMO emerges in case of increased activity in the area and in the premises of NEC with unknown internal causes - they are addressed by the VHP in mutual correlation.

JAVYS, a.s. will elaborate a new Internal Emergency Plan (VHP) for the 2nd Stage of decommissioning. This document shall provide for personal, technical and documentary background of JAVYS, a.s. personnel and workers of other suppliers of V1 NPP in respect to the implementation of the planned measures, while focus shall be put on:

- Reduction of risks or mitigation of consequences of an V1 NPP event to equipments, employees and inhabitants directly at their origin.
- Prevention of serious health damages (e.g. death or serious injury).
- Reduction of risks of stochastic effects on human health (e.g. cancer or serious hereditary effects).

IV. Proposed measures to prevent, eliminate, minimise and compensate impacts on the environment and health

1. Physical-planning measures

In the framework of territorial planning no measures are required.

2. Preventive measures

The most significant preventive measure will be complex and effective radiation protection which is to prevent occurrence of harmful radiation effects on human health and delimit the probability of stochastic effects to an admissible level. The main target, therefore, will be to secure effective radiation protection in two ways:

1. By detailed planning of technical measures in order to secure radiation protection
2. By preventive supervision (control of submitted project documentation).

Providing of protection of workers and inhabitants from adverse effects of ionising radiation will be basically carried out by implementation and combination of the following principles:

- Elimination/minimising of workers' presence in the reach of hazardous radiation fields.
- Provide for the biggest possible distance of the recipient from centres of radiation fields.
- Ensure the shortest possible presence of persons in the reach of radiation fields.
- Build up passive protection out of shielding material between the workers and radiation field centres.
- Ensure sufficient ventilation (change of) air at working stations with effective air. filtration
- Provide for due organisation of works by means of operational provisions and procedures and a work and emergency plan in the work area.

2.1 Technical and technological measures

The technical and technological measures will be based on the very project proposal for the individual activities and will be designed as to offer sufficient resistance against any operational strains and to prevent leakage of radioactive substances out of the working areas into the environment. Technical measures are provided within the description of the technological design of the proposed activity in the chapter B. II.8.

It will be also of importance to ensure sufficient capacities of suitable technical and technological equipment for execution of fragmentation and decontamination works. Presently, a separate assessment procedure on the construction of a new large-scale fragmentation and decontamination facility V1 NPP is in progress, which assesses in detail the effects of this activity on the environment and provides all measures for mitigation of adverse impacts on environment and human health.

Another significant measure will consist in building-up sufficient RAW storage capacities. This task has been paid increased attention and it is approached by several projects oriented at the preparation of IS RAW in Jaslovské Bohunice (this activity has been subjected to a separate assessment) and enlargement of NRR Mochovce. Completion of these tasks will provide a sufficient capacity for storage and final disposal of RAW produced during 2nd Stage V1 NPP decommissioning.

2.1.1 Measures to prevent radioactive releases into the atmosphere

A critical issue during the 2nd Stage of V1 NPP decommissioning activities will be to minimise and control the airborne contamination, using different minimising measures. These measures will allow for the following approaches:

- Dismounting methods shall be preferred to cutting methods for dismantling of contaminated components and equipment. In respect to highly contaminated components, cutting methods with high potential of spreading of contamination must be completely excluded.
- Barriers for contamination confinement shall be installed.
- Work places with significant risk of airborne contamination (above 50 Bq/m3 beta-gamma radiations) shall be equipped with an air exhausting system.
- Vent lines from tanks containing radioactive liquids should be connected to the ventilation system for contaminated air with exhausts upstream of the filtration equipment. This will minimize both in-plant airborne activity and plant releases into the atmosphere.

The main measures envisaged for minimization of emissions into the atmospheric environment during decommissioning are based on Heating, Ventilation and Air Conditioning (HVAC) systems, which are of the same type as the systems used during operation.

These systems are designed to create suitable hygienic conditions for personnel and equipments, prevent contamination from spreading, provide air filtration, monitoring and discharge of air contaminated by radioactive aerosols in an organized manner, etc.

The HVAC systems are divided into inlets (supply of fresh air and heating of areas by warm air) and outlets (room ventilation and forced discharge of air that could be contaminated by radioactive aerosols through the filtration stations to the ventilation stack).

Other supplementary ventilation systems increasing the overall system efficiency could be added in the course of the 2nd Stage of V1 NPP decommissioning process (e.g. during dismantling or mechanical decontamination). Such units shall be connected to the general plant ventilation system or shall be provided with pre-filters and HEPA (High Efficiency Particulate Air) filters, as well as air absorption, in order to minimise and to control the gaseous effluents to the environment.

2.1.2 Measures to prevent radioactive releases into surface water and groundwater

The main measures envisaged for minimization and reduction of emissions to the hydrosphere during the 2nd Stage of V1 NPP decommissioning are based on three separate sewage systems for rain water, sewage wastewater and low-level radioactive wastewater.

Their objectives are mainly to trap any liquid radioactive substances, generated both in planned decommissioning operations or non-standard situations, by a special drainage system in the working areas. Trapped liquids are transported to the facilities for treatment of liquid waste.

In case of dismounting/dismantling of equipment or components containing liquids, even if they were previously drained, a certain spillage cannot be excluded and therefore corresponding measures to avoid spreading of contaminated liquids need to be taken.

Measures for minimization and mitigation of harmful impacts on surface water and groundwater will be:

- Proper and effective management of liquid RAW,
- Faultless functionality of any sealing elements, both in technological systems and in premises (floors, floor/wall),
- Piping systems subject to clogging shall be provided with systems for flushing with water and/or air,
- Tanks containing contaminated fluids shall not be placed under the ground level, but into above grade rooms,
- Overflow lines from tanks containing radioactive liquids should be routed to contaminated sump or collection tanks,
- Continuous monitoring program including regular control measures and appropriate maintenance procedures of the active drainage system.
- Operational instructions for implementation of the process radiation control of the main sources of liquid RAW.

2.1.3 Measures focused on RAW minimization

Main measures to minimize the generation of radioactive waste at the source will be of prevailingly organizational character and will give precedence to the following processes:

- Consequent segregation of clean materials from contaminated materials (high effectiveness of decontamination).
- Establishing a system of sorting waste and separating waste streams to prevent improper mixing and to assure more efficient characterization and subsequent processing.
- Recycling and reuse of materials.
- Implementation of good operational practices during decommissioning activities, leading to waste reduction.

Measures for reduction of waste quantity and volume should include at least:

- Thorough decontamination and/or cleaning,

- Volume reduction techniques to reduce waste volume (sectioning/size reduction of large objects, in-drum pre-compaction and supercompaction are technologies already available at Bohunice site).

Established waste transport routes and waste storage at strictly defined places are to be observed. Due to the large quantities of waste transported during the 2nd Stage of decommissioning it is crucial to continuously monitor the observance of work procedures and operative provisions.

2.1.4 Health & Safety protection measures

The adequate radiation protection measures against radiation exposure (shielding, distance, radiation monitoring and alarms, time control, etc.) and against contamination (dynamic and static confinements, respiratory masks and/or other protection equipment, surface contamination meters, access control area, etc.) will be implemented commensurate to the risk associated to the decontamination activities according to the applicable Regulations and considering the general radiation protection requirements.

Concerning the health risk for the population in consequence of the 2nd Stage of V1 NPP decommissioning process it should be stated that the impact on public health is almost completely negligible. Therefore, in this case no measures for mitigation of the impact on public health in relation with the project implementation are needed.

In order to prevent the emergence of accident risks various measures of prevailingly organizational character have been proposed:

a) *Loads manipulation:*

- Cranes and other lifting devices used during components manipulation should present a reliability level according to applicable codes and standards. This reliability level shall be verified by means of consequent analyses and tests,
- Lifting devices shall be provided with a system of emergency blocking and load control for safe load manipulation in case of electrical supply interruptions or mechanical breakdowns, in order to prevent load from falling.
- Cranes and other lifting devices shall be operated exclusively by duly qualified and experienced operators,
- Big loads horizontal displacement shall be performed minimizing as much as possible the height above ground,
- Big loads manipulation shall include, if necessary, an evaluation of the integrity/stability of the affected civil structures.

b) *Loss of confinement:*

- In case of a loss of confinement, dismantling operations shall be immediately interrupted in the affected working area. Once the radiological situation is evaluated, corresponding contention, mitigation and corrective measures shall be implemented.

c) *Control of hazardous materials:*

- In order to establish the presence of asbestos or ceramic fibres in large insulation components (potentially carcinogenic material), a specific analysis is to be conducted, and, in case of a positive result, corresponding measures shall be taken in respect to their management and disposal according to applicable standards.

General measures for protection of workers must be implemented:

- Shielding, radiological protection and monitoring,
- Cleaning spaces of hazardous and toxic materials (asbestos, solvents, heavy metals…). .
- Systems drainage, sludge removal and decontamination in-situ in order to lower the dose rate,
- Fuel and flammable materials removal (lubrication oils, fuel, other oils, organic solvents, synthetics, wood...), thus removing the major part of flammable elements from the area, Verification of protective elements if the dismantling works are to be done in steps, leaving in the premises systems still to be operated,
- Delimitation and segregation of areas with anticipated surface contamination due to dismantling or cutting works,
- Control of materials and workers who pass the limits of the controlled zone.

2.1.5 Preventive measures against impacts on air

Activities such as demolition of buildings and crushing of construction material have been identified as sources of dust particles. To prevent these particles from spreading out of the NEC site in a scope that would present an impairment of the immission situation for inhabitants the following mitigation measures will be taken:

- Demolition works: Minimisation of spreading of dustiness in the moment of demolition by a so called water jet method used commonly in combination with suitable demolition methods or in combination with additional dust mitigation measures (trapping barriers, fencing etc.)
- Crushing facilities: crushing of construction materials can also represent a source of dust particles if no suitable project applies to the site. Crushing equipment shall fulfil international standards of BAT and will be provided with closed conveyor bands, wind design management etc.
- Transportation of dusty materials: this can also represent a source of dust, but transport of dusty materials out of the NPP site is not expected. Standard mitigation measures such as usage of reinforced roads, sprinkling of non-reinforced roads and storage surfaces, covering and cleaning of trucks etc. will be applied.

3. Administrative/legislative, organizational and operational measures

Among these measures belong defining responsibilities, limits, conditions, operational regulations and emergency plans and effective control of their observation and implementation.

3.1 Limits and conditions

Set limits and conditions prevent the exceeding of identified discharge limits and determined operational values in technological facilities, preventing emergency situations which may cause jeopardy to personnel and population or facility damages. All activities of the 2nd Stage of V1 NPP decommissioning process will be carried out in accordance with the valid permissions and regulations. Limits and conditions are approved and their fulfilment is followed by the competent authorities (UVZ SR and UJD SR).

3.2 Operational regulations

Operational regulations include technological procedures fulfilment of which ensures achieving the required operational safety. Decommissioning activities of the 2nd Stage of V1 NPP will be carried out exclusively according to the approved operational regulations and procedures.

Decommissioning is a process in which plant conditions and configurations are continuously changing, which implies an increased risk of fire. Fire protection organisational measures will include:

- Personnel must be trained in fire response,
- Clear policies and procedures on radiological protection and security in case of evacuation due to fire must be established.
- Personnel protective equipment is to be regularly inventoried, inspected and maintained to ensure proper performance.
- Manual fire fighting equipment, fire extinguishers, hoses, nozzles, tools, fittings, portable lighting and communication and ventilation devices shall be regularly inventoried, inspected and tested.
- A program for inspection, testing, and maintenance shall be defined to verify the operability of installed fire protection systems and features.
- Planning of processes to be implemented during 2nd Stage of decommissioning, which involve hot works, should exclude works with flammable and combustible materials or other fire hazards in areas with insufficient fire protection systems.
- Organisational measures are also related to the existence and management of documentation which provides in detail for technical and technological measures of the protection of environment and health of workers.

JAVYS disposes already in the present of relevant system documentation drawn up and used for reducing the risk of uncontrolled release of hazardous substances and radionuclides into the environment, e.g.:

- BZ/OŽ/ZSM Environment protection
- BZ/OŽ/SM-01 Protection of waters, handling of hazardous substances and work in the MCHL application
- BZ/OŽ/SM-02 Protection of air, nature and landscape
- BZ/OŽ/SM-03 Waste management
- BZ/RO/ZSM Radiation protection
- BZ/RO/SM-01 Rules of radiation protection
- BZ/RO/SM-02 Implementation of the ALARA principle
- BZ/RO/SM-07 Distribution and registration of radioactive radiators and
- radioactive substances
- BZ/RO/SM-08 Monitoring of radiation situation on secondary objects
- NO/RA/ZSM Management of RAO and IRAO
- NO/RA/SM-01 Separation and registration of RAO and IRAO
- NO/RA/SM-02 Transport of RAO and IRAO
- NO/RA/SM-03 Storage of RAO and IRAO
- NO/RA/SM-04 Conditioning and treatment of RAO and IRAO
- NO/RA/SM-06 Management of FCC
- NO/RA/SM-07 Management of RAW from V1 NPP

In JAVYS a system of environmental, employees safety and health protection (OSH), as well as system of social management has already been implemented and create the framework for other administarative and organisational mitigation measures. Top managing document ensuring the implementation and function of environmental management system, aspects of ESP and social aspects is in force – Guidebook of Integrated Management System (IMS). IMS is implemented and maintaied as a tool of management of all activities in company and which is in harmony with policies focussed on ensurance of nuclear safety of nuclear installations, but it also containes processes focused on work safety, protection of environment, radiological protection (for emploees and inhabitants), effectivness of economy, IT services and other business aspects. To maintain

IMS relevant financial, technical, and human soources are ensured in accordance with sources for ensurance of nuclear safety of nuclear installations of JAVYS.

In compliance with JAVYS strategy in the field of quality ensurance, environment protection, OSH, nuclear safety and radiological protection, expert preparation of employees, IT services and information safety the following policies have been implemented:

- Quality policy
- Environmental policy
- OSH policy
- Policy of IT services
- These policies are parts of JAVYS IMS policy created in harmony with following normative, resp., legal requirements or recommendations:
- Standards STN EN ISO 9001: 2009 Systems of Quality management, Requirementst,
- Standards STN EN ISO 14001: 2005 Systems of environmental management, Specification with guideline for utilization,
- Standards STN OHSAS 18001: 2009 Systems of management OSH at work, Requirements,
- Standards STN ISO/IEC 20000-1: 2008 Informatic Technology. Service management , Part 1 Specification,
- § 25 par. 1 Act No. 541/2004 Z.z. on the Peaceful Uses of Nuclear Energy (Atom act) and regulation of ÚJD SR No. 431/2011 on Quality System ,
- Requirements on safety IAEA GS-R-3 (2006) System of installation and activities management,
- Individual policies are introduced in plans and programmes, e.g.:
- Environmental, OSH and social management plans.
- Goals of JAVYS for 2013 – Top management of JAVYS established the goals to fulfil JAVYS strategy of policies „Goals of JAVYS" for individual years, they repressent specific tasks with measurable parameters.
- Longterm and shorterm environmental goals and environmental management programmes of JAVYS
- Implementation programmes for OSH policy in JAVYS, a.s. in 2013

The individual policies are also applicabkle for 2nd stage of V1 NPP decommissioning.

4. Compensation measures

No compensation measures have been proposed.

5. Other measures

Among specific measures targeted at minimisation of adverse impact of asbestos on the health of workers there belong the following: (apart from the obligation to use PPE)

- Preventive medical care
- Workers exposed to expiration of dust particles shall attend to a medical check prior to commencement of works and upon their termination (however at least every 3 years). The medical check will be carried out by the contractual physician of the company.
- Ensuring control of concentration of airborne respirable fibres
- Measurement and control of airborne respirable fibres is provided on contractual basis by the responsible Regional Public Healthcare Authority.

6. Statement on technical and economic feasibility of the given measures

All previously mentioned measures for prevention, elimination and minimisation of impacts of the proposed activity are fully feasible if the available technical and economic means are used.

The measures will be financed with means that JAVYS, a.s. will provide out of the BIDSF fund and Slovak sources (National Nuclear Fund, own means of JAVYS, a.s.).

V. Comparison of alternatives of the proposed activity and selection of an optimum alternative

Ministry of Environment SR has renounced, on the basis of a request by the Proponent, an alternative solution, hence zero alternative and one additional alternative being the only subjects of assessment.The detailed description of realistic zero alternative – current status of V1 NPP decommissioning (unit 1 and unit 2) is provided at Annex 18.

1. Establishment of a set of criteria and their significance for the optimum alternative selection

For purposes of a multi-criterion assessment of alternatives it is important to define criteria/ environmental aspects relevant in respect to inputs and outputs of the proposed activity in the given environment. The following criteria have been chosen as most significant in respect to the assessment and selection of the optimum alternative:

- Radiation load on the population (exposition to radiation)
- RAW generation and handling
- Generation and handling of conventional waste
- Pollution of air
- Pollution of waters
- Noise and vibrations
- Transport situation
- Quality of life in terms of radiation safety of the population
- Socio-economic context (mainly employment).

A multi-criterion model has been proposed under the perspective of sustainable development, taking into consideration issues of economy, environmental impacts and impacts in the social sphere.

1.1 <u>Weighted criteria</u>

Weighting of criteria established by a freely chosen method is always to a certain extent subjective, conditioned by the chosen method and by the assessors themselves. Therefore, several weighing methods have been applied and evaluated in team. The weight of the individual criteria has been established in two ways - evaluation by comparison in pairs-Fuller's triangle/Saaty's matrix and Metfessel allocation).

In order to establish the weight of the individual criteria quantitative pair comparison has been applied which consists in comparing pairs of criteria to each other and introducing the results into the so called Saaty's matrix S – (s_{ij}) according to the following method:

$$(s_{ij}) = \begin{cases} 1 \text{ – i and j are equal} \\ 3 \text{ – i is slightly preferred to j} \\ 5 \text{ – i is strongly preferred to j} \\ 7 \text{ – i is very strongly preferred to j} \\ 9 \text{ – i is absolutely preferred to j} \end{cases}$$

The values 2, 4, 6 and 8 are left for assessment of intergrades. The value sii = 1 since the criterion is equal to itself and it must be true that sji = 1/sij and the value sij represents an approximate relation of the weight of criteria i and j, expressed mathematically sij ≈ vi/vj. The geometrical average of the lines of the S matrix represents the minimisation of deviation from vi/vj expressed mathematically for any i:

$$s_i = \prod_{j=1}^{k} s_{ij}$$

we calculate the value $R = (s_i)^{\frac{1}{k}} = \sqrt[k]{s_i}$ i , while k= total amount of criteria and establish the weights of criteria according to the equation:

$$v_i = \frac{R_i}{\sum_{i=1}^{k} R_i}$$

The result is shown at Tab. No. 34.

Tab. No. 34. Saaty's matrix of the pair comparison method (Fuller's triangle)

Criterion	a	b	c	d	e	f	g	h	ch	s_i	R_i	v_i
a	1	7	9	5	5	3	3	7	7	694575	3.84	0.33
b	1/7	1	5	3	3	5	5	1/5	1/7	4.5918	1.15	0.10
c	1/9	1/5	1	3	3	1/3	1/3	1/7	1/7	0.00045	0	0
d	1/5	1/3	1/3	1	3	1/3	3	1/7	1/7	0.00136	0	0
e	1/5	1/3	1/3	1/3	1	3	3	1/7	1/7	0.00136	0	0
f	1/3	1/5	3	3	1/3	1	1/3	1/7	1/7	0.00136	0	0
g	1/3	1/5	3	1/3	1/3	3	1	1/7	1/7	0.00136	0	0
h	1/7	5	7	1/7	7	7	7	1	3	735	1.934767	0.17
ch	1/7	7	7	7	7	7	7	1/3	1	5764801	4.74357	0.40
Σ											11.6683	1

Criterion: a - radiation load on the population, b - generation and management of RAW, c - generation and management of conventional waste, d - pollution of air, e - pollution of waters, f - noise and vibrations, g - transport conditions, h – quality of life in terms of radiation safety, ch - socio-economic context (mainly employment).

The criterion weight is descending in the order: socio-economic context > radiation load on the population > quality of life in terms of radiation safety > generation and management of RAW >> pollution of air = pollution of groundwater = noise and vibrations = transport conditions > generation and management with conventional waste.

Two criteria - radiation load on the population and socio-economic context are, according to the multi-criterion assessment, the environmental criteria with the most significant weight of assessment and comparison of alternatives.

Allocation of 100 points to the individual criteria according to their significance pursuant the Metfessel allocation method is shown in the Tab. No. 35.

Tab. No. 35. Allocation of a total of 100 points (Metfessel allocation)

Criterion	Points	Weights of criteria
Radiation load on the population	20	0.20
RAW generation and management	15	0.15
Generation and management of conventional waste	5	0.05
Pollution of waters	5	0.05
Pollution of air	5	0.05
Transport conditions	5	0.05
Noise and vibrations	5	0.05
Qaulity of life in terms of radiation safety	10	0.10
Socio-economical context (mainly employment).	30	0.30

2. *Selection of the optimum alternative or establishment of the order of suitability of the assessed alternatives*

Methods of multi-criterion assessment of alternatives could not be applied to the full extent since an alternative solution has been renounced and only the zero alternative and one solution alternative can be compared under consideration of the weights of the individual criteria established by the two methods (A - method of pair comparison Saaty's matrix/Fuller's triangle and B - Metfessel allocation). The significance of impacts has been evaluated on a 5-grade scale.

Tab. No. 36. Choice of the optimum alternative

Criterion/environmental aspect	Weight of criterion in		Weight average	Zero alternative	Impact size/extent of alternative 1	Impact significance
	A	B				
Radiation load on the population	0.33	0.20	0.2750	0	-1	-0.275
RAW generation and management	0.10	0.15	0.1250	0	-2	-0.250
Generation and management of conventional waste	0	0.05	0.0025	0	-2	-0.005
Contamination of waters	0	0.05	0.0025	0	-1	-0.005
Contamination of air	0	0.05	0.0025	0	-1	-0.005

Tab. No. 36. Choice of the optimum alternative

Criterion/environmental aspect	Weight of criterion in		Weight average	Zero alternative	Impact size/extent of alternative 1	Impact significance
	A	B				
Transport conditions	0	0.05	0.0025	0	-1	-0.005
Noise and vibrations	0	0.05	0.0025	0	-2	-0.005
Quality of life - safety	0.17	0.10	0.1350	0	+2	+0.270
Socio-economical context (mainly employment).	0.40	0.30	0.3500	0	+3	+1.050
Sum					-5	+0.770

* The signs“-“ and “+“ refer to a adverse and positive impact within the given criterion

The table above shows that the solution alternative brings about an overall positive impact.

The evaluation of impacts significance has shown that by implementing the activity an overall positive impact and a significant socio-economic-impact would be procured which is by no means surprising considering that the assessed activity aims at a complex removal of the presently non-operative nuclear facility and release of the territory for further industrial usage, by which conditions are created for generation of new job opportunities in future and, at present, for allocation of the existing qualified workforce over a period of 17 years of preparations and execution of decommissioning activities. Adverse impacts of the decommissioning activity have not proven as significant.

The alternative 1 brings, in comparison to the zero alternative, also a positive impact on the quality of life of the affected population in terms of radiation safety and a very low adverse impact, which does not represent a major risk of deterioration the present state of the environment. Apart, any adverse impacts are of short-term character (max. duration 5-10 years). The model calculation of effective doses has not shown a risk of adverse effects of radiation load on the health of inhabitants in the affected area.

3. Reasons for the proposed optimum alternative

In case of a one-alternative solution, either the alternative 1 or the zero alternatives can be recommended. We recommend implementing the assessed alternative 1 of the proposed activity on the basis of the following reasons:

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 strategic and conceptual documents of SR in the sphere of energetics and JAVYS, a.s.

Interrupting the decommissioning process after the 1st stage of decommissioning would mean ineffective/ unreasonable utilisation 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 impacts 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.

VI. Proposed monitoring and post-project analysis

1. Proposal for monitoring from the beginning of construction, during the construction, during implementation and after termination of the proposed activity

Monitoring of activities which are significant under the perspective of radiation protection has been already in place according to the Regulation of the Government 345/2006 Coll. on the Basic Safety Requirements to Protection of Health of Workers and Population against Ionising Radiation, the Act No. 355/2007 Coll. on Protection, Support and Development of Public Health and on Alternations and Amendments to some Acts and the Regulations of Ministry of Health of SR No. 545/2007 Coll. on the Establishment of Detailed Requirements to Securing Radiation Protection during Activities Resulting in Irradiation and Activities Significant as to Radiation Protection.

1.1 Monitoring of discharges of RAC through the ventilation stack

Monitoring of discharges of RAC through the ventilation stack is carried out by means of an upgraded monitoring system located in the building SO 460 - Ventilation stack. This system represents a backed up continuous measurement of aerosols and proportional extraction of aerosol samples on a filter with subsequent measurement of activity.

The present monitoring systems have the capacity to measure the following specific types of radioactive emissions:

- Radioactive noble gases (Ar, Kr a Xe), which are considered as source of external irradiation.
- Radioactive aerosols with a longer decay period (> 24 h) considered to be a source of internal contamination resulting from inhalation.
- Radioactive ^{131}I is due to its radio-chemical characteristics (it occurs in gaseous state and as aerosol) monitored separately by catching on selective sorbents and it is considered as a source of organ dose (dose equivalent rate in the thyroid gland).

Apart, radionuclides in waste gases are also monitored, in particular those which play an important role in the assessment of impacts on the population, e.g. ^{3}H, ^{14}C, ^{90}Sr, ^{239}Pu, since these radionuclides are significant from the point of view of total impacts of the operation on the environment. This monitoring is provided for by extraction of samples (water steam, aerosols, compounds of carbon oxides and carbohydrates) and subsequent radio-chemical analysis as to the occurrence of the above mentioned radionuclides, using methods of selective detection (liquid scintillation detector, alpha spectrometry.

The applied facilities fulfil the requirements posed to the "established measuring tools" pursuant to the Act on Metrology No. 142/2000 and the Executive Regulation No. 210/2000.

1.2 Monitoring of liquid discharges

Monitoring of liquid discharges is carried out in the building 800:V1 and at the border of JAVYS, a.s. to the pipe collector Socoman. Wastewater is, upon measurement in the tank, directed into the collector Socoman in which they are monitored in continuous measurements of the summary activity by the monitor MR 100. The facilities fulfil the requirements posed to the "established measuring tools" pursuant to the Act on Metrology No. 142/2000 and the Executive Regulation No. 210/2000.

1.3 Monitoring of the environment in the surroundings of JAVYS, a.s.

The most important component of the environment monitoring in the surroundings of JAVYS, a.s. is the so called teledosimetric system which monitors:

1.3.1 Aerosols from continuous extraction

Extraction of aerosols is carried out continuously at 24 stations of the so called teledosimetric system located in the surroundings of the Jaslovské Bohunice site by means of large-volume suction extracting equipments with an air flow of ca. 200 $m^3.hod^{-1}$. Filters are, after a 14-day exposition, pressed into the shape of a tablet and measured at the front of the HPGe detector.

1.3.2 Radioactivity of deposits

Deposits are extracted by means of large-area extraction facilities, installed at chosen stations.

1.3.3 Radioactivity of milk

Milk samples are extracted in weakly intervals at two milk plants and two agricultural farms (Dolné Dubové – cowshed, Drahovce – cowshed, Nižná – cowshed, Trnava – cowshed) in a volume of 2 l. These samples are analysed by gamma-spectrometric analysis as to the presence of artificial radionuclides. Weekly samples are cumulated into a monthly sample which is processed radio-chemically and subjected to a gamma-spectrometric analysis.

1.3.4 Radioactivity of drinking and surface waters

Drinking water: Samples of drinking waters are extracted only once in three months at ten extraction points for drinking water (Hlohovec, Kátlovce, Malženice, Siladice, Trakovice I and II, Veľké Kostoľany, Zelenice, Žlkovce I and II) in an amount of 10 l. Samples are processed radio-chemically and their total activity and volume of tritium (3H) is established by means of liquid scintillation spectrometry.

Surface waters: Samples of surface waters are taken once a month in an amount of 50 l (Dudváh – Bučany and Veľké Kostoľany, Váh - Várov Šúr, Madunice, Žlkovce – channel). Samples are processed radio-chemically and their total activity and volume of tritium (3H) is established by means of liquid scintillation spectrometry.

1.3.5 Radiation control boreholes

Water samples are extracted at the radiation control boreholes two times a year in an amount of 10 l – in spring and in autumn. Samples are processed radio-chemically and their total activity and volume of tritium (^3H) is established by means of liquid scintillation spectrometry.

1.3.6 Radioactivity of agricultural products

Grass samples are collected twice a year, in spring and in autumn, close to the teledosimetric stations (grass samples from 15 locations, clover samples from three locations). Samples are dried in laboratories and pressed into a cylindrical shape. Upon such processing samples are subjected to gamma-spectrometric analysis.

1.3.7 Radioactivity of soils

Samples of soils are extracted once a year at ten localities in two depths - at 0 to 2 cm and at 2 to 5 cm. Samples are collected in two groups - from grass plots in spring and from arable land in autumn. In laboratories, samples get dried, homogenised and evaluated by means of gamma spectrometry.

1.3.8 Insitu measurements

Insitu gamma spectroscopy is carried out twice a year, in spring and in autumn, close to the teledosimetric stations.

1.3.9 Measurement of doses

Measurement of dose equivalent rate of gamma radiation is carried out by means of dosimeters TLD located in teledosimetric stations. TLD dosimeters from stations are evaluated after an exposition period of one month.

1.3.10 Measurement of dose rates

Dose rates are measured continuously at all 24 stations of teledosimetric.

1.3.11 Specific monitoring

At present, a geological project on the task "Monitoring and protection of groundwater and maintenance of probes and boreholes at the V1 NPP and ISFS site", No. of the task 2012-160 is being elaborated. Works are projected and carried out by the company GEO Slovakia s.r.o., Košice. It also includes a monitoring plan for the years 2013 and 2014. The task aims at execution of regular monitoring of the hydro-geological conditions and quality of groundwater in order to evaluate the hydro-geological and contamination situation with view to historically identified sources and potential sources of groundwater contamination by tritium at the JAVYS, a.s. site in J. B. Subject to monitoring and protection is in the first place groundwater referred to as water of the 1. water-bearing bed (monitored at chosen monitoring boreholes) and percolation water (at percolation probes).

Monitoring aims at:

- Providing control of impacts of NEC Bohunice operation on the groundwater as one of the environmental units.
- Providing 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.

1.4 Evaluation of environment monitoring in the surroundings of JAVYS, a.s.

In the years 2010 and 2011, analyses of ca. 2,000 samples from the environment of the surroundings of SE-EBO and JAVYS, a.s. were carried out per year. Results of these analyses show that the influence of SE-EBO and JAVYS, a.s. on their surroundings is very small to negligible.

1.5 Monitoring of discharges of non-radioactive harmful substances from the CZ into the environment

Wastewater from CZ is discharged in doses. Prior to discharge, chemical and radio-chemical analysis of water prepared for discharge is performed. Should the water not meet the discharge requirements established by national supervisory authorities the process of purification is repeated. Data on discharged water is registered in detail.

2. Proposal for the control of compliance with the established requirements

There is no need for a proposal for control of compliance with established requirements since it is clearly provided for in the organisation of JAVYS, a.s. by Decisions of UVZ SR and UJD SR, which are based on the requirements of the legal provisions of SR.

VII. Methods applied in the process of environmental impact assessment of the proposed activity and concept and sources of acquisition of data on the current state of the environment in the area where the proposed activity is to be carried out

The characteristics of the current state of environment has been drafted on the basis of:

- The existing reports and documentation a list of which is provided in the chapt. C.XII
- Knowledge, experience and evaluations of experts
- Results of monitoring activities on the state of environment at the NPP Bohunice
- Reports and analyses elaborated especially for purposes of NPP V1 (chapt. C.XII).

In order to identify and assess the impacts the following methods have been applied:

- Evaluation and estimation of experts
- Experience gained in decommissioning of similar NPPs abroad
- Comparison with valid criteria defined by legal provisions of SR
- Expert systems/ model calculations; INTERTRAN-2/RADTRAN 4
- Expert system/model calculation of radiation load for inhabitants in affected area from JAVYS discharges – Programme/software ESTE AI, verzion 3.31
- Internationally accepted methods of health risks evaluation
- Multi-criteria impact assessment, method of pairwise comparison of environmental criteria, Saaty's matrix, Metfessel allocation.

During the whole assessment process the impact evaluation has been carried out taking into consideration the requirements and standpoints of the affected authorities and municipalities submitted at consultation days and the individual meetings with the Proponent or the Drafter of the Report. The entire process has been accompanied by an informational campaign pursuant to the adopted Stakeholder Engagement Plan.

The experiences from NPP decommissioning in other countries have been also taken in cosideration (see the Annex 17).

VIII. Insufficiencies and uncertainties of the known data found in the process of Assessment Report drafting

The basic documentation for purposes of impact assessment originates from several BIDSF projects at different levels of elaboration that, in difference to the complex technical project, contain more general information on the technical approaches. For example, the estimation of output amounts, consumption of raw materials and energies is to a considerable extent imprecise, which, however, is not unusual at the pre-project assessment stage and specification shall be provided in the following steps of authorisation process.

IX. Annexes to the assessment report

Annex 1. Time schedule for the 2nd Stage of V1 NPP decommissioning

Annex 2. Dismantling and stages of processing of activated materials from PC

Annex 3. Dismantling and stages of processing of contaminated materials from PC

Annex 4. Order of dismantling activities and processing of activated materials

Annex 5. Order of dismantling activities and processing of contaminated materials

Annex 6. Ground plan of the area for cutting of the reactor vessel

Annex 7. Placement of the inner reactor components into the RPV - Complex view of the control rods unit

Annex 8. Typical configuration of the reactor VVER 440 type V-230

Annex 9. HRAW processing scheme

Annex 10. Information on meeting the requirements of the Scope of assessment

Annex 11. Photographic documentation of the current state of the affected area

Annex 12. Stakeholder information and consultation process

Annex 13. Radiological study

Annex 14. Study on risks of RAW transport

Annex 15. List of objects of V1 NPP to be decommisioned and objects noit to be decommissioned

Annex 16. Division of radionucleads according to radiotoxicity classes

Annex 17. Selected international experiences of NPP decommissioning

Annex 18. Current status of V1 NPP units

X. Non Technical Executive Summary

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 (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.

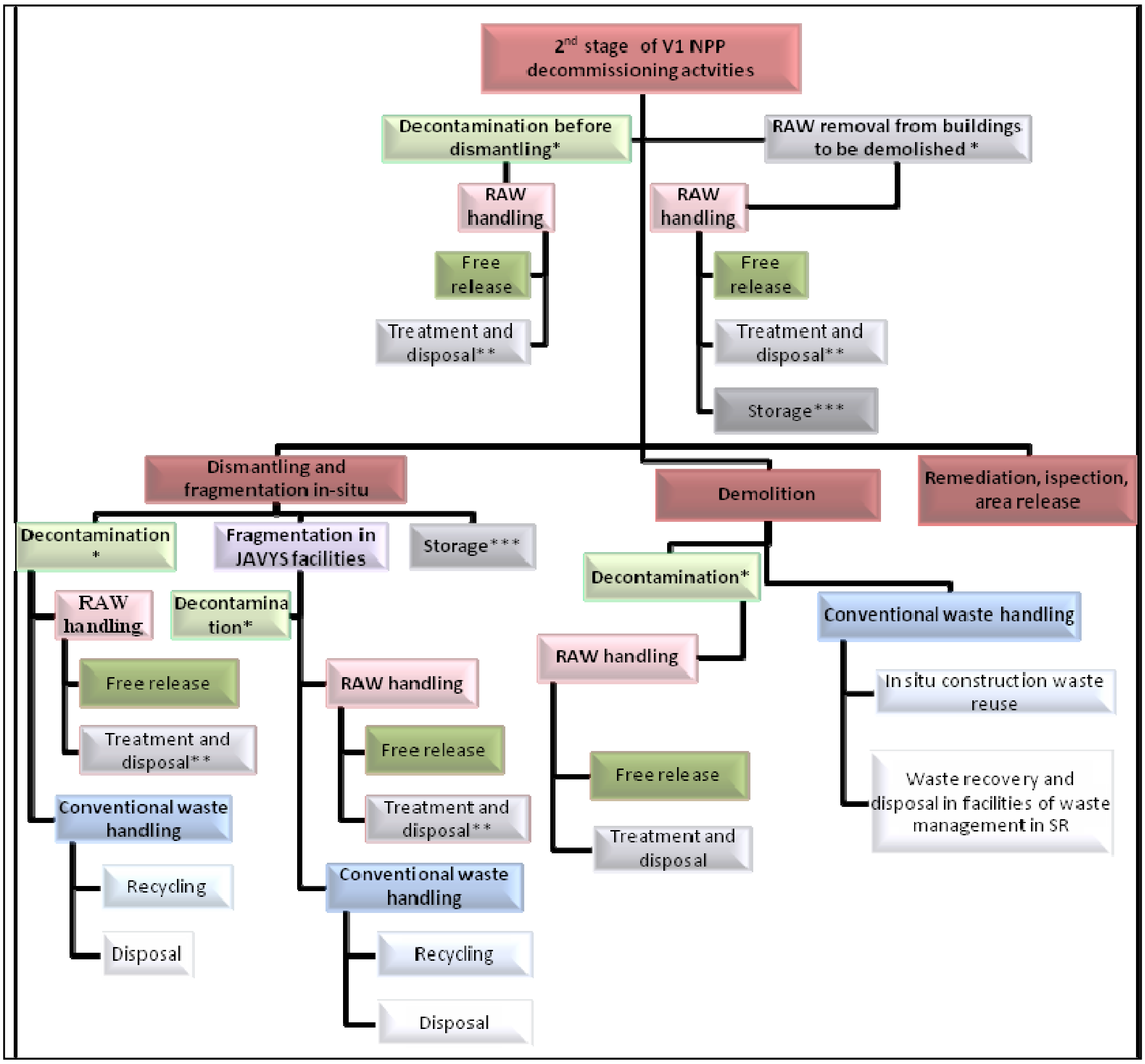
b) Groups of auxiliary activities

- 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. 83. 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. 37. 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

Tab. No. 38. 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 Con-ditioning, 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

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

Tab. No. 39. 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	—	—
r Shieldi ng Assem	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. 40. 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.

7.2.3 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.

7.2.4 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.

7.2.5 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.

7.2.6 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.

7.2.7 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.

7.2.7.1 *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.

7.2.7.2 *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.

7.2.8 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.

7.2.9 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.

7.2.10 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. 41. 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
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
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

Tab. No. 42. 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. 43. 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 od decommissioning will be significantly lower than limit values. On cumulative radiological impact the proposed project may paricipate 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.
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 utilitaztion of area with a potential of new emplyment will be created.
Safety and quality of life, project acceptance for affected municipalities	yes	+2	Nucluear installation will be removed and RAW will be safely stored , V1 NPP decommossioning is, in global percepted 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 romoval 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.

Tab. No. 43. Identification and evaluation of project impacts

Impact	Impact identification yes/no	Impact evaluation scale 1-5*	Comment/explanation
Impact on air	yes	-1	In short-term period and in local scale the dust – emmission of partuculate matters will increase during demolition of buildings and in-situ mechanical treatment of construction waste
Impact on water	yes	-1	During the decommissioning the dischrges of RAL into surface water reciietns will continue with decreasing trend in sence of permits from CA
Impact on soil	no		The use of surounding 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 teritory, inputs and outputs from this project can not change the current status surounding fana, flora and biotops.
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, untill 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 1. degree of landscape and nature protection (according to Slovak Act on Lndscpae and nature protection). Although NATURA 2000 -Protected bird aea is located in vicinity of NEC (CHVÚ Špačinsko – nižnanské polia), the project will not influnce the cnditions on securing a favourable 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.
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 palaeontological localities and	no		Not present in the area.

Tab. No. 43. Identification and evaluation of project impacts

Impact		**Impact identification yes/no**	**Impact evaluation scale 1-5***	**Comment/explanation**
significant geological sites localities				
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 bachfilling of wholes after buildings demolition (mainly conrete), 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 tonnes 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 utilisation 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. 44. 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

Tab. No. 44. Identification of mitigation measures

Impact	Receptor	Mitigation measures	
		Kind	**Description**
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
		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
    - Insitu 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.

XI. List of experts and organisations involved in the drafting of the Assessment Report

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XII. List of additional analytical reports and studies available to the Proponent on the basis of which the assessment report has been drafted

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XIII. Date and signature (stamp) of the authorised representative of the Drafter of the Assessment Report and the Proponent to confirm the accuracy and integrity of data

At: Jaslovské Bohunice
Date: 2013

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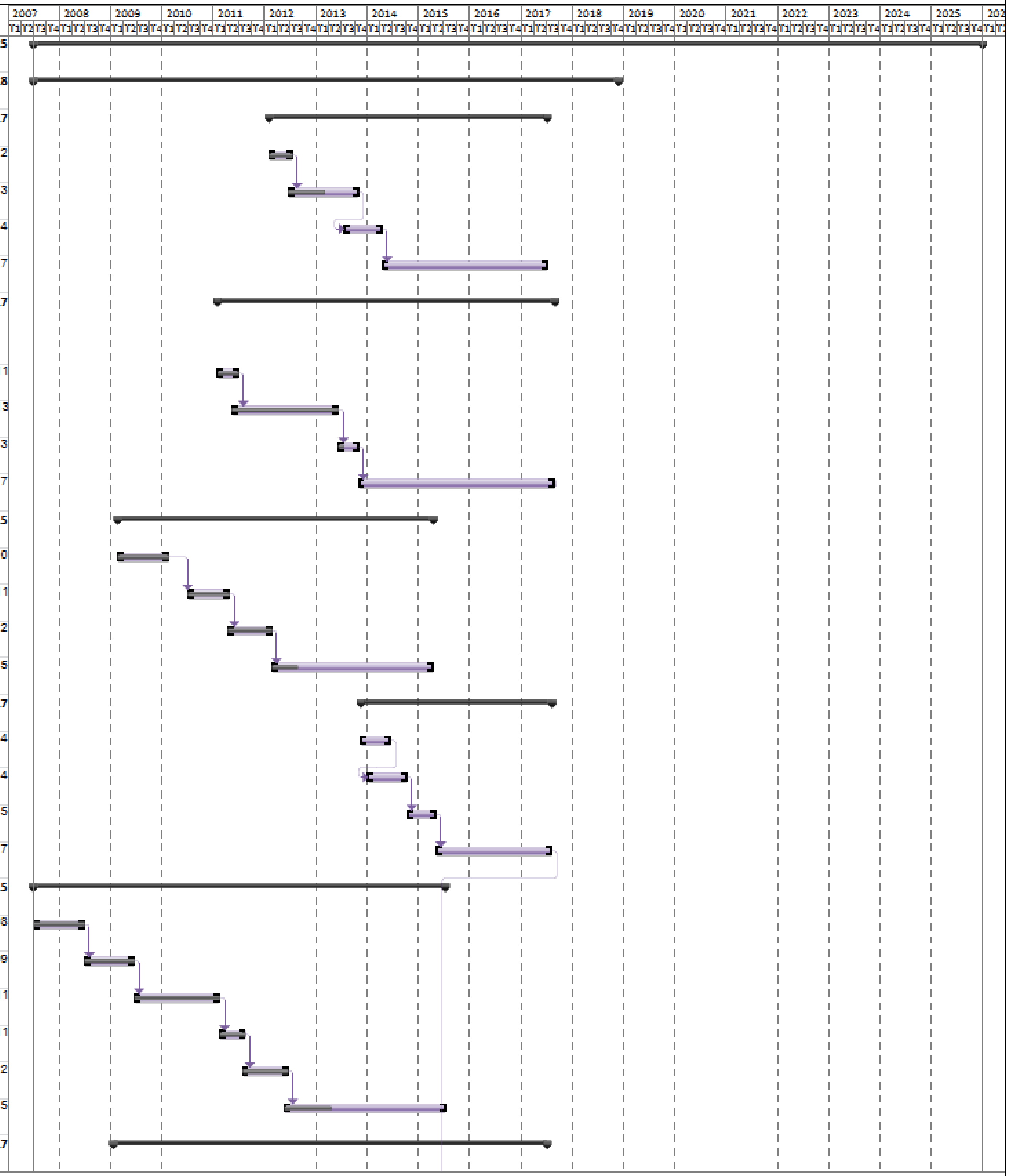
ANNEXES

Annex 1. Time schedule for the 2nd Stage of V1 NPP decommissioning

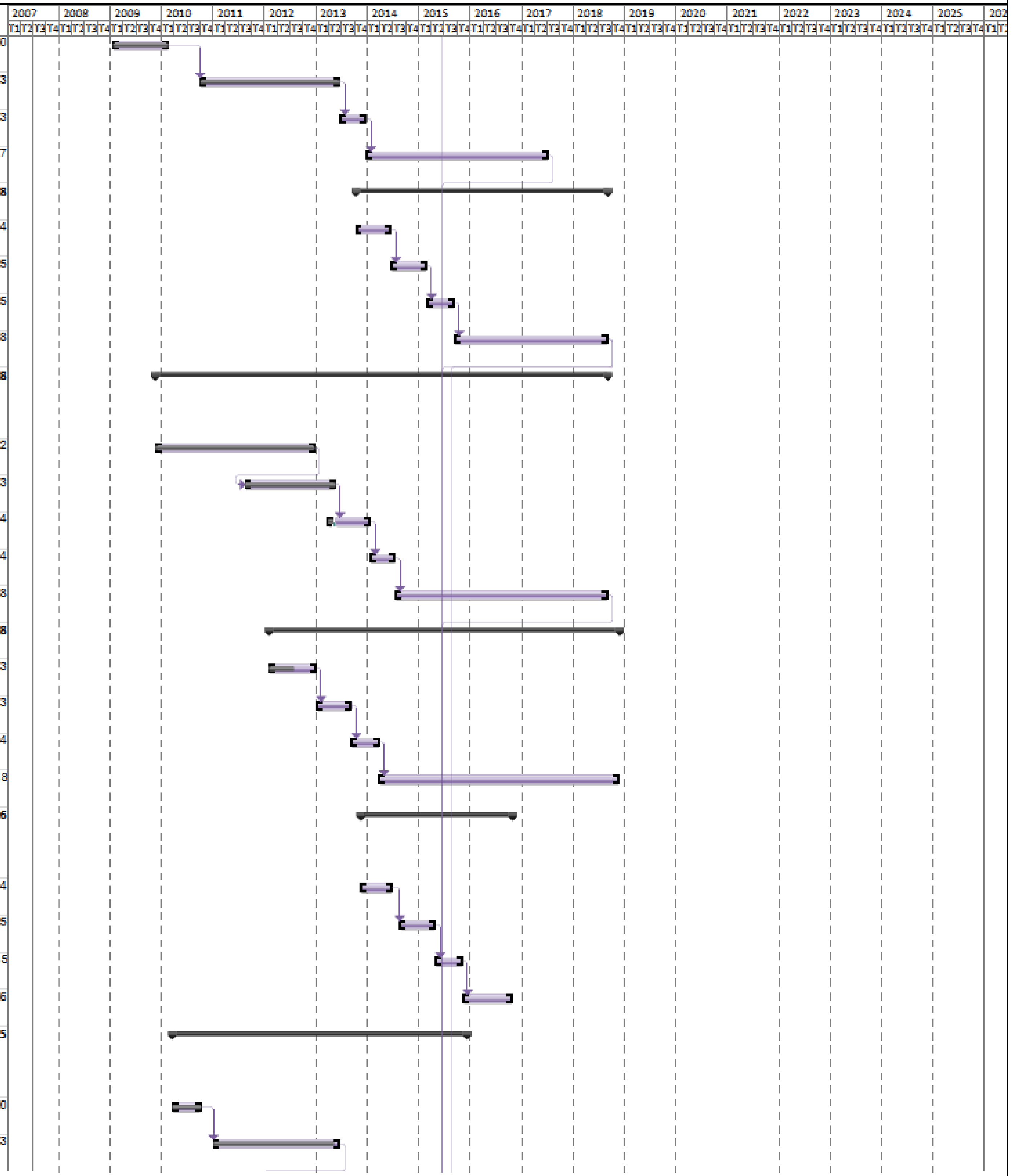
Bohunice V1 NPP - Stage II Decommissioning General Time Schedule

Id	WBS	Activity Name	% Complete	Duration	Start	Finish
1		**Bohunice V1 NPP Decommissioning Stage II**	**26%**	**4829 d**	**29/06/2007**	**31/12/2025**
2	**SO**	**Stage I Projects (finished during Stage II)**	**41%**	**2976,88 d**	**29/06/2007**	**26/11/2018**
3	**SO.B66A**	**B6.6A Decommissioning Support Survey**	**20%**	**1415,63 d**	**01/02/2012**	**05/07/2017**
4	SO.B66A.G	GA Phase	100%	120 d	01/02/2012	17/07/2012
5	SO.B66A.P	Preparation Phase	52%	358 d	18/06/2012	30/10/2013
6	SO.B66A.T	Tender Phase	0%	196 d	19/07/2013	18/04/2014
7	SO.B66A.I	Implementation Phase	0%	837 d	21/04/2014	05/07/2017
8	**SO.B72**	**B7.2 Personnel Training for the Purposes of 1st Stage of V1 NPP Decommissioning**	**39%**	**1719,88 d**	**31/01/2011**	**01/09/2017**
9	SO.B72.G	GA Phase	100%	109 d	31/01/2011	30/06/2011
10	SO.B72.P	Preparation Phase	100%	543 d	13/05/2011	11/06/2013
11	SO.B72.T	Tender Phase	25%	101 d	12/06/2013	30/10/2013
12	SO.B72.I	Implementation Phase	0%	1002 d	31/10/2013	01/09/2017
13	**SO.C7A3**	**C7-A3 Erection of the new large capacity F&D facility NPP V1**	**55%**	**1606 d**	**20/02/2009**	**17/04/2015**
14	SO.C7A3.G	GA Phase	100%	260 d	20/02/2009	18/02/2010
15	SO.C7A3.P	Preparation Phase	100%	215 d	01/07/2010	27/04/2011
16	SO.C7A3.T	Tender Phase	100%	225 d	13/04/2011	21/02/2012
17	SO.C7A3.I	Implementation Phase	16%	823 d	22/02/2012	17/04/2015
18	**SO.C7A4**	**C7-A4 Metalic RAW premelting facility**	**0%**	**974 d**	**18/11/2013**	**10/08/2017**
19	SO.C7A4.G	GA Phase	0%	154 d	18/11/2013	19/06/2014
20	SO.C7A4.I	Preparation Phase	0%	200 d	06/01/2014	10/10/2014
21	SO.C7A4.T	Tender Phase	0%	147 d	10/10/2014	05/05/2015
22	SO.C7A4.I	Implementation Phase	0%	593 d	05/05/2015	10/08/2017
23	**SO.C7B**	**C7-B Treatment of Historical Waste - Sludges and Sorbents**	**73%**	**2095 d**	**29/06/2007**	**09/07/2015**
24	SO.C7B.G	GA Phase	**100%**	260 d	29/06/2007	26/06/2008
25	SO.C7B.P	Preparation Phase	**100%**	253 d	27/06/2008	16/06/2009
26	SO.C7B.T	Tender Phase	**100%**	435 d	17/06/2009	15/02/2011
27	SO.C7B.P	Preparation Phase (stage 2)	**100%**	129 d	16/02/2011	15/08/2011
28	SO.C7B.T	Tender Phase (stage 2)	**100%**	231 d	29/07/2011	15/06/2012
29	SO.C7B.I	Implementation Phase	**29%**	816 d	24/05/2012	09/07/2015
30	**SO.C8**	**C8 Interim Storage of RAW at Bohunice Site**	**48%**	**2206 d**	**21/01/2009**	**05/07/2017**



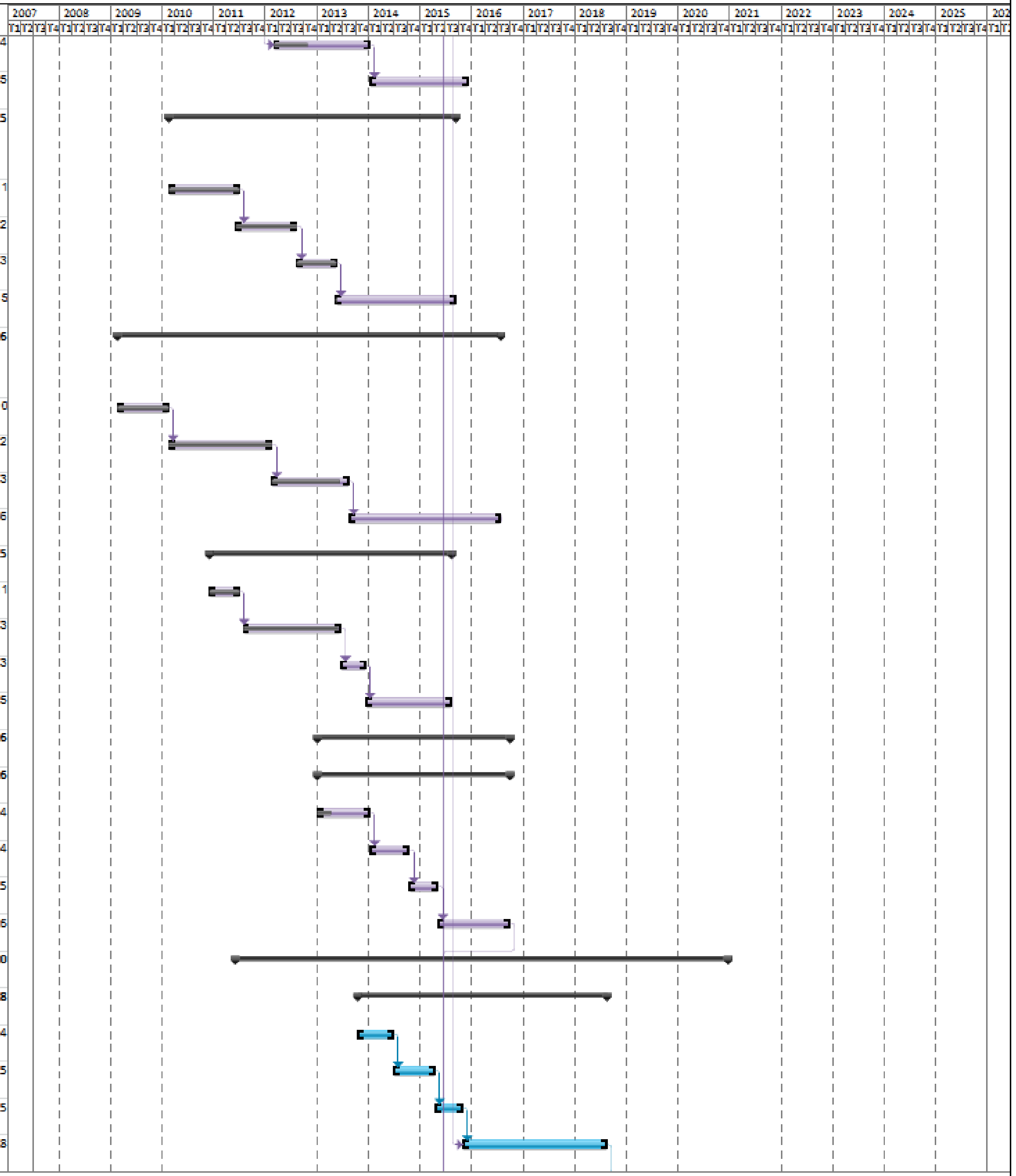
Bohunice V1 NPP - Stage II Decommissioning General Time Schedule

Id	WBS	Activity Name	% Complete	Duration	Start	Finish
31	SO.C8.G	GA Phase	100%	279 d	21/01/2009	15/02/2010
32	SO.C8.P	Preparation Phase	100%	710 d	01/10/2010	20/06/2013
33	SO.C8.T	Tender Phase	0%	132 d	21/06/2013	23/12/2013
34	SO.C8.I	Implementation Phase	0%	922 d	24/12/2013	05/07/2017
35	**SO.C8B**	**C8-B Interim storage RAO for special wastes**	**0%**	**1279 d**	**11/10/2013**	**05/09/2018**
36	SO.C8B.G	GA Phase	0%	179 d	11/10/2013	18/06/2014
37	SO.C8B.P	Preparation Phase	0%	180 d	19/06/2014	25/02/2015
38	SO.C8B.T	Tender Phase	0%	141 d	26/02/2015	10/09/2015
39	SO.C8B.I	Implementation Phase	0%	779 d	11/09/2015	05/09/2018
40	**SO.C94**	**C9.4 Design and Erection of New Disposal Facilities for LLW and VLLW from V1 NPP Decommissioning at NRR Mochovce**	**48%**	**2295 d**	**17/11/2009**	**03/09/2018**
41	SO.C94.G	GA Phase	100%	806 d	17/11/2009	18/12/2012
42	SO.C94.E	EIA process	100%	457 d	17/08/2011	16/05/2013
43	SO.C94.P	Preparation Phase	13%	205 d	26/03/2013	22/01/2014
44	SO.C94.T	Tender Phase	0%	127 d	22/01/2014	18/07/2014
45	SO.C94.I	Implementation Phase	0%	1077 d	18/07/2014	03/09/2018
46	**SO.C10A**	**C10A Execution of Free Release of Decommissioning Materials**	**7%**	**1778,88 d**	**01/02/2012**	**26/11/2018**
47	SO.C10A.G	GA Phase	52%	240,89 d	01/02/2012	02/01/2013
48	SO.C10A.P	Preparation Phase	0%	176 d	07/01/2013	09/09/2013
49	SO.C10A.T	Tender Phase	0%	142 d	09/09/2013	25/03/2014
50	SO.C10A.I	Implementation Phase	0%	1220 d	25/03/2014	26/11/2018
51	**SO.C122**	**C12.2 Laboratory Equipment Necessary In The Process Of V1 NPP Decommissioning Stage II**	**0%**	**769 d**	**15/11/2013**	**27/10/2016**
52	SO.C122.G	GA Phase	0%	157 d	15/11/2013	23/06/2014
53	SO.C122.P	Preparation Phase	0%	181 d	19/08/2014	29/04/2015
54	SO.C122.T	Tender Phase	0%	138 d	29/04/2015	09/11/2015
55	SO.C122.I	Implementation phase	0%	252 d	10/11/2015	27/10/2016
56	**SO.C15A**	**C15.A Integrated computer system for V1 NPP decommissioning logistic system**	**52%**	**1495 d**	**18/03/2010**	**10/12/2015**
57	SO.C15A.G	GA Phase	100%	143 d	18/03/2010	04/10/2010
58	SO.C15A.P	Preparation Phase	95%	642,84 d	03/01/2011	19/06/2013



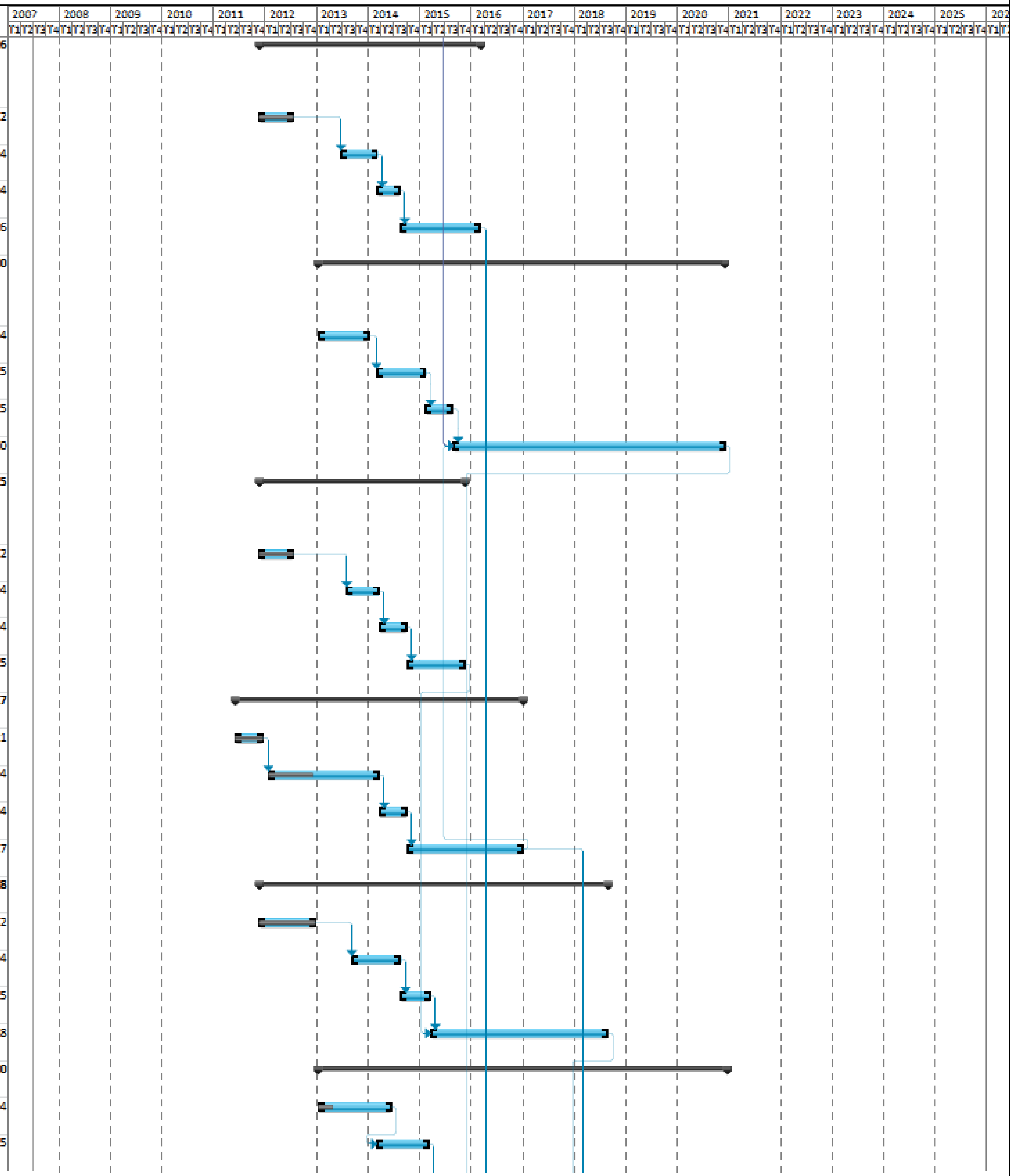
Bohunice V1 NPP - Stage II Decommissioning General Time Schedule

Id	WBS	Activity Name	% Complete	Duration	Start	Finish
59	SO.C15A.T	Tender Phase	35%	486 d	29/02/2012	09/01/2014
60	SO.C15A.I	Implementation Phase	0%	500 d	09/01/2014	10/12/2015
61	**SO.D12**	**D1.2 Dismantling of the technical Equipment in the V1 NPP Turbine Hall**	**59%**	**1455 d**	**15/02/2010**	**11/09/2015**
62	SO.D12.G	GA Phase	100%	358,88 d	15/02/2010	30/06/2011
63	SO.D12.P	Preparation Phase	100%	308,88 d	06/06/2011	09/08/2012
64	SO.D12.T	Tender Phase	100%	198,88 d	11/08/2012	15/05/2013
65	SO.D12.I	Implementation Phase	1%	609 d	14/05/2013	11/09/2015
66	**SO.D31**	**D3.1 Dismantling and Demolition of V1 NPP External Buildings – Phase 1**	**58%**	**1941,88 d**	**16/02/2009**	**26/07/2016**
67	SO.D31.G	GA Phase	100%	259 d	16/02/2009	11/02/2010
68	SO.D31.P	Preparation Phase	100%	523 d	12/02/2010	14/02/2012
69	SO.D31.T	Tender Phase	88%	390 d	15/02/2012	13/08/2013
70	SO.D31.I	Implementation Phase	0%	770 d	14/08/2013	26/07/2016
71	**SO.D34**	**D3.4 Diesel Group Dismantling**	**52%**	**1227 d**	**01/12/2010**	**14/08/2015**
72	SO.D34.G	GA Phase	100%	151,88 d	01/12/2010	30/06/2011
73	SO.D34.P	Preparation Phase	97%	491,88 d	29/07/2011	17/06/2013
74	SO.D34.T	Tender Phase	0%	121 d	21/06/2013	09/12/2013
75	SO.D34.I	Implementation Phase	0%	438 d	10/12/2013	14/08/2015
76	**PM**	**Plant Modifications**	**7%**	**975 d**	**02/01/2013**	**27/09/2016**
77	**PM.D41**	**Project D4.1 - Plant modifications and new installations**	**7%**	**975 d**	**02/01/2013**	**27/09/2016**
78	PM.D41.G	GA Phase	26%	257 d	02/01/2013	09/01/2014
79	PM.D41.P	Preparation Phase	0%	199 d	10/01/2014	15/10/2014
80	PM.D41.T	Tender Phase	0%	147 d	16/10/2014	08/05/2015
81	PM.D41.I	Implementation phase	0%	352 d	11/05/2015	27/09/2016
82	**DD**	**Equipment Decontamination & Dismantling**	**11%**	**2494 d**	**01/06/2011**	**21/12/2020**
83	**DD.C14**	**Project C14 - Disposal of Remote Handled Waste from 'Mogilnik'**	**0%**	**1262 d**	**16/10/2013**	**16/08/2018**
84	DD.C14.G	GA Phase	0%	179 d	16/10/2013	23/06/2014
85	DD.C14.P	Preparation Phase	0%	211 d	24/06/2014	14/04/2015
86	DD.C14.T	Tender Phase	0%	139 d	15/04/2015	26/10/2015
87	DD.C14.I	Implementation phase	0%	733 d	27/10/2015	16/08/2018



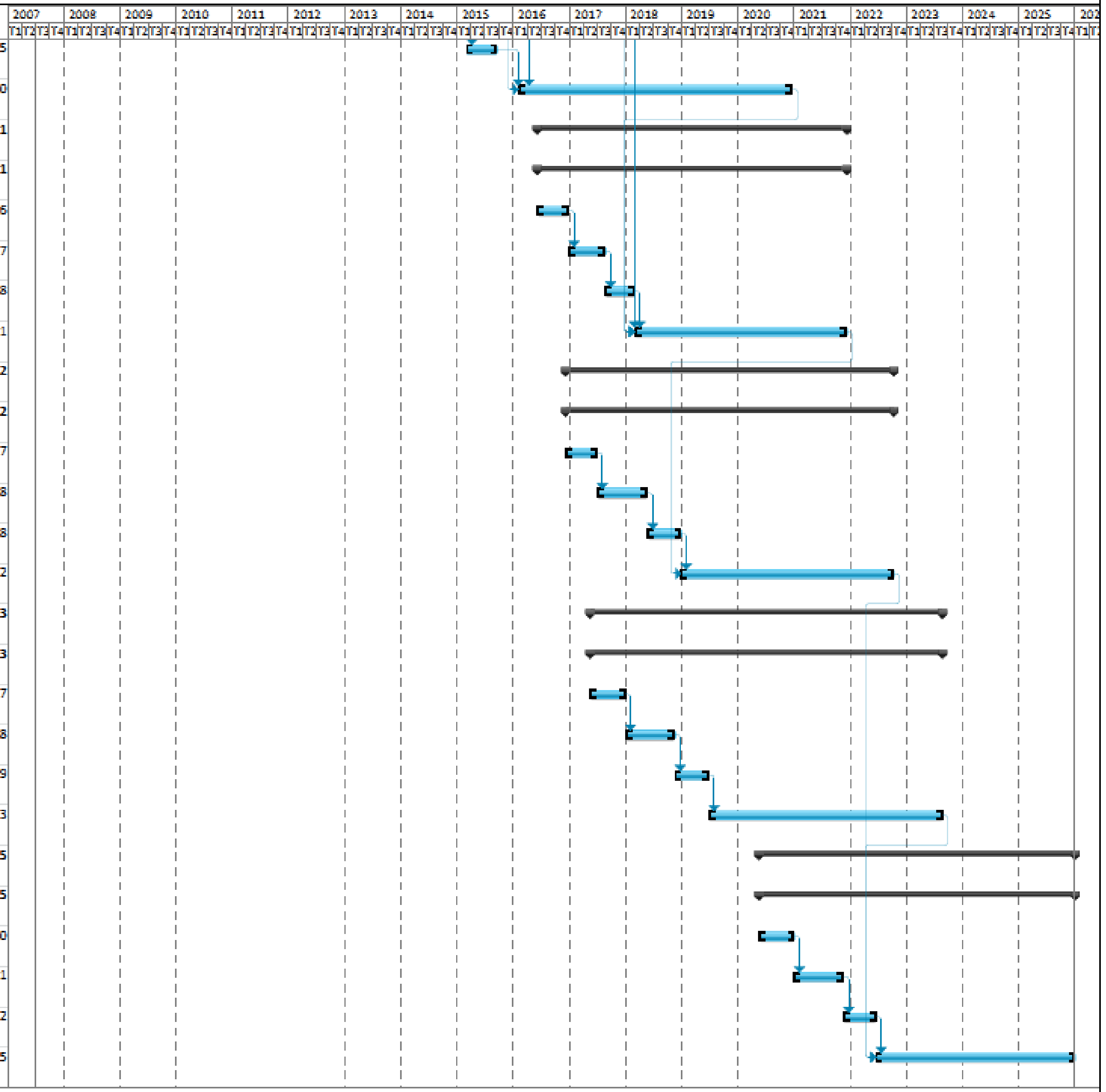
Bohunice V1 NPP - Stage II Decommissioning General Time Schedule

Id	WBS	Activity Name	% Complete	Duration	Start	Finish
88	**DD.D21**	**Project D2.1 - Decontamination of Spent Fuel Pool and other Contaminated Tanks**	**20%**	**1122 d**	**21/11/2011**	**08/03/2016**
89	DD.D21.G	GA Phase	100%	172 d	21/11/2011	17/07/2012
90	DD.D21.P	Preparation Phase	0%	184 d	21/06/2013	05/03/2014
91	DD.D21.T	Tender Phase	0%	115 d	06/03/2014	13/08/2014
92	DD.D21.I	Implementation phase	0%	409 d	14/08/2014	08/03/2016
93	**DD.D42**	**Project D4.2 - Dismantling of reactor coolant system large components**	**0%**	**2059 d**	**11/01/2013**	**02/12/2020**
94	DD.D42.G	GA Phase	0%	258 d	11/01/2013	07/01/2014
95	DD.D42.P	Preparation Phase	0%	249 d	28/02/2014	11/02/2015
96	DD.D42.T	Tender Phase	0%	139 d	12/02/2015	25/08/2015
97	DD.D42.I	Implementation phase	0%	1376 d	26/08/2015	02/12/2020
98	**DD.D43**	**Project D4.3 - Dismantling of insulation in the V1 NPP Controlled Area**	**22%**	**1043 d**	**21/11/2011**	**18/11/2015**
99	DD.D43.G	GA Phase	100%	172 d	21/11/2011	17/07/2012
100	DD.D43.P	Preparation Phase	0%	165 d	01/08/2013	19/03/2014
101	DD.D43.T	Tender Phase	0%	139 d	20/03/2014	30/09/2014
102	DD.D43.I	Implementation phase	0%	296 d	01/10/2014	18/11/2015
103	**DD.D44A**	**Project D4.4A - Auxiliary building systems removal**	**26%**	**1460 d**	**01/06/2011**	**03/01/2017**
104	DD.D44A.G	GA Phase	100%	141 d	01/06/2011	14/12/2011
105	DD.D44A.P	Preparation Phase	40%	561 d	25/01/2012	19/03/2014
106	DD.D44A.T	Tender Phase	0%	139 d	20/03/2014	30/09/2014
107	DD.D44A.I	Implementation phase	0%	590 d	01/10/2014	03/01/2017
108	**DD.D44B**	**Project D4.4B - Systems removal in control area Part I**	**18%**	**1766 d**	**21/11/2011**	**27/08/2018**
109	DD.D44G	GA Phase	100%	282 d	21/11/2011	18/12/2012
110	DD.D44P	Preparation Phase	0%	247 d	06/09/2013	18/08/2014
111	DD.D44T	Tender Phase	0%	151 d	19/08/2014	17/03/2015
112	DD.D44I	Implementation phase	0%	899 d	18/03/2015	27/08/2018
113	**DD.D44C**	**Project D4.4C - Systems removal in control area Part II**	**4%**	**2072 d**	**11/01/2013**	**21/12/2020**
114	DD.D44C.G	GA Phase	20%	369 d	11/01/2013	11/06/2014
115	DD.D44C.P	Preparation Phase	0%	264 d	28/02/2014	04/03/2015



Bohunice V1 NPP - Stage II Decommissioning General Time Schedule

Id	WBS	Activity Name	% Complete	Duration	Start	Finish
116	DD.D44C.T	Tender Phase	0%	139 d	05/03/2015	15/09/2015
117	DD.D44C.I	Implementation phase	0%	1274 d	03/02/2016	21/12/2020
118	**BD**	**Buildings Decontamination**	**0%**	**1440 d**	**06/06/2016**	**10/12/2021**
119	**BD.D45**	**Project D4.5 - Buildings Decontamination**	**0%**	**1440 d**	**06/06/2016**	**10/12/2021**
120	BD.D45.G	GA Phase	0%	146 d	06/06/2016	26/12/2016
121	BD.D45.P	Preparation Phase	0%	171 d	27/12/2016	22/08/2017
122	BD.D45.T	Tender Phase	0%	136 d	23/08/2017	28/02/2018
123	BD.D45.I	Implementation phase	0%	987 d	01/03/2018	10/12/2021
124	**DB**	**Demolition and backfilling**	**0%**	**1526 d**	**05/12/2016**	**10/10/2022**
125	**DB.D46**	**Project D4.6 - Buildings Demolition & Backfilling**	**0%**	**1526 d**	**05/12/2016**	**10/10/2022**
126	DB.D46.G	GA Phase	0%	150 d	05/12/2016	30/06/2017
127	DB.D46.P	Preparation Phase	0%	232 d	03/07/2017	22/05/2018
128	DB.D46.T	Tender Phase	0%	156 d	23/05/2018	26/12/2018
129	DB.D46.I	Implementation phase	0%	988 d	27/12/2018	10/10/2022
130	**SR**	**Site Restoration**	**0%**	**1637 d**	**15/05/2017**	**22/08/2023**
131	**SR.D61**	**Project D6.1 - Site restoration cleanup and landscaping**	**0%**	**1637 d**	**15/05/2017**	**22/08/2023**
132	SR.D61.G	GA Phase	0%	165 d	15/05/2017	29/12/2017
133	SR.D61.P	Preparation Phase	0%	230 d	01/01/2018	16/11/2018
134	SR.D61.T	Tender Phase	0%	157 d	19/11/2018	25/06/2019
135	SR.D61.I	Implementation phase	0%	1085 d	26/06/2019	22/08/2023
136	**FS**	**Final Survey & Site Release**	**0%**	**1468 d**	**18/05/2020**	**31/12/2025**
137	**FS.D62**	**Project D6.2 - Final Survey & Site Release**	**0%**	**1468 d**	**18/05/2020**	**31/12/2025**
138	FS.D62.G	GA Phase	0%	164 d	18/05/2020	31/12/2020
139	FS.D62.P	Preparation Phase	0%	230 d	01/01/2021	18/11/2021
140	FS.D62.T	Tender Phase	0%	150 d	19/11/2021	16/06/2022
141	FS.D62.I	Implementation phase	0%	924 d	17/06/2022	31/12/2025



Annex 2. Dismantling and stages of processing of activated materials from PC

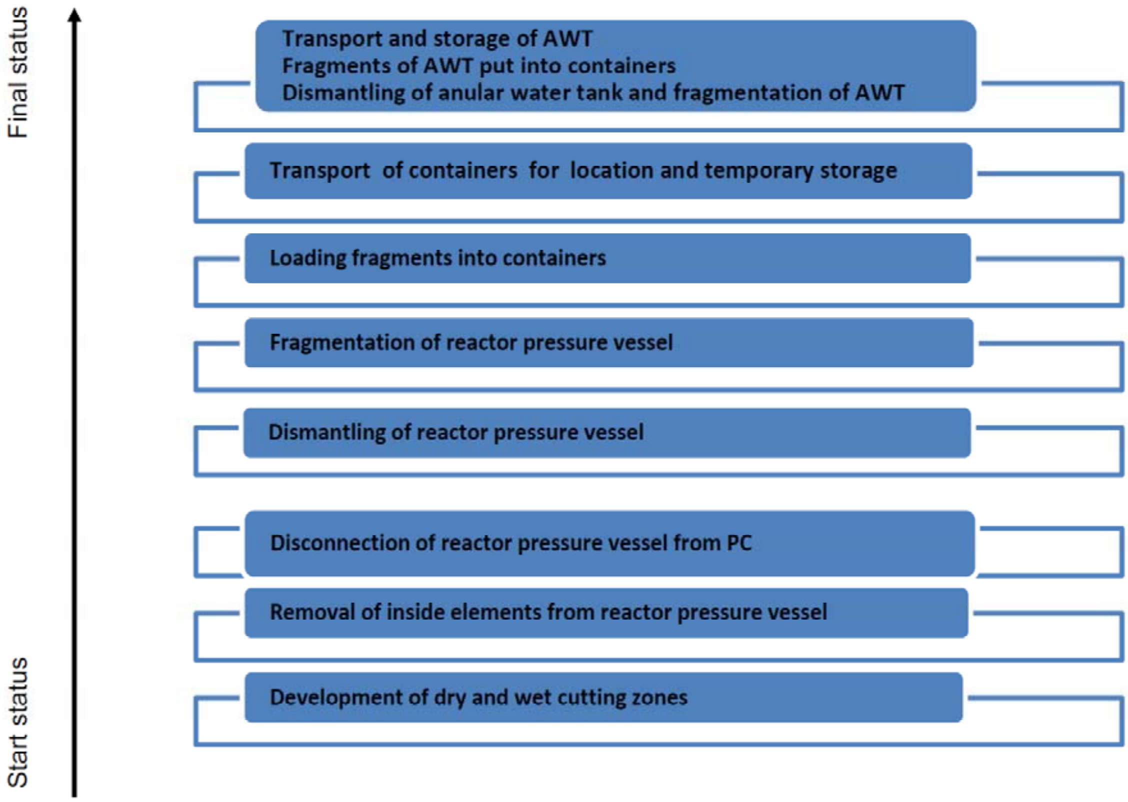
KIND OF FACILITIES	DESMANTLING AND WASTE TREATMENT STAGES (FROM LEFT TO RIGHT)					
	Dismantling of facility and manipulation				Transport In situ and storage	Final treatment, transport, storage
	Preparation	Dismantling	Size reduction	Treatment		
Reactor pressure vessel (RPV)	*Cutting off from all joints/connections* *Removal of internal elements*	*As the whole unit*	*Remote dry cutting*	*Separation LA RAW from MA RAW ;* *Loading of MA RAW into protective containers* *Loading LA RAW into FCC*	*LA RAW: Reactor hall -> out by lorry* *MA RAW: Reactor hall -> interim storage by a lorry*	*LA RAW : in RSRAW – in FCC by a lorry ;* *MA RAW: Storage in protective containers in interim storage facility*
Inside reactor elements	*Removal from RPV*	*Removal from PVR as the whole*	*Remote wet cutting*	*Separation LA RAW from MA RAW;* *Loading MA RAW into protective containers MA RAW* *Loading of LA RAW into FCC*	*LA RAW: Reactor hall -> out by lorry* *MA RAW: Reactor hall -> interim storage by a lorry*	*LA RAW : in RS RAW – in FCC by a lorry ;* *MA RAW: Storage in protective containers in interim storage facility*
Biological protection of the annular water tank	*Installation of shielding*	*Cutting off big fragments*	*In situ by steel rope in dry cutting zone*	*Separation of VLA RAW from LA RAW*	*Reactor hall*	*Into RS RAW– in ISO or FCC containers by a lorry*
Shielding sets in AZ	*No*	*Removal from spent fuel pool as a whole*	*No*	*Loading into protective containers (MOSAIK or similar)*	*Reactor hall -> interim storage by lorry*	*Storage in protective containers in interim storage facility*

Annex 3. Dismantling and stages of processing of contaminated materials from PC

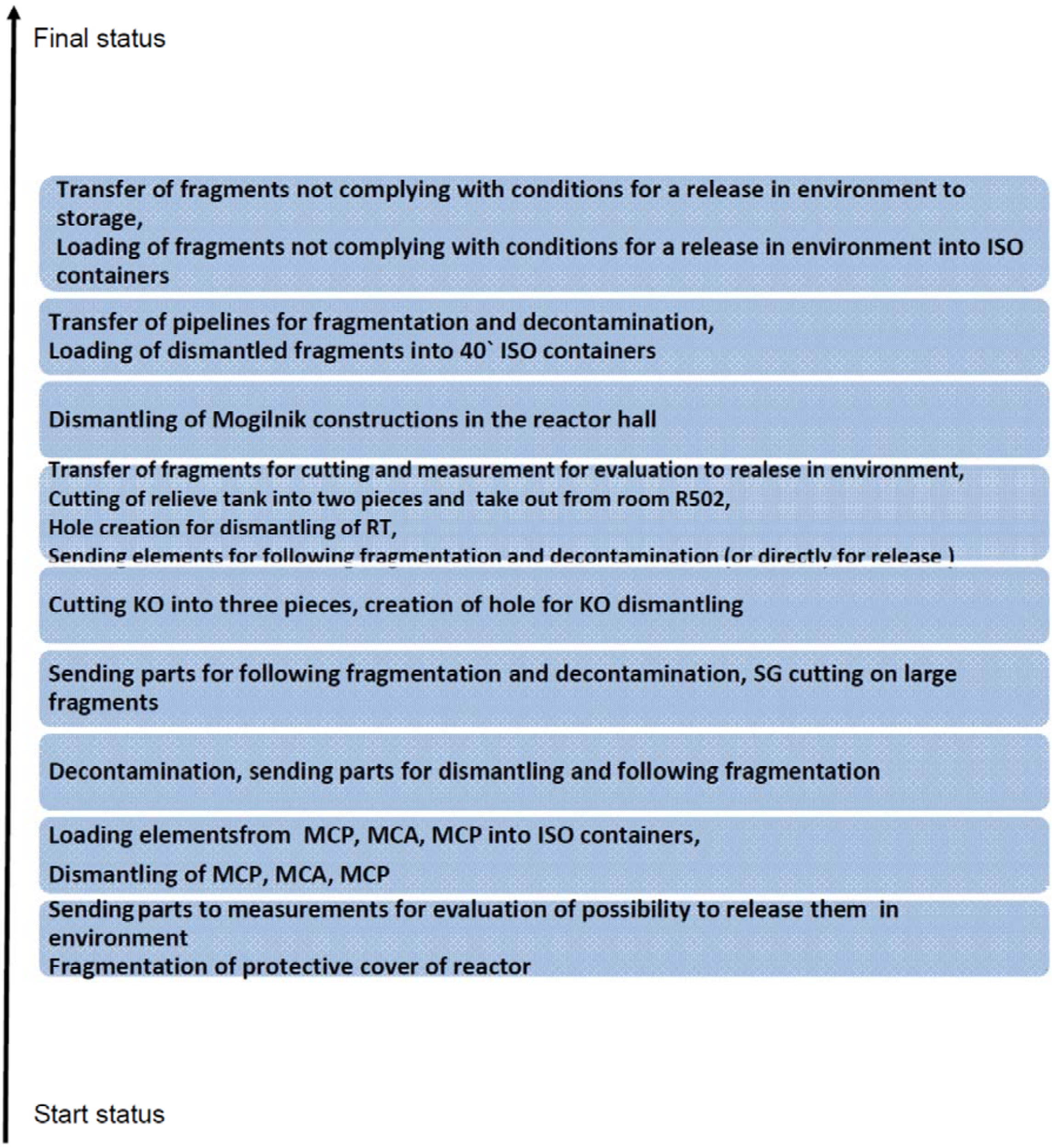
KIND OF FACILITIES	DISMANTLING AND WASTE TREATMENT STAGES (FROM LEFT TO RIGHT)					
	Dismantling of facility and manipulation				Transport In situ and storage	Final treatment, transport, storage
	Preparation	Dismantling	Size reduction	Treatment		
Steam generator (SG)	*Cutting off from all joints*	*In situ cutting by thermal (the main) and mechanical (following) cutting*	*In situ*	*Ultrasound or electro-chemical decontamination in C7-A3 or C7-A2*	*Reactor hall ->C7-A3 by a crane* *Reactor hall -> C7-A2 by a lorry*	*release in environment – on pallet carrier by a lorry;* *in RS RAW-in FCC by a lorry*
Main circulation pumps	*Dismantling from deck of MCP*	*In situ cutting by thermal (the main) and mechanical (following) cutting*	*In situ*	*Ultrasound or electro-chemical decontamination in C7-A3 or C7-A2*	*Reactor hall ->C7-A3 by a crane* *Reactor hall -> C7-A2 by a lorry*	*release in environment – on pallet carrier by a lorry;* *in RS RAW-in FCC by a lorry*
Main shut-off valves	*Dismantling from deck of MCP*	*In situ cutting by thermal (the main) and mechanical (following) cutting*	*In situ*	*Ultrasound or electro-chemical decontamination in C7-A3 or C7-A2*	*Reactor hall ->C7-A3 by a crane* *Reactor hall -> C7-A2 by a lorry*	*release in environment – on pallet carrier by a lorry;* *in RS RAW-in FCC by a lorry*
Main loop pipes	-	*In situ cutting to get small fragments by circular cutter and other equipment*	*In situ*	*Ultrasound or electro-chemical decontamination in C7-A3 or C7-A2*	*Reactor hall ->C7-A3 by a crane* *Reactor hall -> C7-A2 by a lorry*	*release in environment – on pallet carrier by a lorry;* *in RS RAW-in FCC by a lorry*
Pressurizer	*Cutting off all joints* *Decontamination in a box of SG*	*In situ cutting to get small fragments*	*In situ*	*Not required*	*Reactor hall -> by a lorry*	*release in environment – on pallet carrier by a lorry;*
Spillway tank	*Demolition of constructions;* *Cutting off from all joints*	*In situ cutting to get large fragments*	*Following cutting in SG box*	*Not required*	*Reactor hall -> by a lorry*	*release in environment – on pallet carrier by a lorry;*

KIND OF FACILITIES	**DISMANTLING AND WASTE TREATMENT STAGES (FROM LEFT TO RIGHT)**					
	Dismantling of facility and manipulation				**Transport In situ and storage**	**Final treatment, transport, storage**
	Preparation	**Dismantling**	**Size reduction**	**Treatment**		
Mogilnik	*Preparation of temporary containment (tent) with ventilation over Mogilnik; demolition of concrete*	*As a whole*	*Mechanical cutting in SG box*	*Pipes: US or ECh decontamination in C7-A2;* *Concrete: abrading in C7-A3*	*Reactor hall ->C7-A3 by a crane* *Reactor hall -> C7-A2 by a lorry*	*release in environment - container of fragments/chips on pallet carrier in FCCs by a lorry in RS RAW;*
Reactor cover	*Preparation of temporary containment (tent) with ventilation of reactor hall*	*As a whole by a standard procedure*	*Concrete: pneumatic hammers;* *Metal: thermal cutting*	*Not required*	*By a crane in the reactor hall*	*release in environment - container of fragments/chips on pallet carrier in FCCs by a lorry*

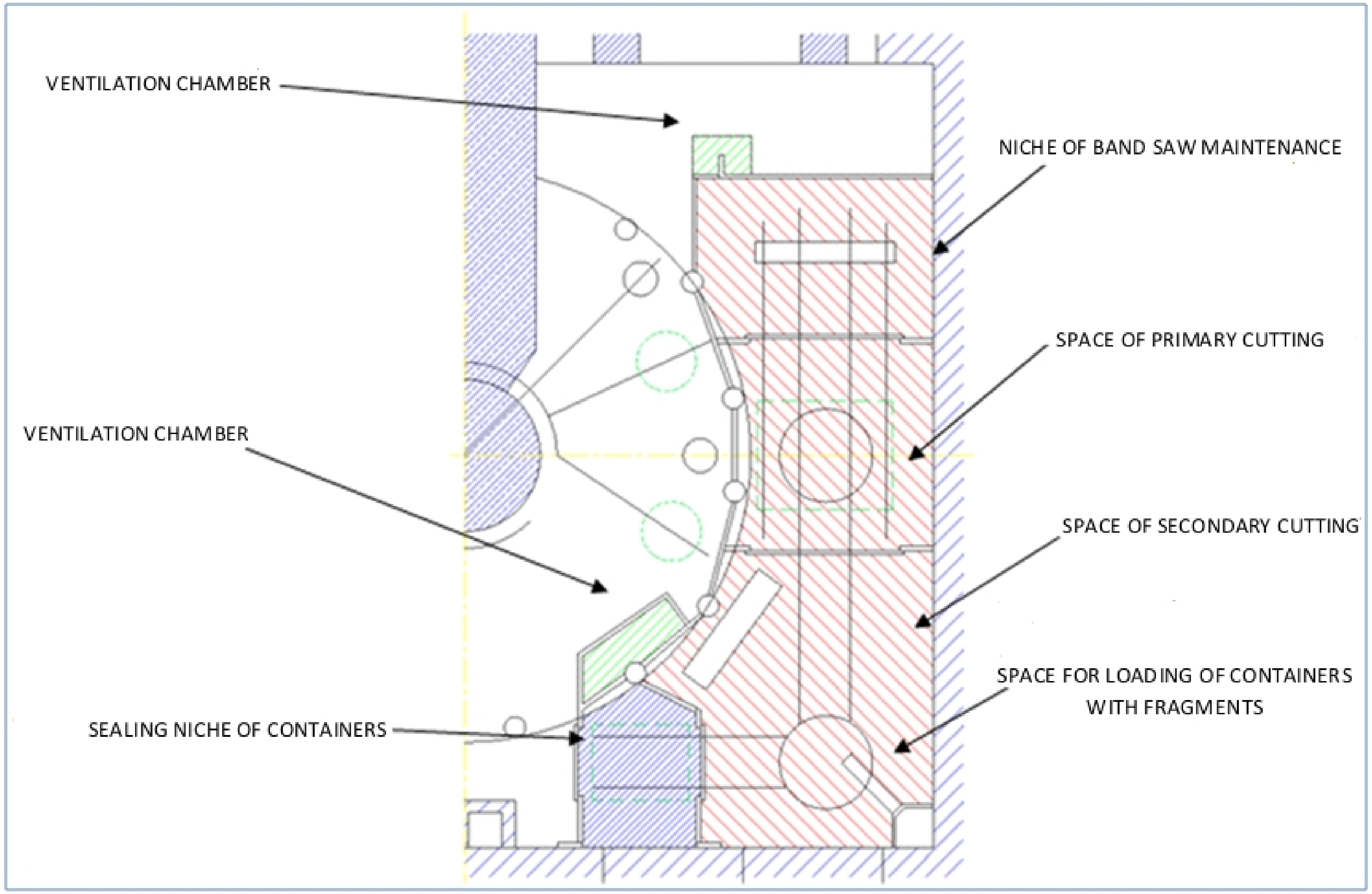
Annex 4. Order of dismantling activities and processing of activated materials


Final status
Transport and storage of AWT
Fragments of AWT put into containers
Dismantling of anular water tank and fragmentation of AWT
Transport of containers for location and temporary storage
Loading fragments into containers
Fragmentation of reactor pressure vessel
Dismantling of reactor pressure vessel
Disconnection of reactor pressure vessel from PC
Removal of inside elements from reactor pressure vessel
Development of dry and wet cutting zones
Start status

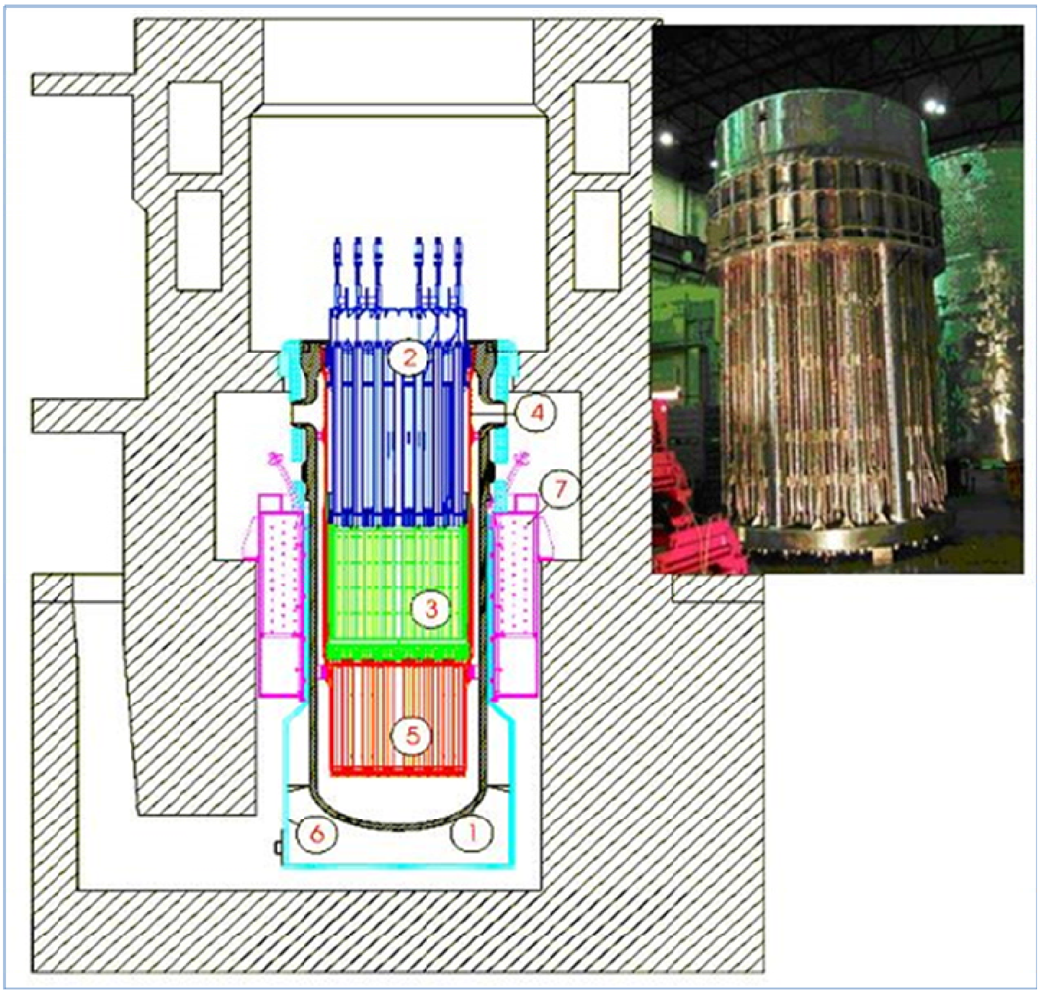
Annex 5. Order of dismantling activities and processing of contaminated materials


Final status
Transfer of fragments not complying with conditions for a release in environment to storage,
Loading of fragments not complying with conditions for a release in environment into ISO containers
Transfer of pipelines for fragmentation and decontamination,
Loading of dismantled fragments into 40` ISO containers
Dismantling of Mogilnik constructions in the reactor hall
Transfer of fragments for cutting and measurement for evaluation to realese in environment,
Cutting of relieve tank into two pieces and take out from room R502,
Hole creation for dismantling of RT,
Sending elements for following fragmentation and decontamination (or directly for release)
Cutting KO into three pieces, creation of hole for KO dismantling
Sending parts for following fragmentation and decontamination, SG cutting on large fragments
Decontamination, sending parts for dismantling and following fragmentation
Loading elementsfrom MCP, MCA, MCP into ISO containers,
Dismantling of MCP, MCA, MCP
Sending parts to measurements for evaluation of possibility to release them in environment
Fragmentation of protective cover of reactor
Start status

Annex 6. Ground plan of the area for cutting of the reactor vessel


VENTILATION CHAMBER
NICHE OF BAND SAW MAINTENANCE
SPACE OF PRIMARY CUTTING
VENTILATION CHAMBER
SPACE OF SECONDARY CUTTING
SPACE FOR LOADING OF CONTAINERS WITH FRAGMENTS
SEALING NICHE OF CONTAINERS

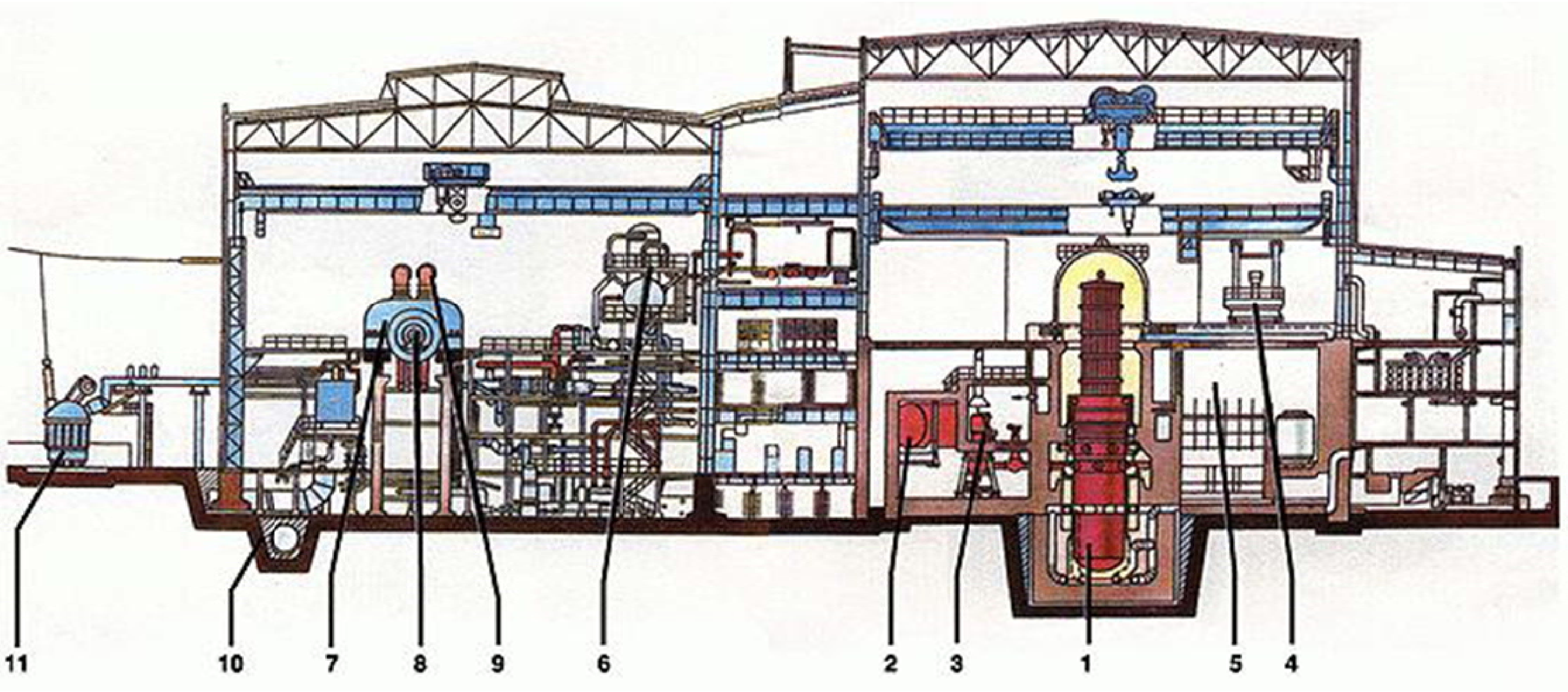
Annex 7. Placement of the inner reactor components into the RPV - Complex view of the control rods unit



Explanations:

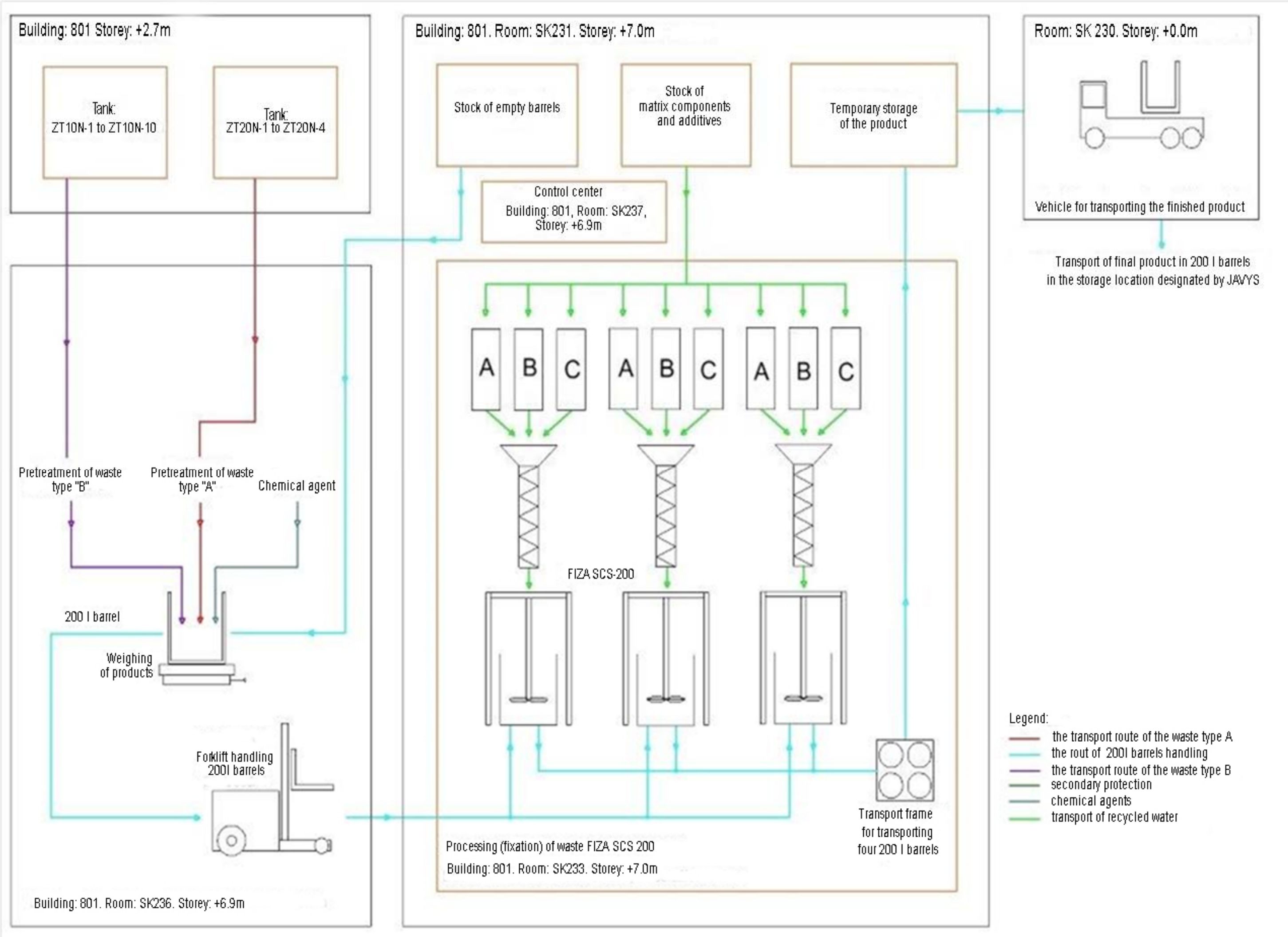
1. **Reactor pressure vessel**
2. **Block of protective tubes**
3. **AZ basket**
4. **Reactor shaft**
5. **Bottom of reactor shaft**
6. **Insulation of RPV**
7. **Annular water tank**

Annex 8. Typical configuration of the reactor VVER 440 type V-230



1. Reactor, **2**. Steam generator, **3**. Main circulation pump, **4**. Machine of loading, **5**. Cooling pool, **6**. De-aerator, **7**. Steam turbine, **8**. Generator, **9**. Steam pipelines, **10**. Cooling water pipelines, **11**. Transformer

Annex 9. HRAW processing scheme


Building: 801 Storey: +2.7m
Tank: ZT10N-1 to ZT10N-10
Tank: ZT20N-1 to ZT20N-4
Building: 801. Room: SK231. Storey: +7.0m
Stock of empty barrels
Stock of matrix components and additives
Temporary storage of the product
Control center Building: 801, Room: SK237, Storey: +6.9m
Room: SK 230. Storey: +0.0m
Vehicle for transporting the finished product
Transport of final product in 200 l barrels in the storage location designated by JAVYS
A B C A B C A B C
FIZA SCS-200
Pretreatment of waste type "B"
Pretreatment of waste type "A"
Chemical agent
200 l barrel
Weighing of products
Forklift handling 200l barrels
Building: 801. Room: SK236. Storey: +6.9m
Processing (fixation) of waste FIZA SCS 200
Building: 801. Room: SK233. Storey: +7.0m
Transport frame for transporting four 200 l barrels
Legend:
the transport route of the waste type A
the rout of 200l barrels handling
the transport route of the waste type B
secondary protection
chemical agents
transport of recycled water

Annex 10. Information on meeting the requirements of the Scope of assessment

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
Ministry of Environment of the Slovak Republic, Department of Environmental Assessment		2.2.1	To include in the EIR all projects which will not be finished in the 1st stage of decommissioning of the Nuclear Power Plant V1 (V1 NPP) in Jaslovské Bohunice and will be shifted to the 2nd phase. To assess environmental impacts of all activities to be carried out in the 2nd stage of V1 NPP decommissioning including activities which were shifted from the 1st stage to the 2nd stage and activities which were not or were not sufficiently assessed in the frame of the *"Report on the Environmental Impact Assessment of V1 NPP Decommissioning" - 1st stage*.	In Part A., Chapter II.8 all activities which will be implemented during the 2nd stage of V1 NPP decommissioning are described. Present status and planned status after the 1st stage of decommissioning is presented in several pictures in chapter A. Annexes No. 15 and 18 provide the explicit description of the current status of installations/objects .
		2.2.2	o quantify properly, understandably and in technical units the scope of the individual activities.	In Chapters B.I and B. II the inputs and outputs of proposed activity are described and assessed in technical units.
Ministry of Environment of the Slovak Republic, Department of Air Protection	Do not have any comments to proposed activity.	-	To keep clauses from Act on Air Protection and also to limit dust during disassembling works, demolishing of houses, cleaning communications and vehicles and also not to increase emission of dust particles and PM10.	Impact on air quality is assessed in Part C, Chapter III.4.2. Proposal of mitigation and preventive measures for this issue are stated in Part C, Chapter IV.3.5.
Ministry of Environment of the Slovak Republic, Department of Environmental Risks and Biological Safety	-	-		-
Ministry of Interior of the Slovak Republic, Presidium of Firemen and Rescuers Body, Bratislava	-	-		-
Ministry of Economy of the Slovak Republic, Bratislava	Agrees with proposed alternative 1, when all the legislative requirements and specified terms will be performance.	2.2.3	o correct picture 5 on page 8 of PES so it reflects the current status of decommissioning.	Formal comment accepted, in EIS new pictures are inserted.
		2.2.4	o synchronize the text with the table content. Fragmentation of shielding cassettes is considered on page 19 of PES although the table on page 135 does not contain this activity.	Formal comment accepted, fragmentation chapter is newly elaborated.

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
		2.2.5	o put down in the EIR that the proposed activity represents a continuation of the decommissioning process on the Bohunice V1 site within the frame of its 2nd stage in the period of 2015 – 2025. In connection with the choice of the specific option it is desirable to mention the fact that SR committed itself to decommission V1 NPP in course of the negotiations on the accession of SR to EU. Interrupting the decommissioning process would represent a breach of international commitments of SR and, moreover, SR would lose the financial means granted from BIDSF.	Comments accepted and new explanation is inserted to the text part.
		2.2.6	To provide meaningful reasoning for the selection of alternative 1 for the 2nd stage of decommissioning of the V1 NPP which represents the most complex part of decommissioning with the most significant environmental impacts in the area of radiation. For this reason an assessment of these activities in more detail is required.	Accepted. In the Part A, Chapter II.2 it is explained, that project is continuation and completion of decommissioning of the V1 NPP. In the Part A, Chapter II.6 is stated that decommissioning of V1 NPP is needed also because it was one of the conditions before the Slovak Republic became the member of EU.
		2.2.7	To standardize the entire PES text regarding technical and formal issues, mainly as far as introduction and uniform usage of abbreviations is concerned, usage of exact denominations, correct citation of legislation and usage of a uniform nomenclature throughout the text.	Formal comment accepted.
		2.2.8	To add proposal of time schedule and sequence of particular main activities of 2nd stage from the reason that it is needed to explain their eventual impact, when they will be performed, on evaluation of radiation health hazards.	Time schedule is described in Annex 1.
		2.2.9	To describe individual activities of decommissioning which, so far, are too general, not certain and little specified, in particular, regarding the technical solution as well as the radiation protection of persons (pages 11 – 36 of PES).	In the Part A, Chapter II.8 new and detailed description of individual activities of decommissioning is added.

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
		2.2.10	o add the value of expected radiation loads for each activity and working place.	In the Part B, Chapter II.5 values of expected radiation loads from each activity are inducted .
		2.2.11,	To specify in more details the space where steam generators will be cut.	Specified in Part A, Chapter II.8.
		2.2.12,	o indicate more precisely where the space for fragmentation (in particular in respect to the activities of the chapters 2.8.2.1 and 2.8.2.2) will be located and what the terms "*lower and upper part of the reactor*" and "*central part of the reactor pressure vessel*" refer to. To provide a method of removing and handling of the hermetic impulse and cable glands.	Specified in Part A, Chapter II.8.
		2.2.13,	Page 18 - the PES should determine the methods of fragments transport and employee protection against radiation during fragments storage.	Specified in Part A, Chapter II.8.
		2.2.14	o provide information on how, when and, first of all, where the activated materials and the content of mogilnik will be treated and stored, which from the point of view of radiation protection represents one of the most hazardous activities.	Specified in Part A, Chapter II.8.
		2.2.15	o provide information on how activated materials will be stored or disposed of.	Specified in Part A, Chapter II.8.
		2.2.16	To explain a discrepancy in PES, which on page 32 states that "*demolition of objects, including cooling towers ...*" will be carried out in the 2nd stage while on page 8 it informs that demolition of cooling towers took place in the 1st stage.	Specified in Part A, Chapter II.8.
		2.2.17	o provide consistent information in respect to the shredder since the PES, on one hand, states that the shredder will be provided by the company in charge of demolition works and, on the other hand, it indicates the necessity to buy such a device and provides its general characteristics.	Formal comment accepted. Shredder will be provided by the company providing demolition works.
		2.2.18	To explain the origin and reasons for the total costs of the 2nd stage of decommissioning in more details.	Accepted and specified in Part A, Chapter II.10.

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
		2.2.19	To indicate whether the PES presupposes higher water consumption which could be also due to measures for reduction of dust generated mainly during demolition.	In Part B, Chapter I.2. any major changes of water consumption due to measures for dust reduction are not expected .
Nuclear Regulatory Authority of the Slovak Republic		2.2.1	To include in the EIR all projects which will not be finished in the 1st stage of decommissioning and will be shifted to the 2nd stage of decommissioning and specify them in EIR. In PES, there are inconsistencies in description of technical solutions.	In Part A, Chapter II.8 the activities, which will be shifted from the 1st stage to the 2nd stage of decommissioning are described , the current real status is defined in Annexes 15 and 18. Description of technical solutions in EIS is provided in different way in comparison with PES, it is more comprehensive than in PES.
Public Health Authority of the Slovak Republic	-	-		-
Regional Authority of Public Health with permanent representation in Trnava	-	-		-
District Environmental Authority in Trnava – Department of protection of nature, chosen elements of the environment and appeal proceedings by the region	Approval	-		-
District Environmental Authority in Piešťany – Department of State Water Management, Nature and Landscape Protection, Department of Environmental Hazards Management	-	-		-

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
District Authority in Piešťany – Department of Civil Protection and Crisis Management	-	-		-
District Environmental Authority in Trnava – Department of protection of nature, chosen elements of the environment and appeal proceedings by the region	Conditional approval conditional by keeping specified conditions.	2.2.20	o provide impact assessment on the surrounding protected areas and the subjects they are designed to protect, protected trees as well as elements of ecological stability systems, significant landscape elements, protected species and biotopes of national and European importance during construction and operation. (NATURA 2000 : SKCHVU056 Protected bird territory Špačinsko – nižnianske polia, declared with effect as of 15th February 2011 by Regulation of the MoE SR No. 27/2011 Coll. according to § 26 para. 6 Act No. 543/2002 Coll. on Protection of Nature and Landscape).	Compliance with legal regulations is a necessity and it is joined with implementation stage. Impact assessment on the surrounding protected areas and the subjects of protection , protected trees as well as elements of ecological stability systems, significant landscape elements, protected species and biotopes of national and European importance was elaborated by the expert on landscape protection in Part C, Chapter III.9 after consultation of scope with District Environmental Office in Trnava.
District Environmental Authority in Trnava, Permanent representation in Hlohovec – Department of protection of nature, chosen elements of the environment and appeal proceedings by the region	Conditional agreement, when will be keep specified terms in the field of waste management.	-		Requirements are related to implementation stage and they are required in compliance with Act on Waste No. 223/2001 Coll. as amended.
District Authority for Construction in Trnava – Department of construction and housing policy	-	-		-

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
District Authority for Road Transport and Land Communications Trnava	Pay attention on necessity to keep terms of Road Act of NC SR No. 135/1961 Coll. in current statutory text and Announcement No. 35/1984 Coll.	-		-
Regional Directorate of the Fire and Rescue Body in Trnava	-	-		-
District Authority for Road Transport and Land Communications in Piešťany	Conditional approval, when will be keeping legal regulations	-		
Trnava Self-Governing Region Authority, Department of Economic Strategies	Approval	-		-
Municipality Dolné Dubové	-	2.2.22	o add comparisons on how similar nuclear facilities have been decommissioned in other countries.	Experiences from decommissioning NPP in other countries are stated in Annex 17.
		2.2.23	To indicate the intensity of RAW transport to the National Radioactive Waste Repository in Mochovce in order to assess the increase of road traffic.	Impact on road traffic was assessed in Part C, Chapter III.16.1. It is expecting 1 000 – 1 500 transits between Jaslovske Bohunice and Mochovce during whole decommissioning stage, what does not mean noticeable increase of road traffic in the affected area.
Municipality Jaslovske Bohunice	-	-		-
Municipality Malzenice	-	-		-
Municipality Pecenady	Approval	-		-
Municipality Radosovce	Approval	-		-

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
Municipality Ratkovce	Approval	--		-
Municipality Velke Kostolany		2.2.24	To provide a proposal for removal of potential sources of groundwater and rock environment contamination by tritium. To describe how to maintain a good condition of groundwater and surface water as required by the provisions of the Act of NC SR No. 364/2004 Coll. on Waters (Water Act) and the Act of NC SR No. 269/2010 Coll. on Establishment of Requirements for Achieving a Good Condition of Waters.	In Part C, Chapters II.6, 16 and III.2 the situation of rock environment and water contamination by tritium and also solution of this problem is described in details. Main contamination source of rock environment and groundwater by tritium is not V1 NPP , but A1 NPP . However, also decommissioning of V1 NPP will contribute to improvement of this situation, because the building, which contributes to contamination will be removed and final remediation will be simpler. Disposal of radioactive waste is described in Part A, Chapter II.8.
Slovak Environmental Agency		2.2.25	o quantify the amount of very law activated (VLA) RAW with values under 300 Bq/m^3 considering the announced amendment of EU law by which the limit of release of radioactive substances into the environment shall be changed.	Specified in Part B, Chapter II.3 and Annex 16.
		2.2.26	o indicate whether the proposed activity is expected to cause changes in water from surface drainage which is released into the rivers Horný Dudváh and Váh in connection with the legal effect of the Decision issued 13th July 2006, No. KUŽP-1/2006/00273/Fr including its amendments.	Impacts on surface water are described in Part C, Chapter III.5.
		2.2.27	To provide more detailed data and information on chemical, toxicological and radiological characteristics of active compounds in waste, which will be subject to treatment and compounds used during treatment. In particular, we recommend to deal with waste containing asbestos.	Whole waste characteristic, including hazardous waste and radioactive waste, is specified in Part B, Chapter II.3. Extra attention was focused on the waste containing asbestos and disposal of this waste.

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
		2.2.28	To define the kind of transport in respect to the expected amounts of transported materials, the main transport routes, transport safety measures applicable to transport of hazardous waste and RAW and mitigation measures to avoid their uncontrolled release into environment, or elimination of the consequences of an eventual release.	Handling of conventional waste and radioactive waste, including transportation, was assessed in Part B, Chapter II.3 and in Part C, Chapter III.1. Transport of radioactive waste in term of risk assessment and safety is described in separate study specified in annex 14.
		2.2.29	To describe the implementation in the working environment of Act No. 124/2006 Coll. on Labor Inspection and on amendment and supplement of the Act No. 355/2007 Coll. on on Protection, Support and Development of Public Health and on Amendments and Supplements to Certain Acts, as well as other generally binding legal acts for protection of safe working conditions and the health of employees from effects of negative working factors.	Described in Part C, Chapter IV.4 (JAVYS).
		2.2.30	To describe the way of impacts evaluation, which are assessed in term of health hazards not only of assessed PES, but also impacts from other devices, which are operated in wider area under standard conditions. To subject the V1 NPP decommissioning activities to an assessment of the impacts of accidental release of radioactive substances and other compounds in different states of matter into the environment (soil, water and air) in case of potential operational breakdowns and accidents in respect to the exposition of the public.	V1 NPP is a part of nuclear complex which includes A1 NPP in decommissioning process; V2 NPP is still in operation as well as the treatment and storage of radioactive waste. Cumulative impacts were assessed due to health of citizens in Part C, Chapter III.1.

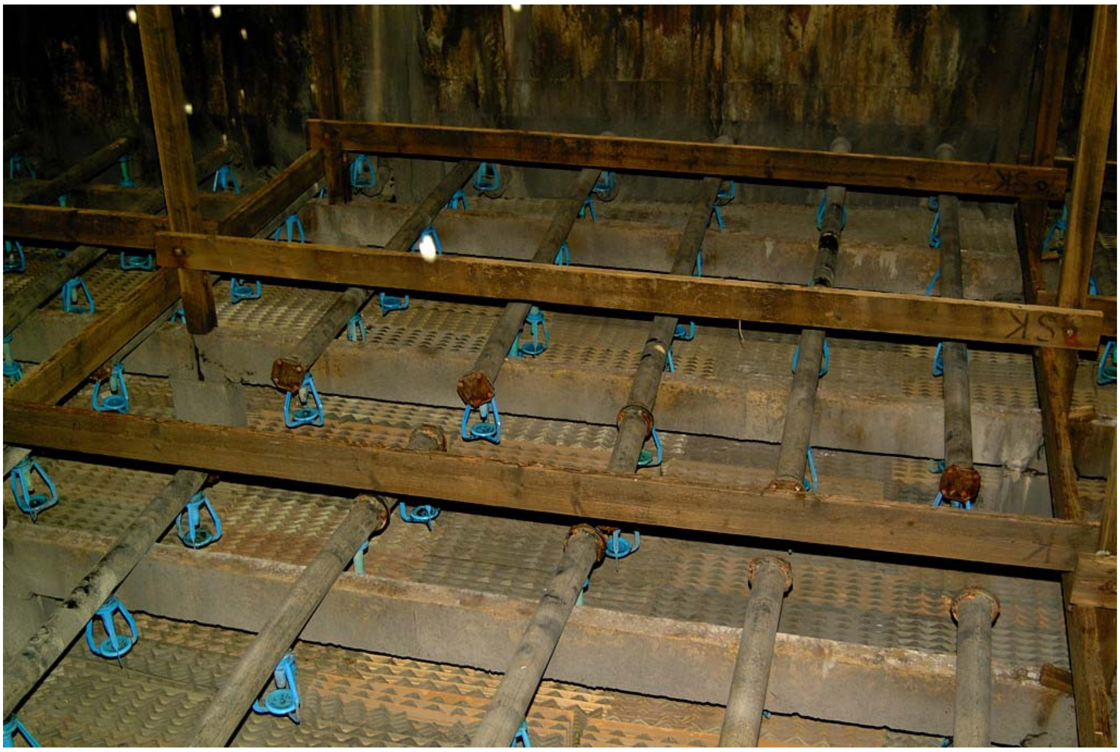
Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
		2.2.31	o evaluate if there is sufficient storage and repository capacity for all kinds of radioactive waste originating from V1 NPP decommissioning.	Storage capacities have been assessed in individual projects and EIA processes. To the NRR Mochovce only LA RAW and VLA RAW will be importing. Necessity to enlarge total capacity for the storage of this waste, not only from the V1 NPP decommissioning, but also from the A1 NPP decommissioning and other sources of radioactive waste, was assessed individually in compliance with EIA Act (Project BIDSF C9.1).
		2.2.32	To describe the load on citizens resulting from environment contamination caused by release of solid low-level-contaminated materials into the environment. With regard to the big volume of materials which will be released into the environment for recycling, further use or disposal on landfills it is to be expected that exposition of critical groups of the public to radiation will not be low.	Disposal of radioactive waste is described in Part B, Chapter II.3. and there are also total amounts of released materials in relation to possible impact on human health.
		2.2.33	o provide information on how the monitoring system on the release of low-level-contaminated materials from administrative supervision is ensured during the whole period of decommissioning. To describe how evaluation of all monitored activities in regular periods is ensured and how the results of monitoring are regularly submitted to the affected authorities and institutions.	All monitoring activities are specified in Part C. IV.
		2.2.34	o describe the treatment, conditioning, recovery or disposal of other and hazardous wastes which are not activated and are treated or disposed of in waste treatment facilities according to the Act No. 223/2001 Coll. on Wastes and on Alternations and Amendments to some Acts, as amended.	Conventional waste handling (category of other and dangerous waste) must be in compliance with Act on Waste No. 223/2001 Coll. In later wordings - but it is obligatory condition for implementation stage.

Authority	Record: Statement approval/ disapproval	Scoping requirements Ord. No.	Text of requirement from Scoping	Evaluation of requirements fulfillment/ Reference on EIR/Notes
		2.2.35	o execute a consistent analysis of any other comments arising from standpoints submitted by the EIA process participants on PES and to pay due consideration to reasonable comments in the EIR.	It is a part of this Annex.
		2.2.36	o evaluate in written form the fulfillment of all requirements and recommendations submitted in standpoints on PES and the fulfillment of the individual parts of this Scope of Assessment and the time schedule for the proposed activity.	Evaluation was performed by this table.

Annex 11. Photographic documentation of the current state of the affected area

Picture No. 1 Nuclear facilities in Jaslovské Bohunice (JAVYS, a.s. and SE, a.s.)

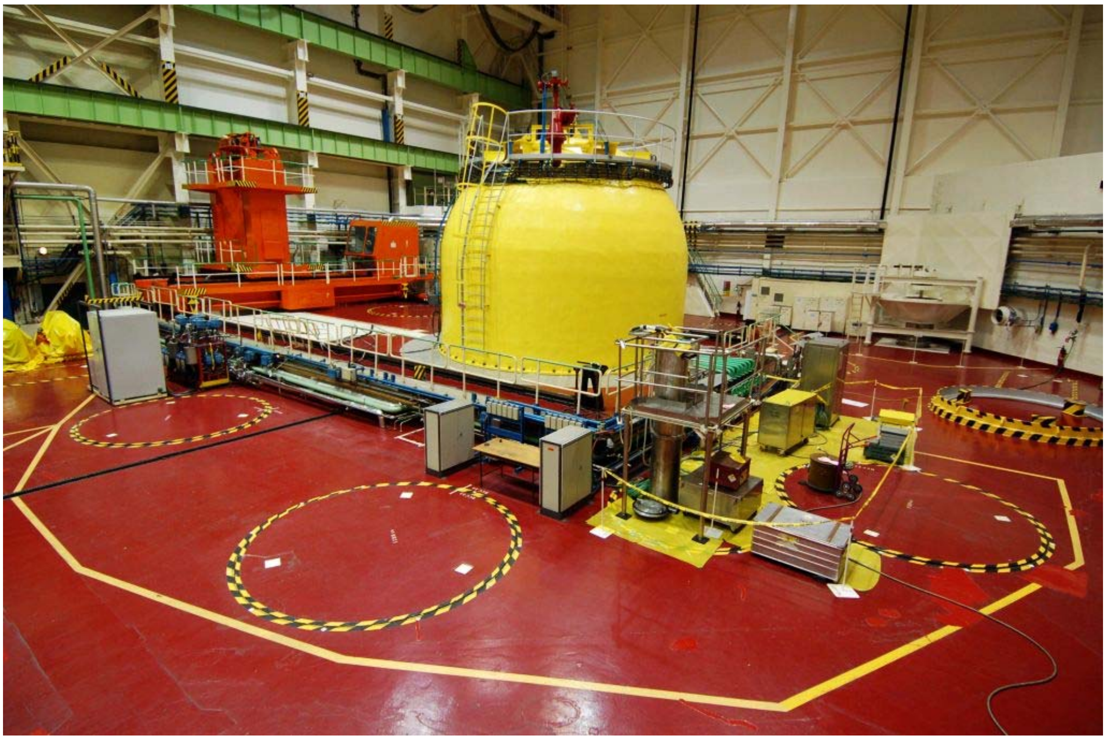
Picture No. 2 V1 Nuclear Power Plant - Cooling towers of V1 and V2 NPP



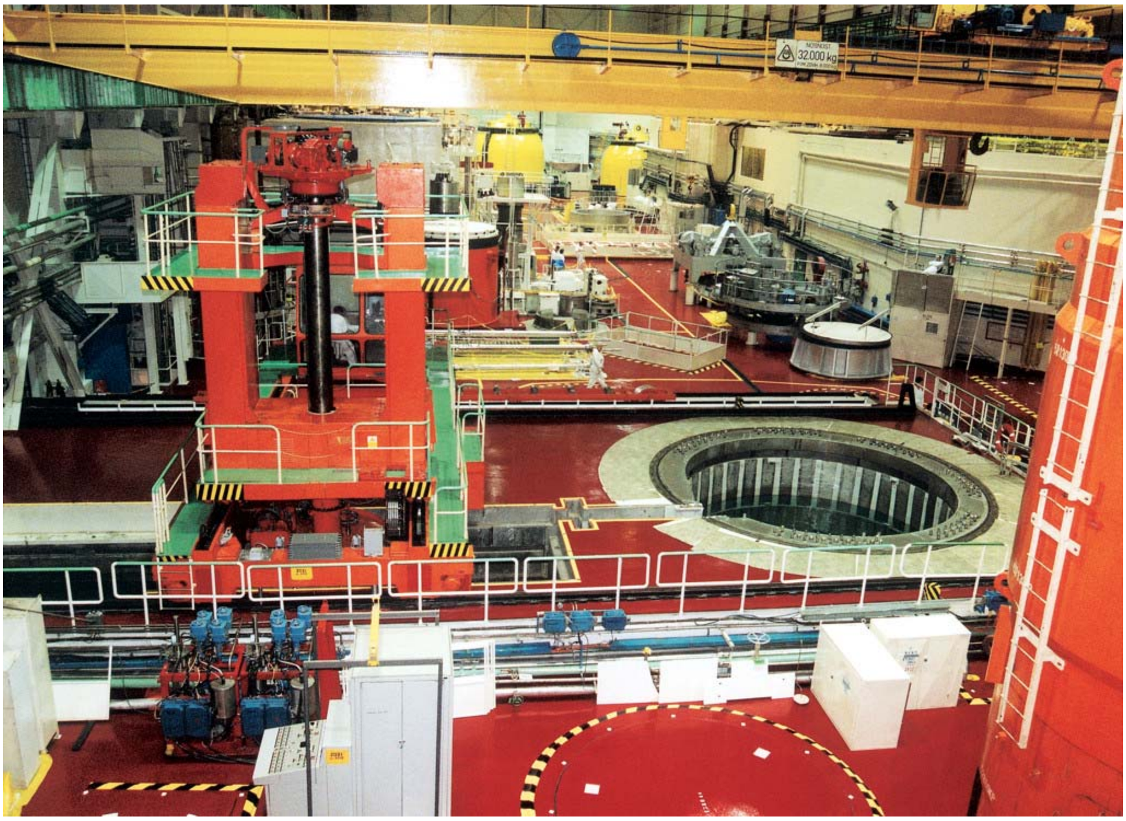
Picture No. 3 V1 Nuclear Power Plant - Spraying jets in tower

Picture No. 4 System of distributing trenches in tower

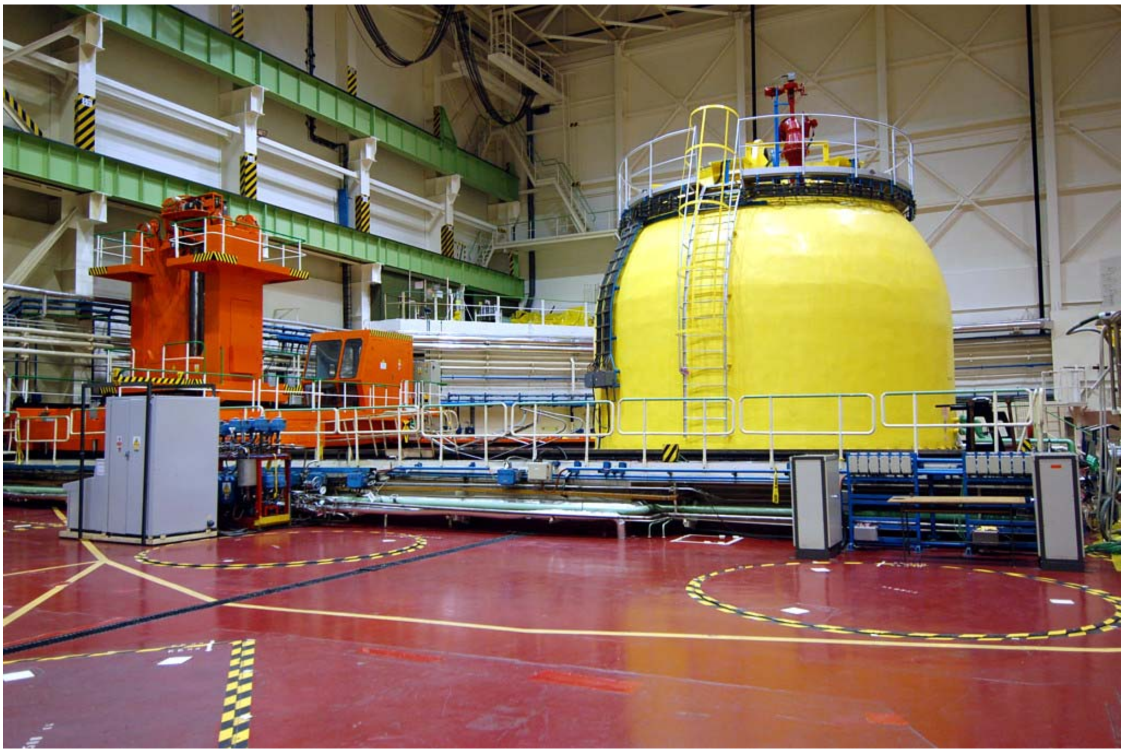
Picture No. 5 V1 Nuclear Power Plant - Cooling water pumps in building of pump station



Picture No. 6 V1 Nuclear Power Plant - Reactor’s postament (filling machine in backgorund)

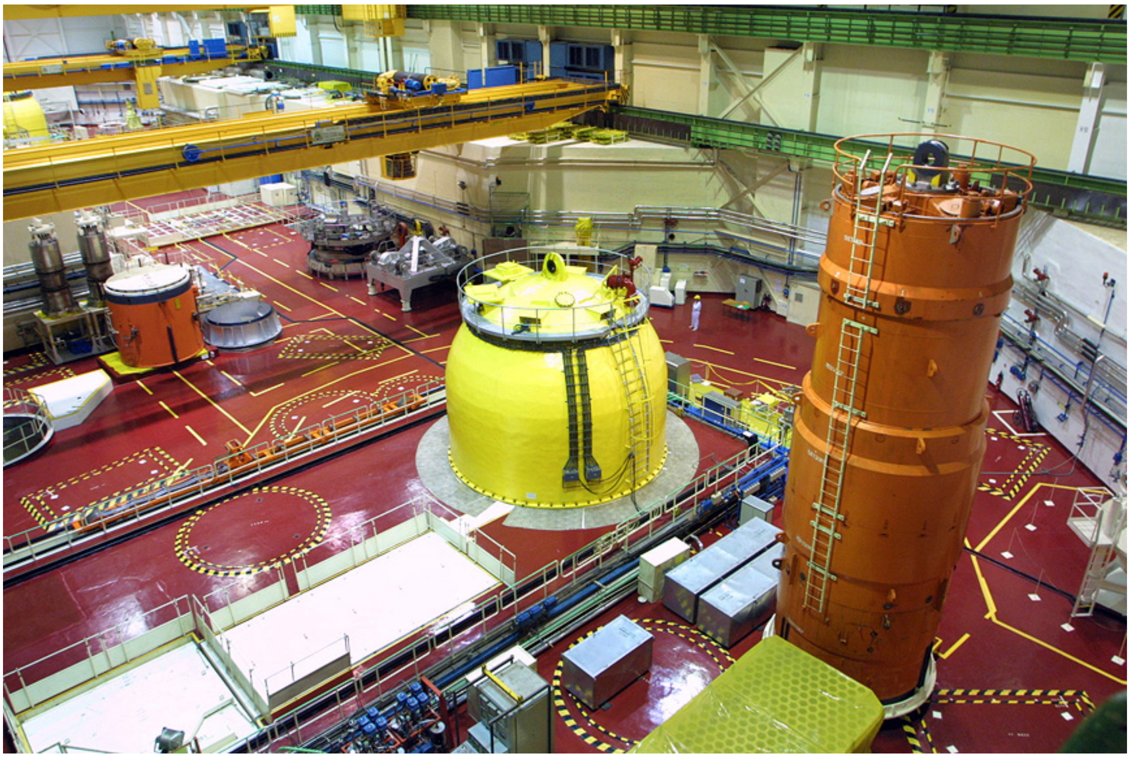


Picture No. 7 V1 Nuclear Power Plant - Placement of SF into storage pool



Graph No. 8 V1 Nuclear Power Plant - Refueling machine is ready

Picture No. 9 V1 Nuclear Power Plant - Reactor’s cover in reactor hall of V1



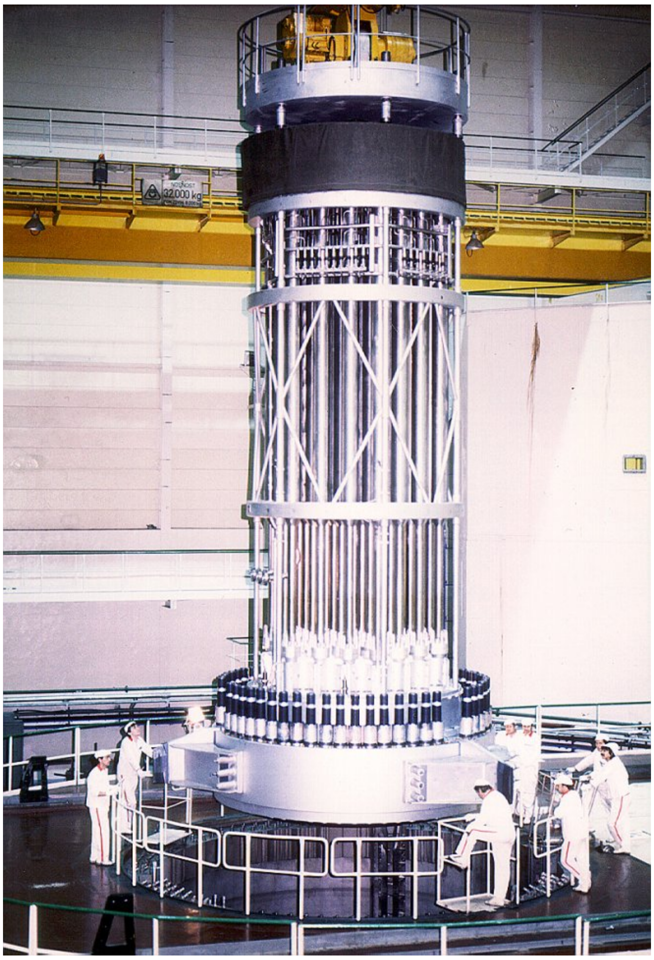
Graph No. 10 General view of V1 NPP Unit 1 reactor in reactor hall

Picture No. 11 V1 Nuclear Power Plant - Refueling machine at fuel replacement

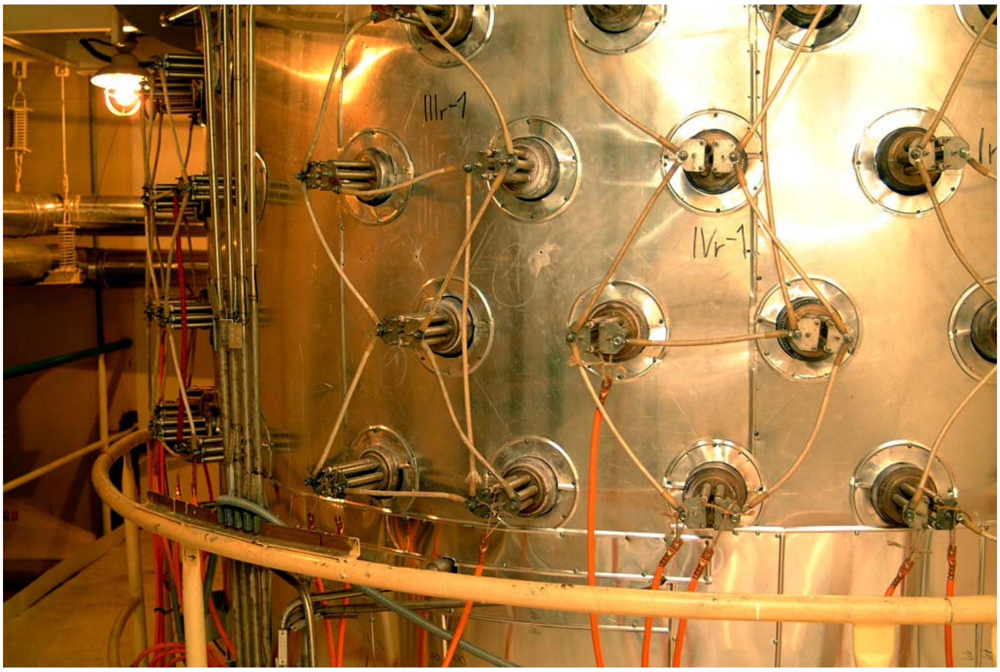
Picture No. 12 V1 Nuclear Power Plant - Container for nuclear fuel

Picture No. 13 V1 Nuclear Power Plant - Unit control room of V1

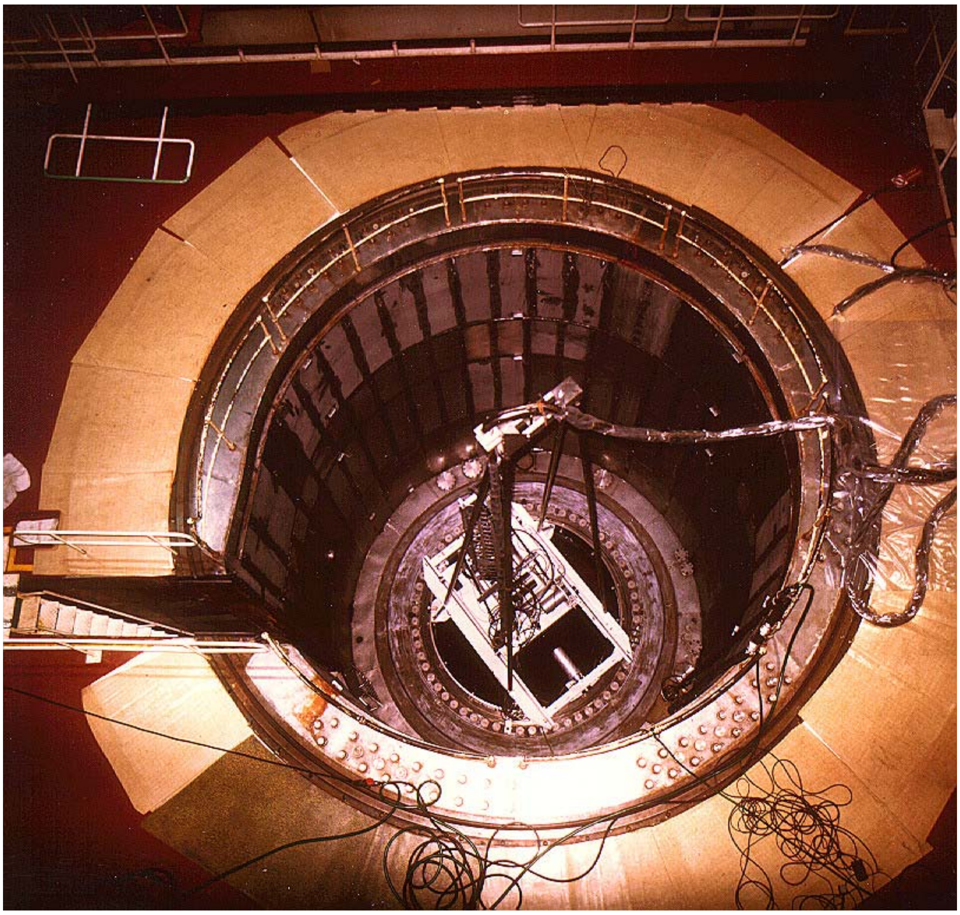
Picture No. 14 V1 Nuclear Power Plant - Main Circulation Pump



Picture No. 15 V1 Nuclear Power Plant - Block of protection pipes



Picture No. 16 V1 Nuclear Power Plant - Volume compensator



Picture No. 17 V1 Nuclear Power Plant - Shaft of reactor of WWER 440 type

Picture No. 18 V1 Nuclear Power Plant - Steam generators of WWER 440

Picture No. 19 V1 Nuclear Power Plant - Works in hermetic box of steam generator

Picture No. 20. Safety system – air technical system (Bezpečnostný system – vzduchotechnika)

Picture No. 21 V1 Nuclear Power Plant - Inspection of safety system facilities

Picture No. 22 Inspection of safety system facilities

Picture No. 23 Switchyard Tr 110kV - NPP V1 (will be reconstructioned)

Picture No. 24 V1 Nuclear Power Plant - Reconstructed auxiliary boiler room

Picture No. 25 V1 Nuclear Power Plant - Reconstructed auxiliary boiler room

Picture No. 26 V1 Nuclear Power Plant – buildings will be demolished in the 2nd Stage

Picture No. 27 V1 Nuclear Power Plant – buildings will be demolished in the 2. stage

Picture No. 28 Reconstruction of the Public Warning and Notification System

Picture No. 29 Reconstruction of the Public Warning and Notification System

Picture No. 30 Monitoring equipment for the release of materials

Picture No. 31 Storage area for material released from control

Picture No. 32 Comprehensive assessment of the state of the environment at SE, a.s.NPP

Annex 12. Stakeholder information and consultation process

In November 2012, in the beginning of environmental impact assessment (EIA) process in the framework of BIDSF project named “Environmental Impact Assessment Report of 2nd Stage of V1 NPP Decommissioning in Jaslovske Bohunice" also “Stakeholder Engagement Plan” (SEP) was elaborated in compliance with Environmental and Social Policy, Policy on Public Information of EBRD and according to principles described in the publication of International Finance Corporation (IFC) on Environmental Division “ Stakeholder engagement plan -Good Practice Handbook for Companies Doing Business in Emerging Markets” (May 2007).

The purpose of stakeholder engagement in the decision-making processes is an enhancement of decision-making on the basis of creation opportunities to consider project acceptability from various points of view. Stakeholders engagement represents an active way of searching the best option how to involve and integrate them into the decision-making process.

The proponent, JAVYS Company, with support of company INYPSA, has tried to create open and transparent relationship with stakeholders according to elaborated SEP and simultaneously according to the requirements of Slovak Act No. 24/2006 Coll. on EIA as amended. Over the framework of the legal obligations of stakeholder engagement into the EIA process the, the proponent together with the experts working on EIA documents provided set of activities leading to the good level of stakeholders informing and the creation of basis for consultation.

The most important activities were, as follows:

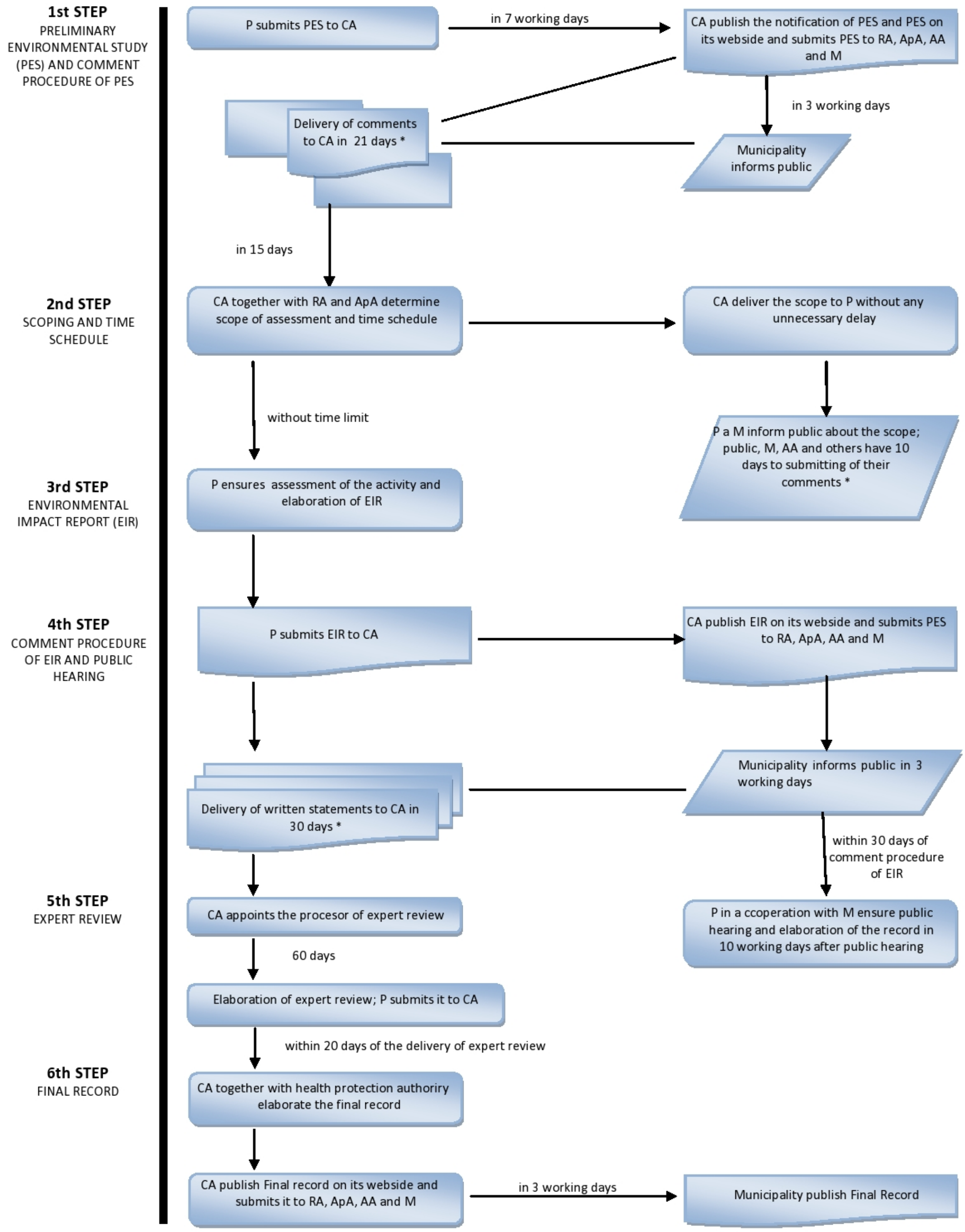
- Dissemination of information about project/proposed activity on the own web page by form of articles and making public of EIA documents
- Dissemination of information about the proposed activity in the own periodical “*JAVYS u vás*”
- Two presentation a discussion meetings with representatives of affected municipalities
- One presentation a discussion meeting with representatives of affected authorities
- Two consultation days during the EIA process for public and affected municipalities and authorities .

In the framework of consultation days space and time for stakeholders was created to have an opportunity to express their opinions on the proposed activity. Top management of JAVYS, its´ experts and also external experts participating in EIA process were available for stakeholders. All of them have been prepared to explain the relevant issue and answer the questions of stakeholders.

The most interest was expressed by representatives of affected municipalities (mayors) and affected authorities, who used all possibilities to participate actively in consultation process. Minor interest was expressed by public. Its representative, one citizen of affected municipality participated in one consultation day, but in very intensive discussion. Disinterest should appear from the fact, that in a connectivity with V1 NPP decommissioning several of EIA processes have already been experienced (1st stage of V1 NPP decommissioning and also individual projects related to facilities for processing of materials and waste from decommissioning).

EIA process and possibilities of stakeholders engagement to this process according to the Slovak Act No. 24/2006 Coll. on EIA as amended, are described in following scheme.

SCHEMATIC DESCRIPTION OF EIA STEPS IN THE FRAME OF OBLIGATORY ASSESSMENT



P – proponent, **RA** – resort authority, **CA** – competent authority, **AA** – affected authority, **M** – affected municipality, **ApA** – approving authority, ***** - ability of public concerned origin

Annex 13. Radiological study

CONTENTS

List of tables

A. RADIATION AND OTHER PHYSICAL FIELDS

The V1 plant status at the end of Stage 1 relating to the existing radiological inventory of equipment, structures and buildings, determines the existence of radioactive sources that contribute to set a certain level of radiation at the site and in the different areas and plant rooms.

The activities to be developed in Stage II, will cause a certain dose load to population during normal operation which depending of the existing radiation source will belong to one of these three types.

1. Sources of dose to workers that perform activities
2. Sources of dose to the population around the plant, due to liquid effluents discharges.
3. Sources of dose to the population around the plant, due to radioactive gaseous or aerosols discharges.
4. Sources of dose to the population in the transport route of RAW to NRR (Mochovce). (to be assessed in a different study)

Accidental circumstances (accident risk assessment) are not assessed in this document.

I. Sources of doses to workers

The dismantling works is carried out in rooms or areas that have a certain dose rate depending on radiation level due to radioactive inventory of the equipment or systems in the area (internal and external contamination of equipment, existing surface contamination walls and floors, etc.) , which causes external radiation absorbed dose. Moreover decommissioning activities themselves (dismantling, fragmentation, in site decontamination, etc.), releases into the atmosphere a fraction of radioactive contamination contained or deposited on equipments, walls or floors, which contribute to the dose to workers (inhalation).

For this reason after radiological characterization survey a categorization of rooms and buildings will be realized based on radiation levels and existing dose rate, to facilitate the accessibility and the dismantling operations.

As the dismantling activities advance eliminating radiation sources (equipment, waste, etc..), dose rates will diminish, also because in situ decontamination.

II. Source term for radioactive liquid discharges

The decommissioning activities which may produce radioactive liquid discharges are:

1. Dismantling and fragmentation of PC large components
2. In situ dismantling and decontamination of components
3. Fragmentation and decontamination in the new F&D facility

1. <u>Dismantling and fragmentation of PC large components</u>

The only operation related to large components fragmentation that produces direct radioactive liquid discharges, according to the proposed methodology in Feasibility Study for the Management of NPP Primary Circuit Components [1], is the segmentation of the Reactor Internals (RI) where underwater plasma cutting is used. The remaining operations are performed by dry cutting.

Following the cited study [1]:

- During wet cutting work performance, the accumulated waste is purified through the filters. Filters efficiency 99.99 %.
- The effectiveness of existing system for water purification at V1 NPP assumed of 99% based on experience from Russian NPPs with VVER type reactors.
- For cutting with plasma underwater, the majority of solid emissions are in the form of sedimented or attached dross. Together these account for around 99% mass of the total solid waste of which a minimum of 90% is sedimented dross. Suspended particles in water are generally around 1 % or less and aerosol particles much lower at 0.025% mass or less.

In the fragmentation of RI, liquid waste generated consists mainly in the inventory of water used in these operations that fills the refueling cavity and the spent fuel pool.

Total activity released to the environment, assuming that after filtering water is discharged to the environment via drainage systems is [1]:

- 1,70E+07 Bq for Unit 1
- 2.55E+07Bq for Unit 2

The source term referred to the activity corresponding to the radionuclide emitted, was evaluated [2], taking into account the RNV corresponding to Reactor Internals obtained from de Data Base [3], as is shown in Table 1.

Table 1. Source term of liquid effluents discharged from large PC component fragmentation

Radionuclide	**Bq**	**Bq**
	Unit 1	**Unit 2**
Fe-55	1,07E+07	1,83E+07
Co-60	2,06E+06	2,73E+06
Ni-63	4,17E+06	4,31E+06
Mn-54	2,96E+04	1,53E+05
Cs-137	4,72E+02	5,04E+02
Nb-94	3,10E+02	3,16E+02
C-14	4,99E+02	5,09E+02
H-3	3,75E+01	4,28E+01
Sr-90	2,09E+01	2,15E+01
Total	**1,70E+07**	**2,55E+07**

2. “In-situ” dismantling and decontamination of components

Liquid radioactive effluents may be generated during dismantling and in-situ decontamination of radioactive components (not pertaining to PC) in Reactor Building and Auxiliary Building.

A screening process has been carried out, using Data Base submitted by JAVYS, following the process as stated in Project Basic Design (D18) [4], to look for components suitable to in-situ decontamination.

The identified equipment, which it is found in both the reactor building and auxiliary building, includes:

- Pipes with a diameter greater than 200 mm and a dose rate at 1 meter greater than 50 μSv/h (being the value of dose rate in contact different than dose rate at 1 meter)

- Heat exchangers with diameter or length greater than 1 m and a dose rate at 1 meter greater than 50 μSv/h (being the value of dose rate in contact different than dose rate at 1 meter)
- Tanks with a dose rate at 1 meter greater than 50 μSv/h (being the value of dose rate in contact different than dose rate at 1 meter) and located within RCA, excepting those that are part of primary systems.

There are several methods for in-situ decontamination. Is assumed conservatively for dose calculations that decontamination is performed with the technique of "hydro jet“, assuming a decontamination factor of 100 (ie. 99% of the activity remains in the water and 1% in the component surface). Conservatively it is assumed that this contaminated water is not further treated means decontamination / purification, before passing to the existing radwaste treatment system r(RAW Treatment Centre).

It is assumed that the evaporator decontamination achieves a factor of 1.00 E-03 [6] for all radionuclides so that the activity in the effluent with respect to radioactive contaminated water is being one to thousand.

The activity content of the liquid effluents, previous to any treatment, in the form of liquid radioactive effluents (source term) due to decontamination activities, is calculated using the DDB, with specific RNV of surface contamination to each component screened out from the Data Base, as is shown in the Table 2.

The calculation [2] takes into account the data of the items to be decontaminated in-situ, the RNV associated and the total surface activity and the decontaminations factors (and conservatively assuming that 99% of the activity migrates to the water) in order to assess the activity transferred to the water and finally the total activity of the radioactive effluent after passing through the evaporator.

Table 2. Source term of liquid discharged during dismantling and in situ decontamination

Radionuclide	Bq	%
Ag-110m	2,42E+03	0,12%
Am-241	2,01E+02	0,01%
C-14	4,39E+02	0,02%

Radionuclide	Bq	%
Ca-41	4,06E+03	0,21%
Ce-144	6,53E+02	0,03%
Co-60	4,28E+05	21,94%
Cs-134	9,52E+02	0,05%
Cs-135	7,25E+03	0,37%
Cs-137	2,36E+04	1,21%
Fe-55	8,38E+05	42,94%
Mn-54	7,52E+03	0,39%
Mo-93	2,72E+04	1,40%
Nb-94	2,99E+03	0,15%
Ni-59	8,93E+03	0,46%
Ni-63	5,57E+05	28,53%
Pd-107	2,90E+03	0,15%
Pu-238	6,24E+01	0,00%
Pu-239+240	1,00E+02	0,01%
Pu-241	1,43E+04	0,73%
Sb-125	2,66E+03	0,14%
Se-79	1,74E+03	0,09%
Sm-151	1,09E+04	0,56%
Sn-126	3,19E+03	0,16%
Sr-90	3,42E+03	0,18%
Zn-65	2,31E+02	0,01%
Zr-93	2,61E+03	0,13%
Total	1,95E+06	100,00%

3. Fragmentation and decontamination in the F& D Facility.

Among the various decontamination techniques that can be used, we are considering the electrochemical and ultrasonic methods as is stated in Project C7-A3 specification [5]. Other possible techniques as the mechanical-abrasive blasting, do not generate liquid effluents.

A screening process has been carried out, using the Data Base submitted by JAVYS,, to look for components suitable to decontamination following the criteria set in [4] and [5], which are the following:

- Contaminated stainless steel components and not pertaining to de PC, which are suitable to be decontaminated to reach clearance levels (1 < RAI < 40) or to reduce contamination level to allow waste decategorization: changing from LLW to VLLW category (100 < RAI < 1000) [4]
- The foreseen decontamination techniques to be used in the C7-A3 facility are electrochemical and ultrasonic [5]

The total activity which passes to the effluent from the decontamination process is calculated assuming that the values for clearance or to pass to category VLLW are reached (RAI=100). The effluent is subsequently treated in the evaporator, which is assigned as in the case above, an efficiency factor of 1E +03 [6].The calculations detailed in [2], offer the results shown in Table 3 for the activity released to the environment.

Table 3. Source term of liquid discharged during fragmentation and decontamination in the new F&D facility

Radionuclide	Bq	%
Ag-110m	1,21E+04	0,11%
Am-241	1,20E+03	0,01%
C-14	1,03E+03	0,01%
Ca-41	2,60E+04	0,24%
Ce-144	3,80E+03	0,03%
Cl-36	0,00E+00	0,00%
Cm-244	3,41E+02	0,00%
Co-57	4,34E+02	0,00%
Co-60	2,28E+06	20,91%
Cs-134	3,59E+03	0,03%
Cs-135	4,63E+04	0,42%
Cs-137	4,78E+04	0,44%
Fe-55	4,60E+06	42,15%
H-3	4,65E+01	0,00%

Radionuclide	Bq	%
I-129	3,80E+02	0,00%
Mn-54	4,20E+04	0,39%
Mo-93	1,74E+05	1,59%
Nb-94	1,81E+04	0,17%
Ni-59	5,43E+04	0,50%
Ni-63	3,34E+06	30,59%
Pd-107	1,86E+04	0,17%
Pu-238	6,00E+02	0,01%
Pu-239+240	6,29E+02	0,01%
Pu-241	8,65E+04	0,79%
Sb-125	1,50E+04	0,14%
Se-79	1,12E+04	0,10%
Sm-151	6,95E+04	0,64%
Sn-126	2,04E+04	0,19%
Sr-90	2,12E+04	0,19%
Tc-99	3,24E+02	0,00%
Zn-65	1,30E+03	0,01%
Zr-93	1,67E+04	0,15%
Total	**1,09E+07**	**100,00%**

III. Source term for radioactive gaseous discharges

The activities which may generate radioactive gaseous or aerosols effluents are:

1. Dismantling and fragmentation of large components of PC
2. Dismantling and fragmentation of contaminated components
3. Fragmentation and decontamination in the new facility (F & D Facility).
4. Decontamination of civil structures

1. Dismantling and fragmentation of large components of PC

Following reference [1] the activated components (except reactor internals) and also the contaminated equipments pertaining to PC are dry cutting principally by plasma and other cold techniques.

The following hypotheses are made:

- During dry cutting work performance, the accumulated waste resulting from cutting is drawn off from the cutting area and purified through the filters. HEPA filters efficiency 99.99%.
- No deposition is accounted, i.e. after filtering all airborne contamination intended to be discharged through the V1 NPP stack.
- V1 NPP effectiveness of ventilation stack filters are assumed of 99,9%.
- The cutting metals by plasma in air generates particles by vaporization of metals and subsequent condensation of the fumes. Only a small fraction 0.3 % of the total cutout metal (kerf release) becomes airborne. The remaining large fraction of the metal particles produced during cutting, arisen from ejection of molten metal, settles on the floor. For calculations the pessimistic assumption is made that 0.5% of the kerf forms aerosols.

Release of activity to atmosphere per total length of activated components [1].

- for Unit 1 is 4.24E+08 Bq
- for Unit 2 is 6.37E+08 Bq.

The total release of activity to atmosphere per total length of contaminated components:

- for Unit 1 is 5.63E+00 Bq
- for Unit 2 is 1.42E+01 Bq.

As can be seen, gaseous effluents by cutting not activated components of the primary system, are negligible compared with the activity discharged from activated components.

The source term referred to the activity corresponding to the radionuclide discharged, was evaluated [2], taking into account the radionuclide vector assigned in the activated material (RPV basic material) [3].

Table 4. Source term of gaseous effluents discharged during large PC component fragmentation

Radionuclide	Unit 1 Bq	Unit 2Bq
Mn-54	1,20E+06	7,78E+06
Co-60	2,46E+07	4,07E+07
H-3	3,56E+07	5,08E+07
C-14	1,54E+06	1,96E+06
Ca-41	3,35E+07	4,26E+07
Ni-59	9,57E+06	1,22E+07
Ni-63	6,33E+07	8,17E+07
Fe-55	8,68E+07	1,85E+08
Se-79	6,30E+06	8,02E+06
Sr-90	6,84E+06	9,14E+06
Mo-93	7,49E+06	9,54E+06
Zr-93	5,66E+07	7,21E+07
Nb-94	1,83E+07	2,34E+07
Tc-99	6,46E+06	8,22E+06
Pd-107	9,57E+06	1,22E+07
Sn-126	2,87E+07	3,66E+07
I-129	1,60E+06	2,03E+06
Cs-135	1,60E+07	2,03E+07
Cs-137	1,52E+06	2,03E+06
Sm-151	7,85E+06	1,02E+07
Pu-238	1,57E+05	2,03E+05
Pu-239+240	1,60E+05	2,03E+05
Am-241	1,59E+05	2,03E+05
Cm-244	1,48E+05	2,03E+05
Total	**4,24E+08**	**6,37E+08**

2. Dismantling and fragmentation of contaminated components

Gaseous effluents can be generated as a result of dismantling and segmentation operations carried out in different areas, from radioactive components pertaining to contaminated systems, excluding components of the primary system (Group B and C or Projects D4.4 [4])

A screening process of components on the DDB, submitted by JAVYS, has been carried out following D18 criteria [4]. This equipment belongs to basically to following groups:

- Piping
- Tanks and containers
- Heat exchangers
- Pumps
- Valves
- Piping feedthroughs

The assumptions for calculating the inventory of radioactive discharges, considers the following hypotheses:

- Kerf with: 0,94 cm
- Kerf release fraction: 0,5%
- Local filter efficiency: 0%
- Ventilation stack filter efficiency: 90%

No credit is given to the local filters located between the particle generation and discharge point to general ventilation system. The V1 NPP effectiveness of ventilation stack filters are conservative assumed to be 90,00% because the uncertainty about the particle size and different selective radionuclide efficiency.

The calculation detailed in ref.[2], conservatively estimates the length of the cuttings, equipment thickness and considers the values of surface contamination and physical and radiological data existing in the database [3]. According with this is obtained 1,68E+10 Bq as volatilized activity and the release to the atmosphere is 8,42E+06 Bq.

The source term referred to the activity corresponding to the radionuclide discharged, through the ventilation stack of gaseous effluents as shown in the following table.

Table 5. Activity discharged as gaseous effluents from dismantling and fragmentation of contaminated components.

Radionuclide	%	Bq
Ag-110m	0,12%	1,02E+04
Am-241	0,01%	9,20E+02
Ca-41	0,27%	2,28E+04
Ce-144	0,04%	3,28E+03
Co-60	21,06%	1,77E+06
Cs-134	0,03%	2,77E+03
Cs-135	0,48%	4,08E+04
Cs-137	0,20%	1,64E+04
Fe-55	42,35%	3,57E+06
Mn-54	0,41%	3,44E+04
Mo-93	1,82%	1,53E+05
Nb-94	0,18%	1,51E+04
Ni-59	0,55%	4,62E+04
Ni-63	29,77%	2,51E+06
Pd-107	0,19%	1,63E+04
Pu-239+240	0,01%	5,18E+02
Pu-241	0,89%	7,53E+04
Sb-125	0,13%	1,12E+04
Se-79	0,12%	9,78E+03
Sm-151	0,73%	6,12E+04
Sn-126	0,21%	1,79E+04
Sr-90	0,22%	1,83E+04
Zn-65	0,01%	1,10E+03
Zr-93	0,17%	1,47E+04
TOTAL	100%	8,42E+06

3. Fragmentation and decontamination in the F & D Facility.

Fragmentation process

In F&D facility material from decommissioning of V1 NPP are further segmented in order to allow transportation in appropriate container or to be treated in the decontamination line of the facility. The cutting of contaminated equipment will be performed preferable by cold techniques to avoid dispersion of radioactive particles (sawing, shearing, etc.).

Taking in account the preferable fragmentation techniques to be used in the facility and the local filtration systems whose exhaust section shall be connected to existing plant HVAC network to the stack filters, it is assumed that the gaseous activity discharged from the facility due to fragmentation process is negligible as is the case of dry cutting of large PC components.

Decontamination process

The only source of gaseous effluents due to decontamination is supposed due to use a process by dry abrasive blasting in a cabin and that will be applied principally to contaminated carbon steel components [4]

Taking in account that this process is performed in a cabin which include filtration systems which in turn are connected to the plant general HVAC and to stack filters, it is assumed that the gaseous activity discharged from the facility due to decontamination process is negligible.

4. Decontamination of civil structures (facing)

Decontamination of concrete walls and floors are planned by scarifying, except in the case of walls that presents activation elements. Total activity of contamination of civil structures is 4,42 E10 Bq (Tab. 8.4 of [3]), while approximate total contaminated surface is 10.650 m^2 (Tab 5.1-2 of [5]).

The scarifying process doesn’t generates significant liquid effluents but particles and aerosols are generated which must be collected by suitable filtration systems adequate to the technique employed.

The activity released will be calculated [2] based in the following conservative assumptions:

- Filtering Efficiency of scarifying equipment: 90% (10% of activity is released to building
- Filtering efficiency of building ventilation (V1 NPP stack or auxiliary building ventilation): 90% (10% of activity is released to environment)

From these data, calculation [2] estimates the total activity released and applying the vector for radionuclide contamination of concrete walls [3], the following results are obtained.

Table 6. Activity discharged as radioactive gaseous effluents from decontamination of civil structures.

Radionuclide	%	Bq
H-3	9,97%	4,37E+06
C-14	4,02%	1,76E+06
K-40	0,44%	1,94E+05
Ca-41	0,06%	2,67E+04
Mn-54	0,14%	6,27E+04
Fe-55	2,29%	1,01E+06
Co-57	0,01%	2,28E+03
Ni-59	0,48%	2,09E+05
Co-60	0,42%	1,86E+05
Ni-63	2,59%	1,14E+06
Zn-65	0,02%	8,47E+03
Se-79	0,03%	1,52E+04
Sr-90	0,14%	6,22E+04
Mo-93	0,35%	1,53E+05
Zr-93	0,05%	2,15E+04
Nb-94	0,01%	3,55E+03
Tc-99	0,12%	5,05E+04
Pd-107	0,06%	2,82E+04
Ag-110m	0,02%	8,73E+03
Sb-125	0,12%	5,23E+04

Radionuclide	%	Bq
Sn-126	0,06%	2,64E+04
I-129	0,39%	1,70E+05
Cs-134	1,47%	6,46E+05
Cs-135	0,03%	1,52E+04
Cs-137	76,04%	3,34E+07
Ce-144	0,18%	8,07E+04
Sm-151	0,03%	1,46E+04
Pb-212	0,03%	1,23E+04
Bi-212	0,16%	7,10E+04
Pb-214	0,07%	3,19E+04
Bi-214	0,06%	2,63E+04
Ac-228	0,04%	1,55E+04
Pu-241	0,08%	3,46E+04
Total	**100,00%**	**4,39E+07**

B. RADIOLOGICAL HEALTH RISKS

I. Impact to the population. Assessment methodology

The methodology used is to compare the total calculated activity released yearly to hydrosphere and to atmosphere during V1 NPP decommissioning with legal limits [OOZPŽ_3760_2011]. Using [7] is guaranteed that, if this limits are not exceeded, the annual radiation limit for a person from the V1 NPP decommissioning approved by the Slovak Public Health Authority and Nuclear Regulatory Authority of the Slovak Republic, are fulfilled.

The yearly approved dose limit for a person approved for the mentioned Slovak authorities from V1 NPP is 25 μSv/year, as a consequence of overall releases of radioactive substances to atmosphere and hydrosphere.

To fulfil this approved dose limit, the legal limits for V1 in term of activity released are the following:

Annual limit values of gaseous effluents:

- Aerosols 8,00E+10 Bq
- 90Sr 1,40E+08 Bq
- alfa 2,00e+07 Bq

Annual limit values of liquid effluents:

River Váh

- Corrosion and fission products 1,30E+10 Bq
- 3H 2,00E+12 Bq

River Dudváh

- Corrosion and fission products 1,30E+08 Bq
- 3H 2,00E+10 Bq

To compare these limits with the source term obtained from the calculation, it is assumed that the releases will be realized during one year instead of the Stage II duration, which is a conservative hypothesis.

Following the study for the DG Environment of the European Commission *"Guidance on the assessment of radiation doses to members of the public due to the operation of* *nuclear installations under normal conditions"*, [8] unless a significant proportion of the annual discharge is released within a short period, it can be assumed that the discharges are continuous during the year, given the other uncertainties in the assessment process.

II. Discharge to hydrosphere

Adding the source terms corresponding to liquid releases, the total global release to hydrosphere due to decommissioning activities during Stage II, and grouping the results to compare with annual limits:

Table 7. Activity discharged with liquid effluents from all decommissioning activities during Stage II and approved limits.

Decommissioning activity	Corrosion and fission products Bq	H-3 Bq
Fragmentation PC large components	4,32E+07	8,19E+01
In situ decontamination	1,97E+06	neligible
Decontamination in F&D facility	1,08E+07	4,65E+01
TOTAL	**5,60E+07**	**1,28E+02**
Approved limits (river Váh)	1,30E+10	2,00E+12
% Discharge over limits	0,43%	~0%

The evaluation shows that the global liquid releases to hydrosphere from decommissioning activities during the Stage II of V1 Bohunice NPP, are well below the approved limits and that in consequence the radiological impact to the population are acceptable and fulfil the requirements of the Slovak responsible Authorities.

III. Discharge to atmosphere

Adding the source terms corresponding to gaseous releases, the total global release to atmosphere due to decommissioning activities during Stage II, and grouping the results to compare with annual limits:

Table 8. Activity discharged with gaseous effluents from all decommissioning activities during Stage II and approved limits.

DECOMMISIONING ACTIVITY	Aerosols Bq	Sr-90 Bq	Alfa
Fragmentation PC large components	1,04E+09	1,60E+07	1,44E+06
In situ fragmentation	8,33E+06	1,83E+04	7,61E+04
Decontamination in F&D facility	Negligible	Negligible	Negligible
Decontamination of civil structures	4,38E+07	6,22E+04	5,59E+04
TOTAL	**1,10E+09**	**1,61E+07**	**1,57E+06**
Approved limits	8,00E+10	1,4E+08	2,00E+07
% Discharge over limits	1,37%	11,47%	7,84%

The evaluation shows that the global gaseous releases to atmosphere from decommissioning activities during the Stage II of V1 Bohunice NPP for the whole decommissioning period, are well below the approved annual limits and that in consequence the radiological impact to the population are acceptable and fulfil the requirements of the Slovak responsible Authorities.

IV. Doses to the personnel

The detail estimation of personnel exposure for specific working places and operations and application of ALARA principle are tasks for the Basic Design of Decommissioning Project. The EIA addresses main aspects influencing personnel safety with purpose to demonstrate that personnel exposure can be handled within permissible radiation safety limits.

The radiological accidental consequences for the staff health may occur in case of improper handling and transportation of radioactive waste and improper storage of radioactive waste during dismantling activities. The impacts will be negative, local, and temporary until incident mitigation.

The most probable accidents, which may have impacts on the personnel, is an accident during replacement of aerosol filters or an accident related to leakages of hazardous chemicals during the equipment decontamination or explosion with radioactive release .The safety analysis evaluation is not a matter of this study. Even in this case the risk for the staff will be low, short term and local.

V. Conclusion

The discharge of liquid and gaseous effluents to the environment from decommissioning Stage II of V1 Bohunice NPP (during the whole decommissioning period), are only a small portion of the annual limits approved which in turn are subject to multiple control measurements.

The approved limits for releases guarantee that the annual radiation limits for a person -25 μSv/year from V1 NPP -are not exceeded as a consequence of overall releases of radioactive substances to atmosphere and hydrosphere. Therefore, population doses due to activities during Stage II of decommissioning Bohunice V1 NPP are well below 25 μSv/year.

Regarding health impact to the personnel, no cumulative impact on the personnel is expected.

C. REFERENCES

[1] Project D7.1 –DOC -015, Rev 02,

[2] Support calculation document for radiological study of V1 NPP during Stage II. Rev 0.

[3] Project B6.4 The V1 Decommissioning Data Base and deliverables

[4] Decommissioning Project Basic Design Technical Document D18-TE-PMU-05003/EN Part 3 and 4

[5] C7-A3, F&D Facility Technical Specification Doc. Id : C-A3-TS-PMU-06001/EN

[6] Use of Evaporation for Treatment of liquids in the Nuclear Industry. Ref. ORNL-4790. Oak Ridge National Laboratory, 1973

[7] JAVYS, Calculation number: 20110407-110746 using the program ESTE AI ver. EBO, 3.24

[8] Radiation Protection 129. "Guidance on the realistic assessment of radiation doses to members of the public due to the operation of nuclear installations under normal conditions". European Commission 2002.

Annex 14. Study on risks of RAW transport

CONTENTS

A. SCOPE AND OVERVIEW

This technical document provides the detailed methodology, input parameters and assumptions, and results for the transportation risk analysis performed in support of the EISR of Stage 2 of the Decommissioning of V1 Bohunice NPP. The analysis evaluates transportation of LLW and VLLW that it is foreseen to be transported to Mochovce NRR during decommissioning activities.

These Slovak regulations for the transport of radioactive materials are all based on and refers to the safety standard on the safe transport of radioactive material established by the International Atomic Energy Agency (IAEA)

The transportation risk assessment considers human health risks from routine transport (normal, incident-free conditions) and from potential accidents.

The radiological risk associated with routine transportation is cargo-related and results from the potential exposure of people to low levels of external radiation near a loaded shipment. It is assumed that there are no cargo-related risks posed by incident-free transport of hazardous chemicals. No direct chemical exposure to radioactive material will occur during routine transport because these materials will be in packages that are designed and maintained to ensure that they will contain and shield their contents during normal transport. Any leakage or unintended release would be considered under accident risks.

Vehicle-related risks during routine transportation are caused by potential exposure to increased vehicular emissions. These emissions include diesel exhaust, tire and brake particulate emissions, and fugitive dust raised from the roadbed by passing vehicles.

The cargo-related radiological risk from transportation-related accidents lies in the potential release and dispersal of radioactive material into the environment during an accident and the subsequent exposure of people through multiple exposure pathways, such as exposure to contaminated soil, inhalation, or the ingestion of contaminated food. Cargo-related hazardous chemical accident impacts to human health during transportation come from immediate inhalation exposure resulting from container failure and chemical release during an accident. Vehicle-related accident risks refer to the potential for transportation-related accidents that result in fatalities caused by physical trauma unrelated to the cargo.

To calculate radiological impacts resulting in external exposure to the population during the transportation of radioactive materials, the INTERTRAN computer code has been used. In assessing the radiological hazards and ensuring that the routeing requirements do not detract from the standards of safety specified in the Transport Regulations, analyses using appropriate risk assessment codes should be undertaken (IAEA Safety Guide No. TS-G-1.1). One such code which may be used, INTERTRAN, was developed through a coordinated research programme of the IAEA. This computer based environmental impact code is available for use by Member States. In spite of many uncertainties stemming from the use of a generalized model and the difficulty of selecting appropriate input values for accident conditions, this code may be used to calculate and understand, at least on a qualitative basis, the factors significant in determining the radiological impact from routeing alternatives involving the transport of radioactive material.

It is essential that the dose assessments are conservative in the sense that the resulting doses are calculated in many cases on basis of the least favorable boundaries of the model. When an input parameter is selected from an interval of possible values, the value which gives rise to the highest possible dose is used. In other words, the modeled doses are the highest possible the scenario can reasonably incur. The model is thus not a description of reality. It is an estimate that provides a good basis for an evaluation of the radiological impact in the context of the EIAR, which may be optimized if pursued in reality.

B. METHODOLOGY

I. Accident-free transport

During incident-free (i.e. routine) transport, workers and members of the public along the road and rail routes are exposed to the external radiation from the packages and any airborne releases. Both these exposure pathways are carefully controlled by package design to satisfy the IAEA Transport Regulations which limit doses to very small levels, but not zero. Nevertheless, collective and maximum individual doses may be calculated using time and distance exposure data. More detailed occupancy data are needed for individual than for collective doses. Models incorporating the package movement patterns and surrounding population distribution are employed.

INTERTRAN-2, developed for the IAEA, is a system for assessing the impact from transporting radioactive material for incident-free transportation and accidental cases (IAEA, 1983; Degrange et al, 1985). INTERTRAN-2 is based in The RADTRAN 4 computer code (Neuhauser and Kanipe 1992) was used in the routine and accident cargo-related risk assessments to estimate the radiological impacts to collective populations. RADTRAN 4 was developed by Sandia National Laboratories to calculate population risks associated with the transportation of radioactive materials by truck, rail, air, ship, or barge. The code has been used extensively for transportation risk assessments since it was originally issued in the late 1970s as RADTRAN (RADTRAN 1) and has been reviewed and updated periodically. RADTRAN 1 was originally developed to facilitate the calculations presented in NUREG-0170 (NRC 1977b).

For normal operation (incident-free), the model contains two submodels for the calculation of the collective doses to the workers and public:

- The population distribution model for 3 population zones (rural, suburban and urban)
- The transportation model consisting of a traffic pattern section (utilising the fraction of travel in each of the 3 population zones) and a shipment section (definition of the transport mode and the package), the transport index (representing the dose rate at 1 m from the surface of the vehicle), the number of packages per shipment, the number of shipments and the distance travelled).

The dose to the public was calculated on the road during transport and at the vehicles rest stops.

For routine transportation, the RADTRAN 4 computer code considers major groups of potentially exposed persons. The RADTRAN 4 calculations of risk for routine highway and rail transportation include exposures of the following population groups:

- Persons along the Route (Off-Link Population). Collective doses were calculated for all persons living or working within 0,8 km of each side of a transportation route. The total number of persons within the 1.6-km corridor was calculated separately for each route considered in the assessment.
- Persons Sharing the Route (On-Link Population). Collective doses were calculated for persons in all vehicles sharing the transportation route. This group includes persons traveling in the same or opposite directions as the shipment, as well as persons in vehicles passing the shipment.
- Persons at Stops. Collective doses were calculated for people who might be exposed while a shipment was stopped en route. For truck transportation, these stops include those for refueling, food, and rest.
- Crew Members. Collective doses were calculated for truck transportation crew members involved in the actual shipment of material. Workers involved in loading or unloading were not considered. The doses calculated for the first three population groups were added together to yield the collective dose to the public; the dose calculated for the fourth group represents the collective dose to workers.

The INTERTRAN-2/RADTRAN 4 calculations for routine dose generically compute the dose rate as a function of distance from a point source. Associated with the calculation of routine doses for each exposed population group are parameters such as the radiation field strength, the source-receptor distance, the duration of exposure, vehicular speed, stopping time, traffic density, and route characteristics (such as population density). The RADTRAN manual contains derivations of the equations used and descriptions of these parameters.

In addition to the assessment of the routine collective population risk, the risk to a maximally exposed individual (MEI) was estimated. In INTERTRAN-2/RADTRAN 4, the MEI is assumed to be located 30 m from the transport route as the radioactive shipment passes by at a speed of 24 km/h.

II. Accidental case

As stated above, the radiological transportation accident risk assessment also uses the INTERTRAN-2/RADTRAN 4 code for estimating collective population risks.

The risk analysis for potential accidents differs fundamentally from the risk analysis for routine transportation because occurrences of accidents are statistical in nature. The accident risk assessment is treated probabilistically in INTERTRAN-2/RADTRAN 4 for radiological risk. Accident risk is defined as the product of the accident consequence (dose or exposure) and the probability of the accident's occurring. In this respect, RADTRAN 4 approach estimates the collective accident risk to populations by considering a spectrum of transportation-related accidents. The spectrum of accidents was designed to encompass a range of possible accidents, including low-probability accidents that have high consequences, and high-probability accidents that have low consequences (such as "fender benders"). For radiological risk, the results for collective accident risk can be directly compared with the results for routine collective risk because the latter results implicitly incorporate a probability of occurrence of 1 if the shipment takes place. Such is not the case for chemical materials, because routine transport would pose no exposure risk.

The INTERTRAN-2/RADTRAN 4 calculation of collective accident risk uses models that quantify the range of potential accident severities and the responses of transported packages to accidents. The spectrum of accident severity is divided into several categories, each of which is assigned a conditional probability of occurrence — that is, the probability that if an accident does occur, it will be of a particular severity. Release fractions, defined as the fraction of the material in a package that could be released in an accident, are assigned to each accident severity category on the basis of the physical and chemical form of the material. The model takes into account the mode of transportation and the type of packaging through selection of the appropriate accident probabilities and release fractions, respectively.

For accidents involving the release of radioactive material, INTERTRAN-2/RADTRAN 4 assumes that the material is dispersed in the environment according to standard Gaussian diffusion models. For the risk assessment, default data for atmospheric dispersion were used, representing an instantaneous ground-level release and a small-diameter source cloud. The calculation of the collective population dose following the release and dispersal of radioactive material includes the following exposure pathways:

- External exposure to the passing radioactive cloud,
- External exposure to contaminated ground,
- Internal exposure from inhalation of airborne contaminants, and
- Internal exposure from the ingestion of contaminated food.

For the ingestion pathway, state-average food transfer factors, which relate the amount of radioactive material ingested to the amount deposited on the ground, were calculated in accordance with the methods described by U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.109 (NRC 1977a) and were used as input to the RADTRAN code. Doses of radiation from the ingestion or inhalation of radionuclides were calculated by applying standard dose conversion factors (DOE 1988 a,b).

C. INPUT PARAMETERS AND ASSUMPTIONS

1. Packaging

Disposal of fragments belonging to the LLW category is done inside fibre-concrete containers in accordance with the available pattern in the surface-type repository located on the Mochovce NRR site. FCCs after conditioning in the RWTC can be buffer stored in the interim storage (IS-RAW) prior to be transported to Mochovce NRR site.

Disposal of fragments belonging to the VLLW category is done inside ISO 20' containers in accordance with the available pattern in the surface-type repository located on the Mochovce NRR site. ISO 20' containers can be buffer stored in the interim storage (IS-RAW) prior to be transported to Mochovce NRR site.

It is expected that only FCCs and VLLW containers will be sent to NRR Mochovce for disposal. Transport of wastes to NRR Mochovce shall be done the current practices and procedures apply currently by JAVYS (8-PVD-006). Is expected that 1000 FCC's (or 500 shipments) will be transported to Mochovce during decommissioning activities in Bohunice V1 NPP.

- Waste form: each type of Fiber-Concrete containers (FCC) filling must be approved by the Nuclear Regulatory Authority. Ratio of cement to other waste volume: ≥ 0.62.
- Restriction of undesirable compounds:
    - Biodegradable (gas developing) substances.
    - Pyrophoric substances and substances producing exothermic reaction with water.
    - Toxic or hazardous wastes.
    - Free liquids.
- Minimum compression strength of cemented waste: 5 MPa
- Leachability of cemented waste: according to USA ANS 16.1 (index >6)
- FCC surface dose rate and contamination: 2 mSv/h; 0.37 Bq/cm^2 beta, gamma; 0.037 Bq/cm^2 alpha.
- Surface not-fixed contamination on FCC by transport to NRR shall be less than 0,3 Bq/cm^2 for radionuclides of firts class radiotoxicity and dose rate shall be less than 2 mSv/h and in the distance 2 m from the container walls shall be less than 0,1 mSv/h.
- Mass of FCC filled with wastes: maximum weight of individual FCC: 12500 kg; maximum weight of disposed FCCs in dilatation unit (4 vaults – 360 FCCs): 3600 t.

- Characteristics of FCC:
  - Quality of outer surfaces.
  - Water-tightness and impermeability.
  - Labelling.
  - Minimum compression strength: 71.5 MPa
  - Minimum splitting strength: 5 MPa
  - Maximum shrinkage: 350 μm/m

Following B6.4 project and the description of activities in D18, a standard FCC content has been assumed, which will be conservative in terms of radiological inventory, always below FCC's limits. In this regard, selected or prototyped package will be a FCC with the following content.

Unit 2 SG tubes, classified as LLW after inline decontamination, is not planned any further treatment. Fragments from Unit 2 SG tubes are subject to compaction. Fragments shall be cut and loaded into drums by means of packaging manipulators. The packaging area shall have an area to place drums waiting for filling up. Drums shall be inserted into the packaging area before the cutting start.

The dose rate on the surface of drums shall not exceed 10 mSv/h. Containers shall be protected to avoid external surface contamination while they are in the controlled area.

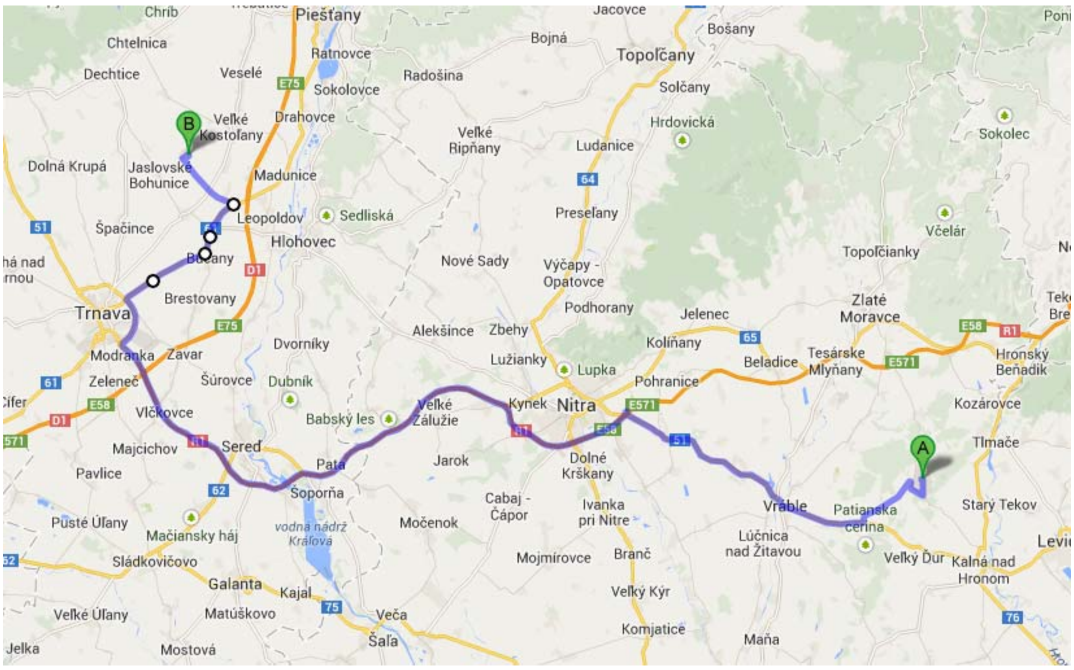
Once filled up with Unit 2 SG tubes, drums shall be transported to the RWTC for compaction, Compacted drums shall be loaded into FCCs where it will be filled with cement mortar for immobilization of waste. After conditioning, FCCs can be buffer stored in IS-RAW prior to be transported to NRR or transported to NRR for disposal. Conditioned FCCs shall comply with the acceptance criteria defined by NRR Mochovce. It is foreseen that 666 drums (200l) and 42 FCC will be needed for Unit 2 SG tubes, therefore it is assumed that all radiological inventory (without decontamination) is divided into 42 FCC's. However, conservatively a factor of 1E1 will be used in order to take into account that, generally, radiological inventory in tubes is not homogeneously divided into FCC's.

Following abovementioned assumptions, the following content in packages (FCC's) is used in order to calculate transport impacts.

Radionuclide	Activoty
Co-60	3,08E+9
Fe-55	2,29E+9
Mo-93	3,22E+8
Ni-63	4,63E+9
Pu-241	1,58E+8
Co-60	3,08E+9

II. Route and and population density

The following route between Bohunice V1 NPP and Mochovce NRR is shown below (93 km).



It has been studied the population density disaggregated with Corine Land Cover 2000, based on a specific cartography of the European Environment Agency with pixels of

100 m x 100 (1 ha) that takes a security area (buffer) of 1,000 meters on either side of the transport route as specified by INTERTRAN 2 code inputs.

Statistical analysis of the affected population density has obtained the following results, dividing land uses in three main groups: urban, suburban and rural.

- Fraction of travel in rural zone = 90% of land --- 45 inhabitants/km2
- Fraction of travel in suburban zone = 2% of land --- 665 inhabitants/km2
- Fraction of travel in urban zone = 7% --- 2,341 inhabitants/km2

III. Accident rates

For calculating accident risks, vehicle accident involvement and fatality rates are taken from “Recommended Road Accident Fatality rates” (Table 2.2) in Report No. 434 – 9 March 2010 “Land transport accident statistics” (International Association of Oil & Gas Producers). HGV rates for urban, rural and motorways have been selected. Accident rates are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel by that mode in the same year. Therefore, the rate is a fractional value — the accident-involvement count is the numerator, and vehicular activity (total traveled distance) is the denominator. Accident rates are derived from multiple-year averages that automatically account for such factors as heavy traffic and adverse weather conditions. For assessment purposes, the total number of expected accidents or fatalities is calculated by multiplying the total shipping distance for a specific case by the appropriate accident or fatality rate.

Note that the accident rates used in this assessment were computed using all kind of HGV shipments, regardless of the cargo. Shippers and carriers of radioactive material generally have a higher-than-average awareness of transportation risk and prepare cargoes and drivers for such shipments accordingly, therefore accident rates assumptions are conservative.

IV. Accident characteristics

Assessment of transportation accident risk takes into account the fraction of material in a package that would be released or spilled to the environment during an accident, commonly referred to as the release fraction. The release fraction is a function of the severity of the accident and the material packaging. For instance, a low-impact accident, such as a "fenderbender," would not be expected to cause any release of material. Conversely, a very severe accident would be expected to release nearly all of the material in a shipment into the environment. Following INTERTRAN-2 input requirements, the NUREG-0170 scheme for accident classification scheme for accident classification has been followed. Category I accidents are the least severe but the most frequent; Category VIII accidents are very severe but very infrequent. To determine the expected frequency of an accident of a given severity, the conditional probability in the category is multiplied by the baseline accident rate.

Each population density zone has a distinct distribution of accident severities related to differences in average vehicular velocity, traffic density, location (rural, suburban, or urban), and other factors. In the next table, taken form NUREG-0170, it is shown the fractional occurrences that for truck accidents by severity category and population density zone that have been used.

	Zone		
Severity	**rural**	**suburban**	**urban**
I	0,4620	0,4349	0,5832
II	0,3024	0,2847	0,3817
III	0,1764	0,2214	0,0278
IV	0,0403	0,0506	6,4E-03
V	0,0118	6,6E-03	7,4E-04
VI	7,2E-03	1,8E-03	1,6E-04

In NUREG-0170, radiological and chemical consequences are calculated by assigning package release fractions to each accident severity category. The release fraction is defined as the fraction of the material in a package that could be released from the package as the result of an accident of a given severity. Release fractions take into account all mechanisms necessary to create release of material from a damaged package to the environment. Release fractions vary according to the type of package and the physical form of the material. In this case, for NFC type packages and cemented wastes, standard Type-B is assumed. Used release fractions are as follows:

Severity	Release fraction
I	0
II	0
III	0,01
IV	0,1
V	1
VI	1

D. TRANSPORTATION IMPACTS

In the following table, it is summarized incident-free population, in terms of collective effective doses (CED) for all transport operations during all decommissioning period of Bohunice V1 NPP.

INCIDENT-FREE POPULATION EXPOSURE IN PERSON-Sv

CREW	OFF LINK	ON LINK	STOPS	TOTALS
3.50E-02	9.55E-04	5.56E-03	3.41E-02	**7.55E-02**

Also, maximum individual dose for a single person is calculated:

MAXIMUM INDIVIDUAL IN-TRANSIT DOSE

4.68E-06 Sv

Finally, expected values of population risk in person-Sv. Accident risk is defined as the product of the accident consequence (dose or exposure) and the probability of the accident's occurring.

EXPECTED VALUES OF POPULATION RISK IN PERSON-Sv

GROUND	INHALED	RESUSPD	CLOUDSH	TOTAL
8.66E-09	1.61E-11	6.90E-11	5.06E-13	**8.74E-09**

E. REFERENCES

IAEA. SAFETY GUIDE NO. TS-G-1.1 (REV. 1)

IAEA 1983. INTERTRAN. A SYSTEM FOR ASSESSING THE IMPACT FROM TRANSPORTING RADIOACTIVE MATERIAL IAEA-TECDOC-287.

BIDFS PROJECT D18. BOHUNICE V1 DECOMMISSIONING PROJECT BASIC DESIGNIG. Rev D18-TE-PMU-05003/EN

BIDSF PROJECT B6.4, DECOMMISSIONING DATABASE, DELIVERABLE 9 "V1 NPP RADIOLOGICAL CHARACTERIZATION REPORT".

NUREG-0170. "FINAL ENVIRONMENTAL. STATEMENT ON THE RANSPORTATION OF RADIOACTIVE MATERIAL BY AIR AND OTHER MODES", NRC 1977

LAND TRANSPORT ACCIDENT STATISTICS. INTERNATIONAL ASSOCIATION OF OIL & GAS PRODUCERS, MARCH 2010). REF. REPORT NO. 434 – 9 "

ANNEX. RADTRAN 4 INPUT FILE

```
TITLE   BOHUNICE V1 DECOM - MOCHOVCE

FORM    UNIT

DIMEN    5   6   1   0 18

PARM     0  3  2  3  0

POPDEN  45  665  2341

PACKAGE  LABGRP  HIGH

SHIPMENT  LABISO  CO60  FE55  MO93  NI63  PU241

ACCIDENT ARATMZ  NMODE=1  0.8E-08  1.3E-08  1.2E-08

         SEVFRC  NPOP=1  NMODE=1  0.46  0.3  0.18  0.04  0.02  7.2E-3

                 NPOP=2  NMODE=1  0.43  0.28  0.22  0.05  6.6E-3  1.8E-3

                 NPOP=3  NMODE=1  0.58  0.38  0.03  6.4E-3  7.4E-4  1.6E-4

DEFINE     MO93  1.28E+6  0.011  0  5.8E-9  0

          0  0  0.1  3  0  0

DEFINE     NI63  3.5E+4  0  0  4.3E-9  0

          0  0  0.1  2  0  0

RELEASE  RFRAC  GROUP=1  0.0  0.0  1E-2  1E-1  1  1

OTHER   BDF=8.60E-03

        XFARM=0.5

        CULVL=7.4E3

        BRATE=3.30E-04

        EVACUATION 1

        ITRAIN=2

EOF

ISOTOPES  -1  500  2  0.4  1.0  0.0  FCC

CO60  3.08E+9  HIGH   3

FE55  2.29E+9  HIGH   3

MO93  3.22E+8  HIGH   3

NI63  4.63E+9  HIGH   3

PU241  1.58E+8  HIGH   3

PKGSIZ  FCC  1.5

LINK  1  93  65  45  4.70E+02  0.8E-08  R  1
```

```
LINK  1  7  33  665  7.80E+02  1.3E-08  S  1

LINK  1  3  33  2341  2.80E+03  1.2E-08  U  1

EOF

EOI
```

ANNEX. OUTPUT OF RADTRAN 4 CALCULATION

```
RUN DATE: [ 2013/09/30 ]            PAGE    1










IIIII  N   N  TTTTT  EEEEE  RRRR   TTTTT  RRRR     AAA  N   N
  I    NN  N    T    E      R   R    T    R   R   A   A NN  N
  I    N N N    T    E      R   R    T    R   R   A   A N N N
  I    N  NN    T    EEEE   RRRR     T    RRRR    A   A N  NN
  I    N   N    T    E      R R      T    R R     AAAAA N   N
  I    N   N    T    E      R  R     T    R  R    A   A N   N
IIIII  N   N    T    EEEEE  R   R    T    R   R   A   A N   N




                             222
                                2
                                2
                               2
                              2
                             2
                            22222
```

INTERTRAN2-RT4 FOR PC DATE: AUGUST 1, 2000

BASED ON RADTRAN 4.0.19.IOSI FOR MAIN FRAME

MODE DESCRIPTIONS

NUMBER	NAME	CHARACTERIZATION
1	TRUCK	LONG HAUL VEHICLE
2	RAIL	COMMERCIAL TRAIN
3	BARGE	INLAND VESSEL
4	SHIP	OPEN SEA VESSEL
5	CARGO AIR	CARGO AIRCRAFT
6	PASS AIR	PASSENGER AIRCRAFT
7	P-VAN	PASSENGER VAN
8	CVAN-T	COMMERCIAL VAN
9	CVAN-R	COMMERCIAL VAN
10	CVAN-CA	COMMERCIAL VAN

```
                    RUN DATE: [ 2013/09/30 ]          PAGE    2



                               ECHO CHECK



TITLE   BOHUNICE V1 DECOM - MOCHOVCE

FORM    UNIT

DIMEN    5   6   1   0 18

PARM     0  3  2  3  0

POPDEN  45  665  2341

PACKAGE  LABGRP  HIGH

SHIPMENT  LABISO  CO60  FE55  MO93  NI63  PU241

ACCIDENT ARATMZ  NMODE=1  0.8E-08  1.3E-08  1.2E-08

         SEVFRC  NPOP=1  NMODE=1  0.46  0.3  0.18  0.04  0.02  7.2E-3

                 NPOP=2  NMODE=1  0.43  0.28  0.22  0.05  6.6E-3  1.8E-3

                 NPOP=3  NMODE=1  0.58  0.38  0.03  6.4E-3  7.4E-4  1.6E-4

DEFINE    MO93  1.28E+6  0.011  0  5.8E-9  0

          0  0  0.1  3  0  0

DEFINE    NI63  3.5E+4  0  0  4.3E-9  0

          0  0  0.1  2  0  0

RELEASE  RFRAC  GROUP=1  0.0  0.0  1E-2  1E-1  1  1

OTHER   BDF=8.60E-03

        XFARM=0.5

        CULVL=7.4E3

        BRATE=3.30E-04

        EVACUATION 1

        ITRAIN=2

EOF

ISOTOPES  -1  500  2  0.4  1.0  0.0  FCC

CO60  3.08E+9  HIGH   3

FE55  2.29E+9  HIGH   3
```

```
MO93  3.22E+8  HIGH   3

NI63  4.63E+9  HIGH   3

PU241  1.58E+8  HIGH   3

PKGSIZ  FCC  1.5

LINK  1  93  65  45  4.70E+02  0.8E-08  R  1

LINK  1  7  33  665  7.80E+02  1.3E-08  S  1

LINK  1  3  33  2341  2.80E+03  1.2E-08  U  1

EOF
```

RUN DATE: [2013/09/30]   PAGE   3

BOHUNICE V1 DECOM - MOCHOVCE

PACKAGE CHARACTERISTICS

FOR MATERIAL	DIMENSION (METERS)	EFFECTIVE DIMENSION	K(0) METERS SQ.
FCC	1.500E+00	1.500E+00	3.063E+00

K(0) IS TI TO DOSE RATE CONVERSION FACTOR

PACKAGE HANDLING THRESHOLDS (METERS)

PKGSZ1= 5.000E-01

PKGSZ2= 1.000E+00

PACKAGES .LE. PKGSZ1 ARE HAND CARRIED

PACKAGES .GT. PKGSZ1 AND .LE. PKGSZ2 ARE HANDLED BY SMALL EQUIPMENT

PACKAGES .GT. PKGSZ2 ARE HANDLED BY HEAVY EQUIPMENT

MATERIAL CHARACTERISTICS

MATERIAL	FRACTION OF GAMMA	FRACTION OF NEUTRON
FCC	1.000E+00	0.000E+00

RUN DATE: [2013/09/30]   PAGE 4

BOHUNICE V1 DECOM - MOCHOVCE

MODE CHARACTERISTICS

MODE	EXCLUSIVE USE	NUMBER OF SHIPMENTS	MATERIALS	DOSE RATE MSV/HR	PACKAGES/ SHIPMENT
TRUCK	YES	5.00E+02			
			FCC	4.00E-01	2.00E+00

BUILDING SHIELDING OPTION= 2

(1=TOTAL SHIELDING, 2=PARTIAL SHIELDING, 3=NO SHIELDING)

RPD= 6.000E+00

(RATIO OF PEDESTRIAN DENSITY (PEDESTRIAN/KM SQ OF SIDEWALK)

TO POPULATION DENSITY (PEOPLE/KM SQ IN URBAN AREAS)

RR = 1.000E+00

(TRANSMISSION FACTOR FOR RURAL AREAS)

RS = 8.700E-01

(TRANSMISSION FACTOR FOR SUBURBAN AREAS)

RU = 1.800E-02

(TRANSMISSION FACTOR FOR URBAN AREAS)

EVACUATION TIME IS 1.00E+00 DAYS

```
SI FLAG IS 1 = TRUE
```

RUN DATE: [2013/09/30]   PAGE   5

BOHUNICE V1 DECOM - MOCHOVCE

SEGMENT RELATED DATA

	LINK 1	LINK 2	LINK 3
MODE	TRUCK	TRUCK	TRUCK
DISTANCE (KM)	9.30E+01	7.00E+00	3.00E+00
SPEED (KM/HR)	6.50E+01	3.30E+01	3.30E+01
POPULATION DENSITY	4.50E+01	6.65E+02	2.34E+03
VEHICLE DENSITY	4.70E+02	7.80E+02	2.80E+03
ACCIDENT RATE/KM	8.00E-09	1.30E-08	1.20E-08
ZONE	RURAL	SUBURBAN	URBAN
ROAD TYPE	FREEWAY	FREEWAY	FREEWAY

MODE RELATED DATA

	LINK 1	LINK 2	LINK 3
PEOPLE IN CREW	2.00E+00	2.00E+00	2.00E+00
CREW EXPOSURE DIST	3.10E+00	3.10E+00	3.10E+00
PEOPLE AT STOPS	5.00E+01	5.00E+01	5.00E+01
STOP EXPOSURE DIST	2.00E+01	2.00E+01	2.00E+01
STOP TIME PER KM	1.10E-02	1.10E-02	1.10E-02
MINIMUM STOP TIME	0.00E+00	0.00E+00	0.00E+00
END POINT STOP TIME	0.00E+00	0.00E+00	0.00E+00

```
PEOPLE AT STORAGE    1.00E+02  1.00E+02  1.00E+02

STOR. EXPOSURE DIST  1.00E+02  1.00E+02  1.00E+02

NUMBER OF HANDLINGS  0.00E+00  0.00E+00  0.00E+00
```

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BOHUNICE V1 DECOM - MOCHOVCE

ISOTOPE RELATED DATA

NUCLIDE	BECQUERELS PER PKG	RELEASE GROUP	RESUSP FACTOR	LUNG TYPE	DISPERS. CATEGORY	1YR INHAL SV/BQ LUNG	1YR INHAL SV/BQ MARROW
FCC							
CO60	3.08E+09	HIGH	4.83E+00	2	3	2.14E-07	1.03E-08
FE55	2.29E+09	HIGH	4.32E+00	2	3	1.57E-09	4.86E-11
MO93	3.22E+08	HIGH	4.66E+01	3	3	0.00E+00	0.00E+00
NI63	4.63E+09	HIGH	4.62E+01	2	3	0.00E+00	0.00E+00
PU241	1.58E+08	HIGH	5.26E+00	3	3	9.73E-08	3.51E-10

NUCLIDE	HALF LIFE	GAMMA ENERGY	CLOUD FACTOR	TRANSFER CROPS	TRANSFER SOIL	DEPOS SPEED
FCC						
CO60	1.93E+03	2.50E+00	4.11E-01	0.00E+00	0.00E+00	1.00E-02
FE55	9.86E+02	1.69E-03	3.64E-06	0.00E+00	0.00E+00	1.00E-02
MO93	1.28E+06	1.10E-02	0.00E+00	0.00E+00	0.00E+00	1.00E-01
NI63	3.50E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-01
PU241	5.26E+03	2.54E-06	0.00E+00	0.00E+00	0.00E+00	1.00E-02

NUCLIDE	50-YR EFFECTIVE SV/BQ	
	INHALE	INGEST
FCC		
CO60	7.57E-08	7.03E-09
FE55	4.32E-10	1.57E-10
MO93	5.80E-09	0.00E+00
NI63	4.30E-09	0.00E+00
PU241	2.68E-06	2.32E-08

RUN DATE: [2013/09/30]   PAGE   7

BOHUNICE V1 DECOM - MOCHOVCE

RELEASE RELATED DATA

RELEASE FRACTIONS

GROUP	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	0.00E+00	0.00E+00	1.00E-02	1.00E-01	1.00E+00	1.00E+00

ACCIDENT SEVERITY FRACTIONS

FOR   TRUCK

ZONE	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	4.60E-01	3.00E-01	1.80E-01	4.00E-02	2.00E-02	7.20E-03
2	4.30E-01	2.80E-01	2.20E-01	5.00E-02	6.60E-03	1.80E-03
3	5.80E-01	3.80E-01	3.00E-02	6.40E-03	7.40E-04	1.60E-04

RUN DATE: [2013/09/30] PAGE 8

BOHUNICE V1 DECOM - MOCHOVCE

AEROSOLIZED FRACTION OF RELEASED MATERIAL

DISP CAT	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06	1.00E-06
3	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02
4	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02
5	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01
6	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
7	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
8	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
9	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
10	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
11	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

FRACTION OF AEROSOLS BELOW 10 MICRONS AED

DISP CAT	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02
3	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02
4	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02

5	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02
6	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02	5.00E-02
7	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
8	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
9	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
10	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
11	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

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BOHUNICE V1 DECOM - MOCHOVCE

COST RELATED DATA

EMERGENCY RESPONSE COST

	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

ON-SCENE COSTS

(RF=RELEASE FRACTION)

RF=0.	0.<RF<=.01	.01<RF<=0.1	.1<RF<=1.
0.	0.	0.	0.

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BOHUNICE V1 DECOM - MOCHOVCE

HEALTH RELATED DATA

EARLY FATALITY PROBABILITIES

DOSE(SV)	LUNG-1	LUNG-2	LUNG-3	MARROW
1000.000	1.000E+00	1.000E+00	1.000E+00	1.000E+00
800.000	1.000E+00	8.500E-01	8.000E-01	1.000E+00
700.000	1.000E+00	8.000E-01	5.000E-01	1.000E+00
400.000	1.000E+00	7.000E-01	0.000E+00	1.000E+00
300.000	1.000E+00	5.000E-01	0.000E+00	1.000E+00
250.000	1.000E+00	2.000E-01	0.000E+00	1.000E+00
200.000	1.000E+00	8.000E-02	0.000E+00	1.000E+00
100.000	6.000E-01	0.000E+00	0.000E+00	1.000E+00
80.000	1.000E-01	0.000E+00	0.000E+00	1.000E+00
60.000	6.000E-02	0.000E+00	0.000E+00	1.000E+00
40.000	3.000E-02	0.000E+00	0.000E+00	1.000E+00
30.000	0.000E+00	0.000E+00	0.000E+00	1.000E+00
20.000	0.000E+00	0.000E+00	0.000E+00	1.000E+00
10.000	0.000E+00	0.000E+00	0.000E+00	1.000E+00
8.000	0.000E+00	0.000E+00	0.000E+00	9.960E-01
7.000	0.000E+00	0.000E+00	0.000E+00	9.000E-01
6.000	0.000E+00	0.000E+00	0.000E+00	4.000E-01
5.000	0.000E+00	0.000E+00	0.000E+00	5.000E-02
4.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

3.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.750	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.500	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.300	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.150	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.050	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.010	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.001	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00
.000	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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BOHUNICE V1 DECOM - MOCHOVCE

DISPERSAL ACCIDENT INPUT

AREADA (M SQ)	DILUTION FACTOR*
4.590E+02	3.420E-03
1.530E+03	1.720E-03
3.940E+03	8.580E-04
1.250E+04	3.420E-04
3.040E+04	1.720E-04
6.850E+04	8.580E-05
1.760E+05	3.420E-05
4.450E+05	1.720E-05
8.590E+05	8.580E-06
2.550E+06	3.420E-06
4.450E+06	1.720E-06
1.030E+07	8.580E-07
2.160E+07	3.420E-07
5.520E+07	1.720E-07
1.770E+08	8.580E-08
4.890E+08	5.420E-08
8.120E+08	4.300E-08
1.350E+09	3.420E-08

* DILUTION FACTOR UNITS ARE (BQ-SEC/M**3/BQ-RELEASED)

NON-DISPERSAL ACCIDENT INPUT

	RADIST(M)	
RURAL	SUBURBAN	URBAN

BUILDING DOSE FACTOR = 8.600E-03

FRACTION OF LAND UNDER CULTIVATION = 5.000E-01

CONTAMINATION CLEAN UP LEVEL (BQ/M**2) = 7.400E+03

BREATHING RATE (M**3/SEC) = 3.300E-04

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BOHUNICE V1 DECOM - MOCHOVCE

REGULATORY CHECKS

FOR THE SHIPMENT OF   FCC BY MODE 1

THE DOSE RATE AT 2 METERS COULD EXCEED 0.1 MSV/HR

PPS*TI HAS BEEN RESET TO EQUAL   .16 MSV/HR

FOR THE SHIPMENT OF   FCC BY MODE 1

THE DOSE RATE IN THE CREW COMPARTMENT COULD EXCEED 0.02 MSV/HR

THE DOSE RATE HAS BEEN RESET FROM   .25 TO 0.02 FOR CREW CALCULATIONS

FOR THE SHIPMENT OF   FCC BY MODE 1

THE DOSE RATE AT 2 METERS COULD EXCEED 0.1 MSV/HR

PPS*TI HAS BEEN RESET TO EQUAL   .16 MSV/HR

FOR THE SHIPMENT OF   FCC BY MODE 1

THE DOSE RATE IN THE CREW COMPARTMENT COULD EXCEED 0.02 MSV/HR

THE DOSE RATE HAS BEEN RESET FROM   .25 TO 0.02 FOR CREW CALCULATIONS

FOR THE SHIPMENT OF   FCC BY MODE 1

THE DOSE RATE AT 2 METERS COULD EXCEED 0.1 MSV/HR

PPS*TI HAS BEEN RESET TO EQUAL   .16 MSV/HR

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FOR THE SHIPMENT OF        FCC BY MODE  1

THE DOSE RATE IN THE CREW COMPARTMENT COULD EXCEED 0.02 MSV/HR

THE DOSE RATE HAS BEEN RESET FROM   .25 TO 0.02 FOR CREW CALCULATIONS
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            BOHUNICE V1 DECOM - MOCHOVCE


     CALCULATIONAL INFORMATION FOR MODE      TRUCK

IN CALCULATING THE DEPLETION OF       MO93 THE CONCENTRATION
IN AREA  7 HAS BECOME NEGATIVE.  THE CONTAMINATION AND
CONCENTRATIONS IN AREAS  7 AND LARGER HAVE BEEN SET TO 0.0.

IN CALCULATING THE DEPLETION OF       NI63 THE CONCENTRATION
IN AREA  7 HAS BECOME NEGATIVE.  THE CONTAMINATION AND
CONCENTRATIONS IN AREAS  7 AND LARGER HAVE BEEN SET TO 0.0.
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BOHUNICE V1 DECOM - MOCHOVCE

MODE   TRUCK

1-YEAR LUNG DOSE - INHALATION PATHWAY

BDF = 1   (SV)

AREA #	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	0.00E+00	0.00E+00	7.65E-09	7.65E-08	7.65E-07	7.65E-07
2	0.00E+00	0.00E+00	3.84E-09	3.84E-08	3.84E-07	3.84E-07
3	0.00E+00	0.00E+00	1.87E-09	1.87E-08	1.87E-07	1.87E-07
4	0.00E+00	0.00E+00	7.22E-10	7.22E-09	7.22E-08	7.22E-08
5	0.00E+00	0.00E+00	3.46E-10	3.46E-09	3.46E-08	3.46E-08
6	0.00E+00	0.00E+00	1.65E-10	1.65E-09	1.65E-08	1.65E-08
7	0.00E+00	0.00E+00	6.26E-11	6.26E-10	6.26E-09	6.26E-09
8	0.00E+00	0.00E+00	2.97E-11	2.97E-10	2.97E-09	2.97E-09
9	0.00E+00	0.00E+00	1.38E-11	1.38E-10	1.38E-09	1.38E-09
10	0.00E+00	0.00E+00	5.21E-12	5.21E-11	5.21E-10	5.21E-10
11	0.00E+00	0.00E+00	2.37E-12	2.37E-11	2.37E-10	2.37E-10
12	0.00E+00	0.00E+00	1.13E-12	1.13E-11	1.13E-10	1.13E-10
13	0.00E+00	0.00E+00	4.17E-13	4.17E-12	4.17E-11	4.17E-11
14	0.00E+00	0.00E+00	1.96E-13	1.96E-12	1.96E-11	1.96E-11
15	0.00E+00	0.00E+00	8.97E-14	8.97E-13	8.97E-12	8.97E-12
16	0.00E+00	0.00E+00	4.79E-14	4.79E-13	4.79E-12	4.79E-12
17	0.00E+00	0.00E+00	2.92E-14	2.92E-13	2.92E-12	2.92E-12
18	0.00E+00	0.00E+00	1.91E-14	1.91E-13	1.91E-12	1.91E-12

1-YEAR MARROW DOSE - INHALATION PATHWAY

BDF = 1 (SV)

AREA #	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	0.00E+00	0.00E+00	3.60E-10	3.60E-09	3.60E-08	3.60E-08
2	0.00E+00	0.00E+00	1.81E-10	1.81E-09	1.81E-08	1.81E-08
3	0.00E+00	0.00E+00	8.78E-11	8.78E-10	8.78E-09	8.78E-09
4	0.00E+00	0.00E+00	3.40E-11	3.40E-10	3.40E-09	3.40E-09
5	0.00E+00	0.00E+00	1.63E-11	1.63E-10	1.63E-09	1.63E-09
6	0.00E+00	0.00E+00	7.76E-12	7.76E-11	7.76E-10	7.76E-10
7	0.00E+00	0.00E+00	2.95E-12	2.95E-11	2.95E-10	2.95E-10
8	0.00E+00	0.00E+00	1.39E-12	1.39E-11	1.39E-10	1.39E-10
9	0.00E+00	0.00E+00	6.49E-13	6.49E-12	6.49E-11	6.49E-11
10	0.00E+00	0.00E+00	2.45E-13	2.45E-12	2.45E-11	2.45E-11
11	0.00E+00	0.00E+00	1.12E-13	1.12E-12	1.12E-11	1.12E-11
12	0.00E+00	0.00E+00	5.30E-14	5.30E-13	5.30E-12	5.30E-12
13	0.00E+00	0.00E+00	1.96E-14	1.96E-13	1.96E-12	1.96E-12
14	0.00E+00	0.00E+00	9.23E-15	9.23E-14	9.23E-13	9.23E-13
15	0.00E+00	0.00E+00	4.22E-15	4.22E-14	4.22E-13	4.22E-13
16	0.00E+00	0.00E+00	2.25E-15	2.25E-14	2.25E-13	2.25E-13
17	0.00E+00	0.00E+00	1.37E-15	1.37E-14	1.37E-13	1.37E-13
18	0.00E+00	0.00E+00	8.99E-16	8.99E-15	8.99E-14	8.99E-14

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BOHUNICE V1 DECOM - MOCHOVCE

MODE TRUCK

GROUND SURFACE CONTAMINATION TABLE (BQ/M**2)

BEFORE CLEANUP

AREA #	SEVER: 1	SEVER: 2	SEVER: 3	SEVER: 4	SEVER: 5	SEVER: 6
1	0.00E+00	0.00E+00	3.77E+02	3.77E+03	3.77E+04	3.77E+04
2	0.00E+00	0.00E+00	1.89E+02	1.89E+03	1.89E+04	1.89E+04
3	0.00E+00	0.00E+00	7.20E+01	7.20E+02	7.20E+03	7.20E+03
4	0.00E+00	0.00E+00	2.01E+01	2.01E+02	2.01E+03	2.01E+03
5	0.00E+00	0.00E+00	5.29E+00	5.29E+01	5.29E+02	5.29E+02
6	0.00E+00	0.00E+00	1.42E+00	1.42E+01	1.42E+02	1.42E+02
7	0.00E+00	0.00E+00	3.10E-01	3.10E+00	3.10E+01	3.10E+01
8	0.00E+00	0.00E+00	1.46E-01	1.46E+00	1.46E+01	1.46E+01
9	0.00E+00	0.00E+00	6.82E-02	6.82E-01	6.82E+00	6.82E+00
10	0.00E+00	0.00E+00	2.57E-02	2.57E-01	2.57E+00	2.57E+00
11	0.00E+00	0.00E+00	1.17E-02	1.17E-01	1.17E+00	1.17E+00
12	0.00E+00	0.00E+00	5.57E-03	5.57E-02	5.57E-01	5.57E-01
13	0.00E+00	0.00E+00	2.06E-03	2.06E-02	2.06E-01	2.06E-01
14	0.00E+00	0.00E+00	9.70E-04	9.70E-03	9.70E-02	9.70E-02
15	0.00E+00	0.00E+00	4.43E-04	4.43E-03	4.43E-02	4.43E-02
16	0.00E+00	0.00E+00	2.37E-04	2.37E-03	2.37E-02	2.37E-02
17	0.00E+00	0.00E+00	1.44E-04	1.44E-03	1.44E-02	1.44E-02
18	0.00E+00	0.00E+00	9.44E-05	9.44E-04	9.44E-03	9.44E-03

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BOHUNICE V1 DECOM - MOCHOVCE

INCIDENT-FREE SUMMARY

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INCIDENT-FREE POPULATION EXPOSURE IN PERSON-SV

	PASSENGR	CREW	HANDLERS	OFF LINK	ON LINK	STOPS	STORAGE	TOTALS
LINK 1	0.00E+00	2.88E-02	0.00E+00	3.22E-04	2.42E-03	3.08E-02	0.00E+00	6.24E-02
LINK 2	0.00E+00	4.28E-03	0.00E+00	6.14E-04	1.24E-03	2.32E-03	0.00E+00	8.44E-03
LINK 3	0.00E+00	1.83E-03	0.00E+00	1.92E-05	1.90E-03	9.93E-04	0.00E+00	4.75E-03
RURAL	0.00E+00	2.88E-02	0.00E+00	3.22E-04	2.42E-03	3.08E-02	0.00E+00	6.24E-02
SUBURB	0.00E+00	4.28E-03	0.00E+00	6.14E-04	1.24E-03	2.32E-03	0.00E+00	8.44E-03
URBAN	0.00E+00	1.83E-03	0.00E+00	1.92E-05	1.90E-03	9.93E-04	0.00E+00	4.75E-03
TOTALS:	0.00E+00	3.50E-02	0.00E+00	9.55E-04	5.56E-03	3.41E-02	0.00E+00	7.55E-02

MAXIMUM INDIVIDUAL IN-TRANSIT DOSE

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LINK  1  4.68E-06 SV

LINK  2  4.68E-06 SV

LINK  3  4.68E-06 SV
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BOHUNICE V1 DECOM - MOCHOVCE

INCIDENT-FREE IMPORTANCE ANALYSIS SUMMARY FOR LINK 1

****

INDEX	DESCRIPTION OF PARAMETER	IMPORTANCE
1	DISTANCE TRAVELED	6.236E-04
2	NUMBER OF SHIPMENTS	6.236E-04
3	DOSE RATE (TRANSPORT INDEX)	3.351E-04
4	PACKAGES PER SHIPMENT	3.351E-04
5	K ZERO	3.351E-04
6	FRACTION OF TRAVEL - RURAL	3.159E-04
7	STOP TIME	3.077E-04
8	PERSONS EXPOSED WHILE STOPPED	3.077E-04
9	NUMBER OF CREW MEMBERS	2.884E-04
10	TRAFFIC COUNT - RURAL	2.420E-05
11	NUMBER OF PEOPLE PER VEHICLE	2.420E-05
12	RURAL SHIELDING FACTOR (RR)	3.222E-06
13	POPULATION DENSITY - RURAL	3.222E-06
14	HANDLER EXPOSURE DISTANCE	0.000E+00
15	PERSONS EXPOSED PER HANDLING	0.000E+00
16	SUBURBAN SHIELDING FACTOR (RS)	0.000E+00
17	NUMBER OF HANDLINGS	0.000E+00
18	EXPOSURE TIME FOR HANDLERS	0.000E+00
19	FRACTION OF TRAVEL ON FREEWAYS	0.000E+00

20	FRACTION OF RUSH HOUR TRAVEL	0.000E+00
21	NUMBER OF FLIGHT ATTENDANTS	0.000E+00
22	TRAFFIC COUNT - URBAN	0.000E+00
23	TRAFFIC COUNT - SUBURBAN	0.000E+00
24	RATIO OF PEDESTRIAN DENSITY (RPD)	0.000E+00
25	DISTANCE FROM SOURCE TO CREW	0.000E+00
26	STORAGE EXPOSURE DISTANCE	0.000E+00
27	FRACTION OF TRAVEL ON CITY STREETS	0.000E+00
28	VELOCITY - SUBURBAN	0.000E+00
29	POPULATION DENSITY - URBAN	0.000E+00
30	FRACTION OF TRAVEL - URBAN	0.000E+00
31	URBAN SHIELDING FACTOR (RU)	0.000E+00
32	POPULATION DENSITY - SUBURBAN	0.000E+00
33	VELOCITY - URBAN	0.000E+00
34	NUMBER OF PERSONS EXPOSED DURING STORAGE	0.000E+00
35	FRACTION OF TRAVEL - SUBURBAN	0.000E+00
36	STORAGE TIME PER SHIPMENT	0.000E+00
37	VELOCITY - RURAL	-3.401E-04
38	EXPOSURE DISTANCE WHILE STOPPED	-6.154E-04

THE IMPORTANCE VALUE ESTIMATES THE PERSON-SV INFLUENCE

OF A ONE PERCENT INCREASE IN THE PARAMETER

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BOHUNICE V1 DECOM - MOCHOVCE

INCIDENT-FREE IMPORTANCE ANALYSIS SUMMARY FOR LINK 2

****

INDEX	DESCRIPTION OF PARAMETER	IMPORTANCE
1	DISTANCE TRAVELED	8.444E-05
2	NUMBER OF SHIPMENTS	8.444E-05
3	FRACTION OF TRAVEL - SUBURBAN	6.128E-05
4	NUMBER OF CREW MEMBERS	4.276E-05
5	K ZERO	4.168E-05
6	PACKAGES PER SHIPMENT	4.168E-05
7	DOSE RATE (TRANSPORT INDEX)	4.168E-05
8	PERSONS EXPOSED WHILE STOPPED	2.316E-05
9	STOP TIME	2.316E-05
10	NUMBER OF PEOPLE PER VEHICLE	1.238E-05
11	TRAFFIC COUNT - SUBURBAN	1.238E-05
12	SUBURBAN SHIELDING FACTOR (RS)	6.141E-06
13	POPULATION DENSITY - SUBURBAN	6.141E-06
14	TRAFFIC COUNT - URBAN	0.000E+00
15	NUMBER OF HANDLINGS	0.000E+00
16	TRAFFIC COUNT - RURAL	0.000E+00
17	NUMBER OF FLIGHT ATTENDANTS	0.000E+00
18	FRACTION OF RUSH HOUR TRAVEL	0.000E+00
19	EXPOSURE TIME FOR HANDLERS	0.000E+00

20	FRACTION OF TRAVEL ON FREEWAYS	0.000E+00
21	HANDLER EXPOSURE DISTANCE	0.000E+00
22	PERSONS EXPOSED PER HANDLING	0.000E+00
23	DISTANCE FROM SOURCE TO CREW	0.000E+00
24	STORAGE EXPOSURE DISTANCE	0.000E+00
25	NUMBER OF PERSONS EXPOSED DURING STORAGE	0.000E+00
26	RATIO OF PEDESTRIAN DENSITY (RPD)	0.000E+00
27	VELOCITY - RURAL	0.000E+00
28	POPULATION DENSITY - RURAL	0.000E+00
29	FRACTION OF TRAVEL - RURAL	0.000E+00
30	FRACTION OF TRAVEL - URBAN	0.000E+00
31	POPULATION DENSITY - URBAN	0.000E+00
32	VELOCITY - URBAN	0.000E+00
33	STORAGE TIME PER SHIPMENT	0.000E+00
34	URBAN SHIELDING FACTOR (RU)	0.000E+00
35	FRACTION OF TRAVEL ON CITY STREETS	0.000E+00
36	RURAL SHIELDING FACTOR (RR)	0.000E+00
37	VELOCITY - SUBURBAN	-4.276E-05
38	EXPOSURE DISTANCE WHILE STOPPED	-4.632E-05

THE IMPORTANCE VALUE ESTIMATES THE PERSON-SV INFLUENCE

OF A ONE PERCENT INCREASE IN THE PARAMETER

RUN DATE: [2013/09/30]   PAGE   19

BOHUNICE V1 DECOM - MOCHOVCE

INCIDENT-FREE IMPORTANCE ANALYSIS SUMMARY FOR LINK 3

****

INDEX	DESCRIPTION OF PARAMETER	IMPORTANCE
1	NUMBER OF SHIPMENTS	4.748E-05
2	DISTANCE TRAVELED	4.748E-05
3	FRACTION OF TRAVEL - URBAN	3.756E-05
4	PACKAGES PER SHIPMENT	2.916E-05
5	DOSE RATE (TRANSPORT INDEX)	2.916E-05
6	K ZERO	2.916E-05
7	TRAFFIC COUNT - URBAN	1.904E-05
8	NUMBER OF PEOPLE PER VEHICLE	1.904E-05
9	NUMBER OF CREW MEMBERS	1.833E-05
10	PERSONS EXPOSED WHILE STOPPED	9.926E-06
11	STOP TIME	9.926E-06
12	POPULATION DENSITY - URBAN	1.917E-07
13	URBAN SHIELDING FACTOR (RU)	1.917E-07
14	NUMBER OF HANDLINGS	0.000E+00
15	EXPOSURE TIME FOR HANDLERS	0.000E+00
16	PERSONS EXPOSED PER HANDLING	0.000E+00
17	HANDLER EXPOSURE DISTANCE	0.000E+00
18	NUMBER OF FLIGHT ATTENDANTS	0.000E+00
19	TRAFFIC COUNT - SUBURBAN	0.000E+00

20	FRACTION OF RUSH HOUR TRAVEL	0.000E+00
21	TRAFFIC COUNT - RURAL	0.000E+00
22	FRACTION OF TRAVEL ON FREEWAYS	0.000E+00
23	DISTANCE FROM SOURCE TO CREW	0.000E+00
24	STORAGE EXPOSURE DISTANCE	0.000E+00
25	NUMBER OF PERSONS EXPOSED DURING STORAGE	0.000E+00
26	FRACTION OF TRAVEL - SUBURBAN	0.000E+00
27	RATIO OF PEDESTRIAN DENSITY (RPD)	0.000E+00
28	VELOCITY - RURAL	0.000E+00
29	POPULATION DENSITY - RURAL	0.000E+00
30	FRACTION OF TRAVEL - RURAL	0.000E+00
31	POPULATION DENSITY - SUBURBAN	0.000E+00
32	VELOCITY - SUBURBAN	0.000E+00
33	STORAGE TIME PER SHIPMENT	0.000E+00
34	FRACTION OF TRAVEL ON CITY STREETS	0.000E+00
35	RURAL SHIELDING FACTOR (RR)	0.000E+00
36	SUBURBAN SHIELDING FACTOR (RS)	0.000E+00
37	VELOCITY - URBAN	-1.833E-05
38	EXPOSURE DISTANCE WHILE STOPPED	-1.985E-05

THE IMPORTANCE VALUE ESTIMATES THE PERSON-SV INFLUENCE

OF A ONE PERCENT INCREASE IN THE PARAMETER

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BOHUNICE V1 DECOM - MOCHOVCE

ACCIDENT SUMMARY

******** *******

NUMBER OF EXPECTED ACCIDENTS

CATEGORY	LINK 1	LINK 2	LINK 3
1	1.71E-04	1.96E-05	1.04E-05
2	1.12E-04	1.27E-05	6.84E-06
3	6.70E-05	1.00E-05	5.40E-07
4	1.49E-05	2.28E-06	1.15E-07
5	7.44E-06	3.00E-07	1.33E-08
6	2.68E-06	8.19E-08	2.88E-09

EARLY FATALITY CONSEQUENCES

CATEGORY	LINK 1	LINK 2	LINK 3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00

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6        0.00E+00  0.00E+00  0.00E+00
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BOHUNICE V1 DECOM - MOCHOVCE

ECONOMIC CONSEQUENCES

CATEGORY	LINK 1	LINK 2	LINK 3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00	0.00E+00
4	0.00E+00	0.00E+00	0.00E+00
5	0.00E+00	0.00E+00	0.00E+00
6	0.00E+00	0.00E+00	0.00E+00

RADIOLOGICAL CONSEQUENCES

50 YEAR POPULATION DOSE IN PERSON-SIEVERT

CATEGORY	LINK 1	LINK 2	LINK 3
1	0.00E+00	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00	0.00E+00
3	3.78E-06	5.59E-05	1.19E-04
4	3.78E-05	5.59E-04	1.19E-03
5	3.62E-04	5.35E-03	1.14E-02
6	3.62E-04	5.35E-03	1.14E-02

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BOHUNICE V1 DECOM - MOCHOVCE

EXPECTED VALUES OF POPULATION RISK IN PERSON-SV

	GROUND	INHALED	RESUSPD	CLOUDSH	*INGESTION	TOTAL
LINK 1	4.44E-09	8.31E-12	3.56E-11	2.61E-13	0.00E+00	4.48E-09
LINK 2	3.84E-09	7.10E-12	3.04E-11	2.23E-13	0.00E+00	3.88E-09
LINK 3	3.82E-10	7.05E-13	3.02E-12	2.21E-14	0.00E+00	3.86E-10
RURAL	4.44E-09	8.31E-12	3.56E-11	2.61E-13	0.00E+00	4.48E-09
SUBURB	3.84E-09	7.10E-12	3.04E-11	2.23E-13	0.00E+00	3.88E-09
URBAN	3.82E-10	7.05E-13	3.02E-12	2.21E-14	0.00E+00	3.86E-10
TOTALS:	8.66E-09	1.61E-11	6.90E-11	5.06E-13	0.00E+00	8.74E-09

* NOTE THAT INGESTION RISK IS A SOCIETAL RISK;

THE USER MAY WISH TO TREAT THIS VALUE SEPARATELY.

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BOHUNICE V1 DECOM - MOCHOVCE

EXPECTED RISK VALUES - OTHER

LINK	ECON $$	EARLY FATALITY
1	0.00E+00	0.00E+00
2	0.00E+00	0.00E+00
3	0.00E+00	0.00E+00
TOTAL	0.00E+00	0.00E+00

TOTAL EXPOSED POPULATION: INCIDENT-FREE

LINK 1 6.70E+03 PERSONS

LINK 2 7.45E+03 PERSONS

LINK 3 1.12E+04 PERSONS

TOTAL 2.54E+04 PERSONS

TOTAL EXPOSED POPULATION: ACCIDENT

(PERSONS UNDER PLUME FOOTPRINT FOR A SINGLE ACCIDENT)

LINK 1 6.08E+04 PERSONS

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                              LINK  2  8.98E+05 PERSONS

                              LINK  3  3.16E+06 PERSONS

EOI

END OF RUN
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Annex 15. List of objects of V1 NPP to be decommisioned and objects noit to be decommissioned

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
301:V1	Demolition			✖	1	Planned build., but not built
301VS:V1	Heat exchangers near to škoda building					Demolition programmed for Stage II
302:V1	Spare building			✖	1	Planned build., but not built
303M:V1	Electro relay - MSVP			✖	2	Project, not build.
303a:V1	110 kV line relaying			✖	2	Project, not build.
303b:V1	220 kV line relaying			✖	2	Project, not build.
303d:V1	6 kV a low voltage line relaying			✖	2	Project, not build.
304:V1	Road relaying			✖	2	Project, not build.
304M:V1	Road relaying - MSVP			✖	2	Project, not build.
305:V1	Pipe relaying			✖	2	Project, not build.
306:V1	Water line relaying - Manivier Brook			✖	2	Project, not build.
307:V1	Vegetation cutting			✖	2	Project, not build.
310:V1	Topsoil removal			✖	2	Project, not build.
311:V1	Earth work			✖	2	Project, not build.

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
311M:V1	Earth work - MSVP			✖	2	Project, not build.
312:V1	Earth work at parking place near HQ building			✖	2	Project, not build.
313:V1	Earth work at waste disposal area			✖	2	Project, not build.
321:V1	Fence of industrial waste water disposal area			✖	5	Long term use at the Nuclear Site
32A	Switchboard building			✖	4	A1 NPP Site
320HVB:V1	Reactor building fence					Demolition programmed for Stage II
330:V1	Gardening			✖	2	Project, not build.
330M:V1	Landscape work			✖	2	Project, not build.
331:V1	Landscape work outside the fence			✖	2	Project, not build.
340:V1	External lighting			✖	6	Part of the external lighting shall be dismantled within demolition of civil buildings during 1st and 2nd phase and remaining lighting shall be optimised in accordance with landscaping and with the requirements for the final state of site which is "brownfield"
340M:V1	External lighting - MSVP			✖	3	MSVP
341:V1	External lighting of waste water disposal area			✖	5	Long term use at the Nuclear Site (connection to 900:V1)

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
350:V1	Trenches and channels of power cables					During the 2nd stage a substantial part of the EK Trenches and channels of power cables shall be dismantled.
350:MSVP	Cable trenches around MSVP			✖	2	Project, not build.
350HVB:V1	Cable trenches around Reactor building					Demolition programmed for Stage II
350M:V1	High and power cable trenches and ducts MSVP			✖	3	MSVP
351:V1	Low voltage trenches and channels, including cabling			✖	6	Decommissioning related to 340:V1 (Lighting)
352:V1	Low voltage trenches and channels, including cabling				7	Support of I&C related mainly to nuclear island
352M:V1	Low voltage trenches - MSVP			✖	3	MSVP
353:V1	Earthing trenches			✖	6	Part of the earthing system will be dismantled during 1st and 2nd stage and remaining part will be optimized for not decommissioned building and equipment.
353M:V1	Earthing trenches MSVP			✖	3	MSVP
360:V1	V1 NPP rain sewage			✖	6	Part of sewage connected to build. demolished will be disfunctioned and blind
360M:V1	MSVP rain sewage			✖	3	MSVP
361:V1	V1 NPP drainage sewage			✖	6	Part of sewage connected to build. demolished will be disfunctioned and blind

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
361M:V1	MSVP drainage sewage			✖	3	MSVP
362:V1	V1 NPP industrial sewage			✖	6	Part of sewage connected to build. demolished will be disfunctioned and blind
363:V1	Final sewage collector from V1 NPP			✖	5	Long term use at the Nuclear Site (connection between 900:V1 to SOCOMAN)
364:V1	Cess pool and sewage water purification plant			✖	5	Long term use at the Nuclear Site
367:V1	Drainage channels			✖	5	Long term use
370:V1	V1 NPP drinking water inlet line			✖	5	Long term use at the V1 NPP Site
371:V1	V1 NPP drinking water piping			✖	6	Part of piping connected to build. demolished will be disfunctioned and blind
371M:V1	MSVP drinking water piping			✖	3	MSVP
372:V1	V1 NPP fire water and service water piping			✖	6	Part of piping connected to build. demolished will be disfunctioned and blind
372M:V1	MSVP fire water and service water piping			✖	3	MSVP
377:V1	Drinking water pumping station and water reservoir V1 NPP			✖	5	Long term use at the V1 NPP Site
400:V1	V1 NPP piping trenches				7	V1 nuclear island support. Contains also TVD inlet to HVB (Reactor Build.). Decommissioned together with nuclear island decommissioning

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
400M:V1	MSVP piping trenches			✖	3	MSVP
400a:V1	A1 - V1 NPP RAW water piping 1200			✖	5	Long term use at the Nuclear Site
401:V1	V1 NPP essential service water channels			✖	5	Long term use at the V1 NPP Site (the channels house heating lines for V1 NPP buildings)
401M:V1	MSVP essential service water channels			✖	3	MSVP
403:V1	V1 - V2 NPP temporary stream and demineralised water connection			✖	5	Long term use at the Nuclear Site (The connection includes also VS JAVYS, a.s. – NaRK –V2 connection. NaRK is a spare for V2 NPP)
44/10:VYZ	Tanks			✖	4	A1 NPP Site
440:V1	Gas control plant, Outer area, Fence, Fire protection			✖	4	Shared build. in front of the A1 NPP Site
441:V1	V1 NPP Run-up and spare stokehold			✖	5	Long term use at the V1 NPP Site
460:V1	V1 NPP ventilation stack				7	V1 nuclear island
461:V1	Air ducts of V1 NPP ventilation stack				7	V1 nuclear island
46:VYZ	Ventilation stack			✖	3	TSÚ RAO
490-1:V1	V1 NPP turbine hall - Unit 1					Deplant, retain the ability to install water electricity pressure air and heating supply for the period after Stage I completion. Also retain the reactor 1st and 2nd essential water supply system.

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
490-2:V1	V1 NPP turbine hall - Unit 2					Deplant, retain the ability to install water electricity pressure air and heating supply for the period after Stage I completion. Also retain the reactor 1st and 2nd essential water supply system.
490:V1	V1 NPP turbine hall					Deplant, retain the ability to install water electricity pressure air and heating supply for the period after Stage I completion. Also retain the reactor 1st and 2nd essential water supply system.
491:V1	V1 NPP turbogenerators foundations					Deplant and demolished down to level 0
510/1:V1	V1, V2 NPP 250MVA Spare unit transformer basement					Spare transformer no longer needed. Demolish spare transformer.
510:V1	Transformer foundations, including oil tank					Main transformers assuring distribution of electricity to the net are no longer needed. Demolish transformers T1, T11, T2, T12, T13, T3, T14, T4. T1R and T2R remain
522:V1	External switchyards 220 kV and 110 kV	len220kV	len220kV	✖		110 kV infrastructure remains in operation. Only 220 kV infrastructure will be dismantled, where applicable
523a:V1	House of relay protection 220kV, 110kV					110 kV relay protection will be moved by JAVYS, A.S. before demolition to 527a:V1
523b:V1	V1 NPP compressor plant for switchyard for r220kV					Support to 220 kV – no longer used
523c:V1	V1 NPP garage next to compressor plant switchyard r220kV					Useless
523d:V1	Garages					Useless

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
526:V1	V1 NPP safety fence of switchyard			✖	5	Remains due to 110 kV infrastructure operation. Only relaying of the fence in the Stage I is possible because of use of the area after 220kVswitchyard for waste dump set up
527:V1	A1 NPP external switchyard reconstruction			✖	5	110 kV infrastructure remains in operation
527a:V1	House of relay protection 110kV			✖	5	110 kV infrastructure remains in operation
530:V1	V1 NPP dieselgenerator station				7	DGs will be definitely out of operation and emergency power supply system (II. Category) will be cancelled.
530a:V1	Dieselgenerator station DGS V1 NPP with additional building DG5				7	DGs will be definitely out of operation and emergency power supply system (II. Category) will be cancelled.
531:V1	Fuel oil system				7	Diesel generator support system will be definitely out of operation.
532:V1	Compressor station and central cooling station			✖	5	Operation support of non-demolished V1 NPP site buildings
533/1:V1	Cooling station of emergency ventilation system – Unit 1					No longer used after reactor shutdown
533/2:V1	Cooling station of emergency ventilation system – Unit 2					No longer used after reactor shutdown
562:V1	V1 NPP heating oil machine room			✖	5	Shared build. At the V1 NPP Site, long-term use
563:V1	V1 NPP channel for heating oil piping			✖		The channel connected the decantation station (no longer e⍰ists) and NaRK; no longer used since using a gas. Since the channel crosses the cable duct EK 19 (housing el. Cables to 441:V1 NraK – remaining in operation), the pipe in the channel will not be demolished

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
574:V1	Inlet channel DN 1400 into Dudváh River			✖	4	Outside of Nuclear Site Bohunice, property of SE, a.s.
578:V1	Pumping station discharge line DN800 Pečeňady – V1 NPP			✖	4	Outside of Nuclear Site Bohunice, property of SE, a.s.
579:V1	Structures in inlet/outlet discharge line Pečeňady – V1 NPP			✖	4	Outside of Nuclear Site Bohunice
580a:V1	Essential service water cooling tower – 1. Subsystem V1			✖	5	Long term use at the V1 NPP Site (TVD remains in operation)
580b:V1	Essential service water cooling tower – 2. Subsystem V1			✖	5	Long term use at the V1 NPP Site (TVD remains in operation)
581:V1	V1 NPP cooling towers					Cooling water system is no longer needed
582:V1	V1 NPP cooling water pipe ducts					Cooling water system is no longer needed
583/1:V1	Pumping station for cooling water pipe discharge					Cooling water system is no longer needed
583:V1	Cooling water pumping station and filtration circuit					Cooling water system is no longer needed. Fire pumps located in the building have to be moved to build. 585:V1a,b
583a:V1	V1 NPP cooling water blow down building					Technology no longer used (moved to Turbine hall). Currently used as a store.
585a:V1	Essential service water pumping station TVD 1. Subsystem V1 NPP			✖	5	Long term use at the V1 NPP Site (TVD remains in operation)
585b:V1	Essential service water pumping station TVD 2. Subsystem V1 NPP			✖	5	Long term use at the V1 NPP Site (TVD remains in operation)

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
589:V1	Aboveground essential service water collector TVD 1. And 2. Subsystems V1 NPP				7	V1 nuclear island support. Contains also TVD inlet to HVB (Reactor Build.). Decommissioned together with nuclear island decommissioning
590:V1	Chemical water treatment – CHUV V1			✖		This building will remain in operation as resource of demineralized water supply to ISFS.
590a:V1	Demineralised water tanks and Emergency Water Feed Tanks			✖		This building will remain in operation as resource of demineralized water supply to ISFS.
590b:V1	V1 NPP emergency water feed pumps building and tank extension					Emergency water feed pumps are no longer used after reactor shutdown
590c:V1	V1 NPP H_2SO_4 dosing station					Part of the cooling water system, no longer needed.
614:V1	Shared water measurement building			✖	4	Outside of V1 NPP Site
621:V1	Lub-oil system					Support of 490:V1 Machinery. Technological part no longer needed.
62:V1	Radwaste treatment laboratories			✖	4	A1 NPP Site
631a:V1	V1 NPP Administration building			✖	8	Long term use at the V1 NPP Site
631b:V1	V1 NPP Canteen			✖	8	Shared build. At the V1 NPP Site, long-term use
631c:V1	V1 NPP connection bridge and entrance hall			✖	8	Long term use at the V1 NPP Site
632b:V1	Entrance buildings – canteen			✖	4	Shared build. At the A1 NPP Site

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
633:V1	Civil structures maintenance			✖	8	Shared build. At the V1 NPP Site, will be used
640/202:V1	Store 202/V1 – electro spare components			✖	8	Shared build. At the V1 NPP Site, will be used
640:V1	Workshops and stores of electrical and connecting material			✖	8	Shared build. At the V1 NPP Site, will be used
641:V1	Metallic material, spare parts and valves store			✖	8	Shared build. At the V1 NPP Site, will be used
642:V1	Metallurgic material and heavy metal store			✖	8	Will be used and shared
644:V1	Hydrogen store					Generators no longer operated, system not used
645:V1	Nitrogen store					
646:V1	Hydrochloric acid dosing for V1 NPP					The building was empty even during operation, not used.
652:V1	Fire protection equipment and signalling			✖	1	Build. Does not exist
653/1:V1	Garages – fire protection equipment			✖	5	Shared build. At the V1 NPP Site, will be used
653/2:V1	Filling of pressure cylinders			✖	5	Shared build. At the V1 NPP Site, will be used
653:V1	Fire station			✖	5	Shared build. At the V1 NPP Site, will be used
656:V1	Approach ramp			✖	5	Shared build. At the V1 NPP Site, will be used
659:V1	HCl dosing station into cooling circuit A1 NPP			✖	1	Build. Does not exist

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
660:V1	Outside railway siding			✖	5	Long term use at the Nuclear Site
663:V1	Security and warning systems			✖	5	Long term use at the Nuclear Site
670:V1	V1 NPP internal railway siding			✖	5	Long term use at the Nuclear Site
670M:V1	MSVP internal railway siding			✖	3	MSVP
68:V1	Investment store			✖	8	Shared build. At the V1 NPP Site, will be used
680:V1	External traffic roads			✖	5	Long term use at the Nuclear Site
682:V1	Car parking and bus station			✖	5	Shared build. At the V1 NPP Site
683:V1	Road connection to industrial waste water disposal			✖	5	Long term use at the Nuclear Site
690:V1	V1 NPP internal roads, including courtyards			✖	5	Long term use at the Nuclear Site
690M:V1	MSVP internal roads			✖	3	MSVP
713:V1	Transformer station 713			✖	5	Will serve as a power source for A1 NPP site
714:V1	Stands for transformers PSWW					Pending further decision of JAVYS taking into account the possible re-use of the equipment.
717:V1	Cable connection of transformer plants			✖	1	Build. does not exist

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
722 (UNIMO 100)	Offices and cloak room at V1 NPP site					
728:V1	Cable connection of telephone exchange and building of investors			✖	4	Outside of V1 NPP Site
740-VII.16	Technological spare components store			✖	8	Shared build. at the V1 NPP Site
740-VII.1A	Machinery workshop			✖	8	Shared build. at the V1 NPP Site
756:V1	Digital telephone exchange			✖	1	Only installation of technology in buildings 750-Ix.9, 740-Ix.11, 631a
760-I.34	Sewage drainage at V1 NPP site			✖	5	Long term use at the Nuclear Site (relating to part of V1 NPP Site shared buildings)
760-I.3:V1	Workshop - abrasive plant			✖	8	Shared build. at the V1 NPP Site, will be used
760-II	Interim store of building debris at V1 NPP site			✖	1	Build. does not exist
760-II.10	Offices at V1 NPP site			✖	8	Shared build. at the V1 NPP Site, will be used
760-II.11	Maintenance offices - design unit			✖	8	Shared build. at the V1 NPP Site, will be used
760-II.12	Maintenance offices			✖	8	Shared build. at the V1 NPP Site, will be used
760-II.13	Cloak room			✖	8	Shared build. at the V1 NPP Site, will be used
760-II.15	Garages			✖	5	Shared build. at the V1 NPP Site, will be used

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
760-II.3	Training centre for maintenance			✖	8	Shared build. at the V1 NPP Site, will be used
760-II.4	Training centre for maintenance			✖	8	Shared build. at the V1 NPP Site, will be used
760-II.5	Training centre for maintenance			✖	8	Shared build. at the V1 NPP Site, will be used
760-II.6	Store at V1 NPP site					
760-II.7	Centralised distribution of goods					
760-II.9	Offices and cloak room at V1 NPP site					
760-III.1	Workshop at V1 NPP site			✖	8	Shared build. at the V1 NPP Site, will be used
760-V.4:V1	Workshop and store at V1 NPP site			✖	8	Shared build. at the V1 NPP Site, will be used
760-V.5:V1	Workshop and store at V1 NPP site			✖	8	Shared build. at the V1 NPP Site, will be used
780:V1	Civil defence shelter in V1 NPP building No.631a			✖	8	Relation to 631a:V1 which will be long term used at the V1 NPP Site
781:V1	Civil defence shelter in V1 NPP building No. 803				7	V1 nuclear island
792:V1	Fire protection equipment			✖	1	Build. does not exist
800-1:V1	V1 NPP reactor building - Unit 1				7	V1 nuclear island
800-2:V1	V1 NPP reactor building - Unit 2				7	V1 nuclear island

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
800/a:V1	Cross side electrical building - Unit 1					Deplant partial
800/b:V1	Longwise side electrical building - Unit1					Deplant partial
800/c:V1	Longwise side electrical building - Unit2					Deplant partial
800/d:V1	Cross side electrical building - Unit 2					Deplant partial
800/e:V1	V1 NPP diagnostic system				7	V1 nuclear island
800:V1	V1 NPP reactor building				7	V1 nuclear island
800M:V1	Reconstruction in V1 NPP reactor building due to MSVP			✖	2	Project, not build
801/2:V1	Auxiliary building - extension				7	V1 nuclear island
801:V1	Auxiliary building				7	V1 nuclear island
801a:V1	Auxiliary building - extension				7	V1 nuclear island
801G:V1	Garages					Demolition programmed for Stage 1
802:V1	V1 NPP auxiliary building - clean condensate tanks				7	V1 nuclear island
803:V1	Operation and sanitary building-building-bridge 631a-803 and 803-800				7	V1 nuclear island

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
804:V1	Interconnecting bridge 800-801 V1				7	V1 nuclear island
805:V1	V1 NPP reactor building settlement measurement building - CB no. 800 and CB No. 491			✖	1	Build. does not exist
808:VYZ	Bohunice Radioactive Waste Treatment Centre			✖	3	TSÚ RAO
809C:V1	Cementation plant				7	Cementation plant KWU
840M:V1	MSVP building			✖	3	MSVP
880:V1	V1 NPP waste waters activity measurement building			✖	5	Long term use at the Nuclear Site (measurement relating to build. 900:V1)
881M:V1	Probers for monitoring common waters - MSVP			✖	3	MSVP
900:V1	V1 NPP industrial waste water disposal			✖	5	Long term use at the Nuclear Site
900A/1:V1	V1 NPP industrial waste water disposal - pumping station			✖	5	Long term use at the Nuclear Site
900A/2:V1	V1 NPP industrial waste water disposal - sedimentation tanks			✖	5	Long term use at the Nuclear Site
900C:V1	V1 NPP industrial waste water disposal - de-oiling			✖	5	Long term use at the Nuclear Site
900E:V1	V1 NPP industrial waste water disposal - spare tanks			✖	5	Long term use at the Nuclear Site
920:V1	110kV line Madunice - V1 NPP			✖	4	Outside of Nuclear Site Bohunice

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
921:V1	110kV line Malženice - V1 NPP			✖	4	Outside of Nuclear Site Bohunice
922:V1	220kV line A1 - V1 NPP			✖	4	Outside of Nuclear Site Bohunice (electricity distribution company's property)
924:V1	Extension of 110kV - switchyard HC Madunice			✖	4	Outside of Nuclear Site Bohunice
942/NV/A1	Entrance gate for vehicle (reception)			✖	5	Long term use at the Nuclear Site
942:V1	V1 NPP guar room			✖	5	Long term use at the Nuclear Site
942A	Entrance gate for vehicle (reception)			✖	5	Long term use at the Nuclear Site
950M:V1	Operation workplace of wagoncontainer - MSVP-UNIMO			✖	3	MSVP
C301:V1	Demolition - Cementation plant			✖	2	Project, not build.
C306:V1	Relaying water line - Cementation plant			✖	2	Project, not build.
C330:V1	Landscape/remediation - Cementation plant			✖	2	Project, not build.
C350:V1	Cable duct - Cementation plant				7	V1 nuclear island
C401:V1	Pipe duct - Cementation plant				7	V1 nuclear island
C690:V1	Road - Cementation plant			✖	2	Project (road reconstruction during cementation plant construction project)

Identification	Name of CB	V1 NPP Buildings to be Decommissioned		Buildings not to be Decommis.	Code	Note
		Stage I (finish in 2014)	Stage II (2015-2025)			
C804:V1	Air-duct - Cementation plant				7	V1 nuclear island
P360:V1	Connection of lines at No. 900 building site			✖	5	Long term use at the Nuclear Site (relating to build. 363:V1, sewage modifications in 900:V1)
P368:V1	Final shared measurement building			✖	5	Long term use at the Nuclear Site (measurement relating to build. 900:V1)
R801:V1	Liquid waste store - extension				7	V1 nuclear island
T715:V1	Transformer at V1 NPP site				1	Transformer is located in 715:V1 that is already listed
1-491a:V1	Heat feeder exchanger Leopoldov – Hlohovec heat exchanger EBO					Steel frame, useless
35	External switchyard 220 kV					
528	House of relay protection 220kV					

Legend:

1. ***On the basis of analysis the buildings in the table are marked in following way:***
   - *mark '✖' in the column 'V1 NPP building not to be decommissioned', or*
   - *green background in the column 'V1 NPP building to be decommissioned – next period', if the technological equipment inside the building will be dismantled and consequently the building will be demolished in the period after the Stage I completion or*
   - *green background in the column 'V1 NPP building to be decommissioned – Stage I', if the technological equipment inside the building will be dismantled and consequently the building will be demolished in the Stage I.*
2. ***Some buildings may be marked in the column 'V1 NPP building to be decommissioned– Stage I' in the following way:***
   - *yellow background, if during the Stage I only dismantling of either all or part of technological equipment present in the building will be performed, but the building is not to be demolished in the Stage I,*
   - *white-green background, if only part of the building is either demolished or decommissioned; it is in the case of some tranches and duct channels and other elements of infrastructure.*

3. Further marks in the column 'V1 NPP building not to be decommissioned' and allocation of the building to the groups of buildings in the column code:

- *grey background and No. 1 marks items – buildings only planned but never erected, or building erected but later demolished, buildings recorded dubiously, technologies recorded as building but located in other recorded building – it means all this items are non-existing buildings,*
- *blue background and No. 2 marks items representing performed projects but not buildings,*
- *orange background and No. 3 represent items that according the buildings structure and technology belong to nuclear installation Spent Nuclear Fuel Store, nuclear installation TSÚ RAO respectively,*
- *violet background and No. 4 marks items which are located partially or entirely outside the V1 NPP area (outside the Bohunice nuclear site, or inside A1 NPP area as buildings shared or exclusively used for A1 NPP, or buildings located outside of overall site security fence in front of V1 NPP area or in front of A1 NPP area),*
- ***no coloured background and No. 5** marks items that represent security site infrastructure and site engineering infrastructure i.e. AKOBOJE barriers, AKOBOJE support systems, area fences, area lightning and road and rail in the area, media and energy supply for the area, area trenches and duct channels, and these all will be long –term used,*
- ***no coloured background and No. 6** marks items represent Site infrastructure/network/underground services, that are connected to demolished buildings in the way that they can be slightly reduced within demolition of the relevant buildings during the 1st or the next stage (or blind in case of pipes), while part of this infrastructure/network/underground services will further be long term operated for the Site use,*
- ***no coloured background and No. 7** marks items represents nuclear island buildings (i.e. HVB - reactor building, auxiliary building, connecting bridge, sanitary building, vent stack) and buildings serving as a support to the nuclear island (e.g. reactor building fence, supply of TVD to reactor building and piping trenches, cable trenches around the reactor building, low voltage trenches and channels, diesel-generator plant with fuel oil system as a spare power source in the case of mains outage, nitrogen store, since nitrogen is needed above water bio-shield due to gas cushion keeping),*
- ***no coloured background and No. 8** marks items represents buildings located at the V1 NPP Site and at the same time according to the JAVYS Building Development Plan. They are buildings shared with A1 NPP: administration building, canteen, connecting bridge, offices and common cloak rooms, common workshops and stores. Such shared buildings at the V1 NPP Site are planned to be used for decommissioning support activities and later for support activities concerning administration of the Site.*

Annex 16. Division of radionucleads according to radiotoxicity classes

Table 1

Clearance levels for the release of radioactive substances into the environment and maximum values for the radioactive contamination of materials and their surfaces

Location of the radioactivity	Radiotoxicity class according to Table 2				
	1	2	3	4	5
Objects and materials, solids and plotted, used from the workplace or otherwise entering into the environment	Clearance levels mass activity for radioactive contamination [kBq.kg-1]				
	0,3	3	30	300	3000
Materials and surfaces of objects removed from the workplace or otherwise introduced into the environment	Surface activity of clearance levels for surface radioactive contamination [kBq.m-2]				
	3	30	300	3.000	$3 \cdot 10^4$
Surfaces of floors, walls, ceilings, furniture, equipment and so forth in the controlled area of work with open emitters Exterior surfaces of protective and operational equipment, personal protective equipment	Maximum permitted levels of radioactive contamination of surface to work with sources of ionizing radiation [kBq.m-2]				
	30	300	3.000	$3 \cdot 10^4$	$3 \cdot 10^5$
Body surface and the inner surfaces of personal protective equipment Work surfaces outside the controlled area	3	30	300	3.000	$3 \cdot 10^4$

Table 2

Distribution of radionuclides into classes according to the radiotoxicity and the potential threats to external irradiation

Class	Radionuclide (*)
1	Na-22, Na-24, Mn-54, Co-60, Zn-65, Nb-94, Ag-110m, Sb-124, Cs-134, Cs-137, Eu-152, Pb-210, Ra-226, Ra-228, Th-228, Th-230, Th-232, U-234, U-235, U-238, Np-237, Pu-239, Pu-240, Am-241, Cm-244
2	Co-58, Fe-59, Sr-90, Ru-106, In-111, I-131, Ir-192, Au-198, Po-210
3	Cr-51, Co-57, Tc-99m, I-123, I-125, I-129, Ce-144, Tl-201, Pu-241
4	C-14, P-32, Cl-36, Fe-55, Sr-89, Y-90, Tc-99, Cd-109
5	H-3, S-35, Ca-45, Ni-63, Pm-147

(*) For radionuclides not mentioned in Table 2, the class is defined as the minimum of the values like 1 MeV / (E_{gamma} + 0,1 E_{beta}), (20/h_{inh})·μSv / Bq (2/h_{ing})·μSv / Bq, where E_{gamma} is the efficient energy radionuclide emitted gamma radiation in MeV and E_{beta} is the efficient energy beta radiation emitted by the radionuclide, and h_{inh} and h_{ing} are, respectively, the conversion factors for inhalation intake and ingestion of radionuclide for workers with the resources listed in the tables in Annex no. 6 of the Regulation no. 345/2006 of the Government of the Slovak Republic of 10 May 2006 on the essential safety requirements to protect the health of workers and the population against ionizing radiation.

Annex 17. Selected international experiences of NPP decommissioning

Table of contents

1 INTRODUCTION

Over the past 40 years considerable experience has been gained in decommissioning various types of nuclear facilities; including not only power plants but nuclear submarines, fuel processing plants and uranium mines. According to the International Atomic Energy Agency (IAEA) standards, there are three options for decommissioning of nuclear power plants, the definitions of which have been internationally adopted:

- **Immediate Dismantling** (or Early Site Release; "*Decon*" in the US). This option allows for the facility to be removed from regulatory control relatively soon after shutdown or termination of regulated activities. Usually, the final dismantling or decontamination activities begin within a few months or years, depending on the facility. Following removal from regulatory control, the site is then available for reuse.
- **Safe Enclosure** (or Deferred Dismantling; "*Safestor*" in the US). This option postpones the final removal of controls for a longer period, usually in the order of 40 to 60 years. The facility is placed into a safe storage configuration until the eventual dismantling and decontamination activities occur after residual radioactivity has decayed.
- **Entombment** ("*Entomb*" in the US). This option entails placing the facility into a condition that will allow the remaining on-site radioactive material to remain on-site without the requirement of ever removing it totally. This option usually involves reducing the size of the area where the radioactive material is located and then encasing the facility in a long-lived structure such as concrete, that will last for a period of time to ensure the remaining radioactivity is no longer of concern.

The selection of a decommissioning strategy based on existing experience and IAEA recommendations, and must be done specifically taken into account a number of regulatory, technical, economic and social considerations. A higher priority must be given to the most important of them:

- Existence of the legislative and regulatory framework and national policies.
- Availability of funding.
- Radiological and conventional safety considerations.

- Availability of waste management system;
- Availability of qualified and trained personnel;
- Future use of the facility or site.

Other factors with potential impact on the process of the selection of a decommissioning strategy include but not limited to:

- Availability of an adequate waste management system.
- Availability of a strategy for spent nuclear fuel management.
- Availability of criteria for the management and reuse of materials (restricted or unrestricted) with low level of activity.
- Availability of technical resources for dismantling, decontamination, and handling of radioactive and other hazardous material.
- Social and economic impact of the shut down and decommissioning of the plant.
- Lessons learnt from similar decommissioning projects.

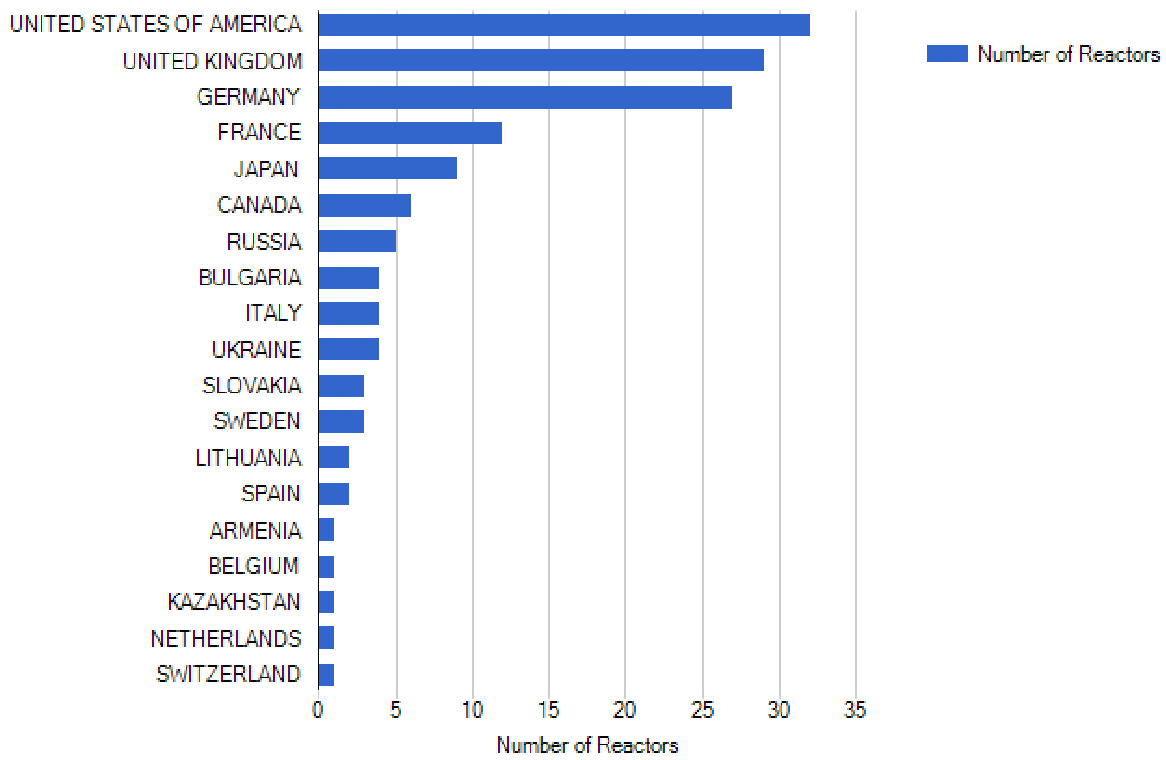
As can be expected, the application of every “pure” version of the decommissioning strategy options defined in IAEA documents would be extremely difficult. That is why a combination of elements from different options will be considered for the specific decommissioning strategy.

According to IAEA data, until March 2013, 144 nuclear power units had been permanently shut down in 19 countries, including 28 in the United States, 27 in the United Kingdom, 27 in Germany, 12 in France, 9 in Japan and 5 in the Russian Federation, corresponding with commercial power reactors and experimental or prototype power reactors. The current status of NPP at final shutdown is as follows:

- Sixteen power reactors have now been fully dismantled. Among them, eight sites had been released for unconditional use.
- About fifty reactors are in the process of being dismantled.
- About sixty are being kept in a safe enclosure mode.
- Three are entombed,

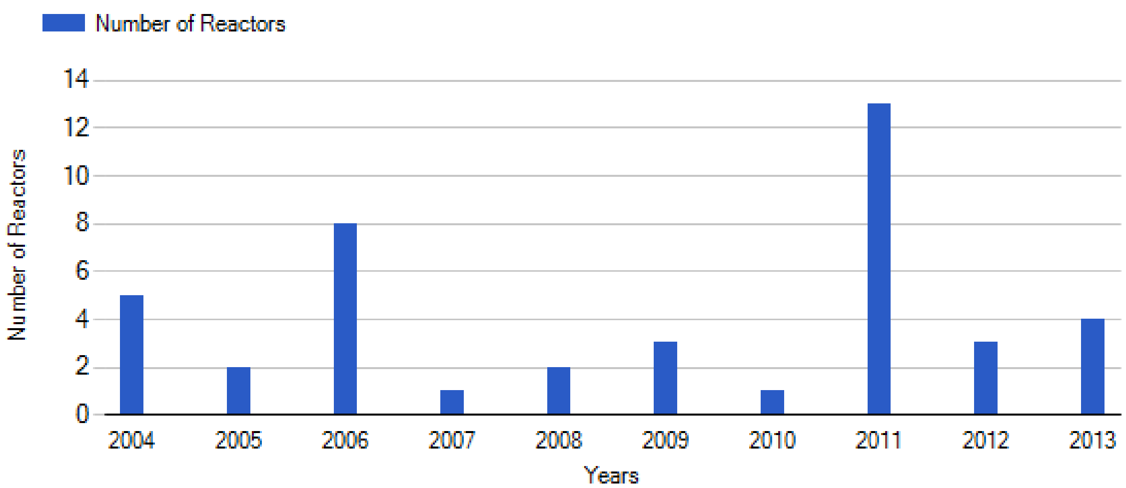
The rest do not yet have a specified strategy for decommissioning.

Graph No. 1. Number of permanent shutdown reactors all around the world at 2013



SOURCE: Power Reactor Information System (PRIS), database developed and maintained by the IAEA

Graph No. 2. Recent trend on permanent shutdown reactors



SOURCE: Power Reactor Information System (PRIS), database developed and maintained by the IAEA

2 DECOMMISSIONING OF WWER TYPE NPP

The V1 NPP belongs to the WWER-440/230 type of pressurized water reactors. The acronym WWER (Water, Water, Energy, Reactor; direct English translation of Russian *Водо-водяной энергетический реактор*) refers to Soviet design water cooled, water moderated, electricity generating reactors. The acronym WWER-440 designates the WWER type having a designed net electrical output of 440 MW(e). Model 230 was the first generation of this kind of reactors, and actually the most common design outside Russia, while the WWER-440/213 represents the second generation of the reactor design, with reduced pressure containment.

All WWER-440 plants have six loops, with isolation valves and a main circulating pump on each loop and horizontal steam generators (SG). All use 220 MW(e) steam turbines. The reactor core is composed of hexagonal fuel assemblies with 126 fuel rod positions each. Control rod assemblies are combination of fuel assembly and an absorbing extension. The WWER-440 uses a rack and pinion drive mechanism to move the control rods. The reactor pressure vessel and the key mechanical and fluid system components are of a standardized design and are produced with standardized manufacturing procedures. However some reactor pressure vessels have a stainless steel cladding others do not. The primary coolant system including steam generator heat transfer tubes is invariably in stainless steel. The secondary side including SG shells is in carbon steel. Although the basic WWER design has undergone changes in engineering and institutional judgements, there has been little change in the basic component and system design. The changes have tended to be material changes and the addition to later plants of safety-related features and equipment. The necessity for rail transport limits the diameter of the reactor pressure vessel.

For the original design of WWER-440/230 the design basis accident (DBA) is a rupture of a 100 mm pipe from the primary circuit with a diaphragm with 32 mm diameter for flow restriction with simultaneous loss of electrical supply. A few modifications of the safety systems have been implemented in recent years. The pressure compartment system is a closed compartment system with a net volume of about 14.000 m^3 enclosing as a confinement the main components of the primary circuit and is designed for an overpressure of 1 bar. The compartment system is connected to the environment by exhaust ventilation flaps. Opening of the flaps protects the pressure compartment system in case of a rupture of a pipe up to 200 mm nominal diameter.

Tab. No. 1. Comprehensive list of WWER-440 units

Country	NPP	Unit	First power	Design lifetime final shutdown year*
Russian Federation	Novovoronezh	Unit 3	1971	2001
		Unit 4	1972	2002
	Kola	Unit 1	1973	2003
		Unit 2	1974	2004
		Unit 3	1981	2011
		Unit 4	1984	2014
Armenia	Armenian	Unit 1	1979 (permanent shutdown in 1989)	-
		Unit 2	1980	2015 (including 5 years of cold shutdown)
Bulgaria	Kozloduy	Unit 1	1974	2004
		Unit 2	1975	2005
		Unit 3	1980	2010
		Unit 4	1982	2012
Slovakia	Bohunice	Unit 1	1978	2003
		Unit 2	1981	2006
		Unit 3	1984	2014
		Unit 4	1985	2015
	Mochovce	Unit 1	1998	2028
		Unit 2	1999	2029
Germany	Greifswald	Unit 1	1973	n.a.
		Unit 2	1974	n.a.
		Unit 3	1978	n.a.
		Unit 4	1979	n.a.
		Unit 5	1988 (permanent shutdown in 1990)	-
Czech Republic	Dukovany	Unit 1	1985	2015
		Unit 2	1986	2016
		Unit 3	1986	2016
		Unit 4	1987	2017

Tab. No. 1. Comprehensive list of WWER-440 units

Country	NPP	Unit	First power	Design lifetime final shutdown year*
Finland	Loviisa	Unit 1	1977	n.a.
		Unit 2	1981	n.a.
Hungary	Paks	Unit 1	1983	2013
		Unit 2	1984	2014
		Unit 3	1986	2016
		Unit 4	1987	2017
Ukraine	Rivne (Rovno)	Unit 1	1980	2010
		Unit 2	1981	2011

(*): The design lifetime concept does not imply that a unit should be closed down necessarily at the established time if a case can be made that it might continue operation safely and efficiently. In some countries, the design lifetime is calculated from the startup rather than from the commercial operation date.

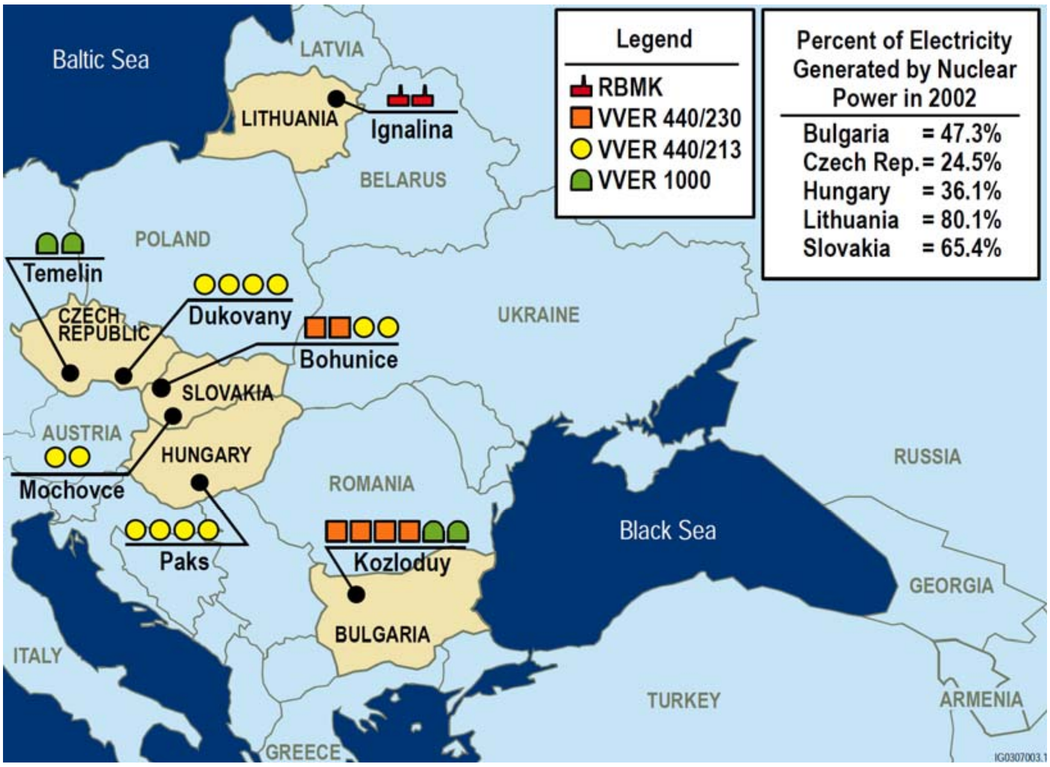
SOURCE: IAEA-TECDOC-1133. “The decommissioning of WWER type nuclear power plants”. January 2000

Despite of the information previously exposed, up to now only 12 out of the 35 WWER-440 nuclear units that have been put in operation in the past, have been finally permanently shut down. Five of them are in Germany (Greifswald NPP, shutdown in 1990), and one in Armenia (Armenian NPP unit 1, shutdown in 1989). In addition, following the agreements between the European Commission (EC) and the Bulgarian and Slovak Governments, it was decided that all the four units of Kozloduy NPP, as well as both units of Bohunice V1 NPP should be permanently shutdown. In the case of Bulgaria, units 1 and 2 were shutdown in 2002, and units 3 and 4 in 2006. In Bohunice, the first reactor was shut down at the end of 2006, the second on the last day of 2008. All of them belong to the WWER-440/230 type.

The following points must be taken especially into account:

- All four Dukovany NPP units commenced, at the beginning of 2009, its “Long Term Operation” (LTO) project, the immediate focus of which was to extend the planned operating lifetime of the reactors by 10 years. Current expected years for shutdown are 2025 (unit 1), 2026 (units 2 and 3) and 2027 (unit 4). Further 20-year life extensions, to 2045-47, are under consideration.
- In the case of Novovoronezh NPP (units 3 and 4), in 2002–2003, the design operation life was extended for 15 more years each, up-to 2016/17.

Graph No. 3. Location of WWER-440 (and other Soviet technology NPP) in Central and Eastern Europe



Graph No. 4. Location of WWER-440 (and other Soviet technology NPP) in Russia

SOURCE: "Status Report - Ten Years of Safety Improvements". Office of International Nuclear Safety and Cooperation U.S. Department of Energy (2003)

- The other WWER 440 plants located at Russia were extended in his life by 15 years, up-to 2018/19 in the case of 230 type (Kola NPP units 1 and 2) and by 25 years, up-to 2036/38 and in the case of 213 type (Kola NPP units 3 and 4).
- The Loviisa NPP reactors (WWER 440, 213 type), in order to comply with Finnish nuclear regulation, were supplemented with Westinghouse and Siemens equipment and engineering expertise. The pressure vessel of Unit 1 was successfully heat annealed in 1996 in order to clear embrittlement caused by neutron bombardment and impurities of the welding seam between the two halves of the vessel. The operating license for both units was then renewed for a 50 year lifetime, Loviisa NPP unit 1 up-to 2027, and Loviisa NPP unit 2 up-to 2030. A third reactor (from 800 - 1,600 MW of electrical generation, and up-to 1000 MWt of district heating supply) was proposed for the Loviisa site, but on 21 April 2010, the Finnish government declined the application.
- The two Rivne NPP WWERs-440 (units 1 and 2, 213 type), the oldest operating Ukraine's reactors (30 years), were extended the operating license in December 2010 for another 20 years, up-to 2030/31.
- In 2000, the Paks NPP commissioned a feasibility study which concluded that the plant may remain in operation for another 20 years beyond the original 30 year design lifetime. The study was updated in 2005 with similar conclusions. The feasibility study concluded that the non-replaceable parts are in sufficient condition to remain in operation for another 20 years while a minority of replaceable parts needed replacement or refurbishment. Current expected year for shutdown are 2032 (unit 1), 2034 (unit 2), 2036 (unit 3) and 2037 (unit 4).
- The unit 2 of the Armenian NPP was, as unit 1, initially closed in 1989 following a decision of the USSR Ministers Council due to the 1988 earthquake. The severe energy crisis in Armenia, after the collapse of the USSR and the following events (economic and transportation blockades by Azerbaijan and Turkey) which created energy shortages, forced the Government, on April 7th, 1993, to take a decision on restart of the unit 2. Since then, the International Atomic Energy Agency (IAEA) has been participating in safety improvements at the plant, which was scheduled to close in 2016, but will now continue until the new planned unit (Armenia NPP unit 3, WWER-1000, with first power expected for 2020) was commissioned. In September 2013, an agreement with Russia to extend the life of the plant by ten years was announced, apparently up-to 2026, with no mention of plans for a new unit.

2.1 Greifswald NPP

Obviously, the most relevant example for WWER-440 NPP decommissioning is the Greifswald decommissioning project. Greifswald is the forerunner of WWER decommissioning or even of commercial pressurized nuclear reactor decommissioning. Besides, it is the world's largest decommission project of nuclear power plants

The Greifswald NPP, also known as Lubmin NPP, was the largest nuclear power station in the former German Democratic Republic (GDR). It is located in Land of Mecklenburg-Western Pomerania in the North-Eastern part of Germany. At the Greifswald site, there were to be in total 8 reactors of the WWER-440 design. Units 1-4 are of the model 230, and units 5-8 of the more recent model 213. With 1.760 MW installed power; they contributed with about 11% of the overall energy production in the former GDR.

Immediately after the reunification of Germany in 1990, the 4 operating units were shut down, and the trial run of unit 5 and construction works at the units 6-8 were stopped. The decision was taken to decommission all the units, in 1990 for units 1-4, followed by the same decision for unit 5 in 1991. The last operating reactor at Greifswald NPP (actually, the last operating reactor in the former GDR) was shut down on December 18th, 1990. The licence for the decommissioning of the overall plant and for the dismantling of plant parts was issued on June 30th, 1995. The dismantling works in the turbine hall units 1-5 and in the controlled area of unit 5 started in October 1995.

2.1.1 Situation analysis and key decisions

When making the key decisions on the decommissioning strategy for the Greifswald NPP, the most important aspects needed to be taken into account are those related to personnel, waste and material management, licensing, site reuse and project management. These issues are interrelated and had to be solved in an integrated and iterative manner.

Due to unexpected shut-down, there had been no preparatory decommissioning planning, so it was absolutely necessary to establish the planning basis for the overall project and to define the company objectives. First of all, a strategic analysis of the company was performed, considering all boundary conditions – technical, legal, economical, political, and social – in order to: establish and evaluate all possible alternative developments; evaluate personnel needs and qualifications; transfer the company structure from operational to decommissioning tasks.

As a result of this analysis, the following key decisions were taken:

- Complete direct dismantling.
- No safe enclosure period.
- Construction of a large interim storage for all waste and fuel arising from decommissioning of all reactor units to achieve independence.
- Change of the operating licence into decommissioning licence.
- Perform as much as possible of the decommissioning activities using existing personnel.
- Reuse of the site.

A first decision had to be made between direct and deferred dismantling. In order to solve this issue with its major implications, a comprehensive project planning and calculation exercise had to be performed for each alternative. The result showed that the direct dismantling is about 20% cheaper, produces less radioactive waste and less dose uptake. The direct dismantling option also demonstrated a positive influence on the job situation in the region. Moreover, by selecting the immediate dismantling option, the valuable plant knowledge of the personnel has been retained.

The dismantling of the equipment and components started in unit 5 in November 1995 and has been continued step by step with the other units:

- The contaminated equipment of units 1, 2, 4 and 5, formerly used for energy generation, has been dismounted and stored in the Interim Storage North (ISN).
- The reactor pressure vessel of unit 5 has been in trial run for a total of only 17 effective days, and thus had low contamination level. Therefore it was dismantled in 2003 as a complete component and transported to the ISN.
- The remote dismantling of the activated reactor internals of reactor unit 1 started in September 2004.
- The non-contaminated facilities of the turbine hall units 3 to 5 have been dismantled, cut and disposed after clearance measurements. The preparations for dismantling the equipment of the turbine hall unit 2 were started in 2004.

For cutting the activated reactor components, a complex remotely controlled facility, successfully tested and commissioned, was developed. For special requirements, adapted laser cutting techniques were available. Other techniques like water abrasive jet cutting have also been used.

2.1.2 Dismantling of activated components

Due to high activation level of 1-4 units, it was decided to use the principle of remote dismantling. To dismantle and cut those units, the concept was applied for the first time that allowed testing the dismantling and transportation model as well as the equipment for cutting and packaging of the dismantled and activated components using non contaminated components that were not put in operation.

In compliance with this concept, the unit 5 reactor was transported as a whole for temporary on-site storage. After 50-70-year storage, reactor structures will be fragmented without using remote techniques. Reactor pressure vessels of units 1 and 2 were removed in a manner similar to that of RPV in unit 5 (the exception lies with the peculiarities of work implementation caused by a higher radiation background as, for example, in cutting of circulation pipelines of the reactor pressure vessel). Reactor pressure vessels of units 3 and 4 were removed in a similar manner however parts of RIS were emplaced in the vessels (barrel with bottom).

All dismantled activated components are placed for temporary on-site storage.

2.1.2.1 Strategy for dismantling of activated components in case there is no temporary storage facility

The strategy for dismantling of activated components consists in creating three areas for dismantling and fragmentation. Two areas are arranged in emptied steam generators compartment while the other one is arranged in the reactor pit.

Depending on the activation level and doses, the decision is to be taken in what area of fragmentation each piece of components will be transported.

At specific activity lower than 10^7 Bq/g, components will be fragmented in the area for dry cutting. At specific activity higher than 10^7 Bq/g, components will be fragmented in the wet area.

The annular tank has to be dismantled in situ, as, with the diameter of 6 m, it is impossible to act otherwise without damaging reactor hall structures.

One of the emptied steam generator compartments is provided to cut activated components of both reactors. Cutting devices are installed as well as wet and dry areas are arranged in steam generator compartment. Steam generators and other components located in the compartment are previously dismantled.

2.1.2.2 Reactor pressure vessel

The vessel cutting was conducted by horizontal upward cuts. A band saw used in this process was remotely controlled. The saw is withdrawn from the cut when the specified depth of cutting is reached. When performing this operation at the plant, gas and plasma cutting devices were tested. Nevertheless, preference was just given to mechanical cutting. Then, a cut fragment is sent by the platform-hoist to the dry cutting area where it is fragmented into small parts and fragments are loaded in the protective container. This strategy was tested at non contaminated components. After a temporary storage facility was built, the dismantling strategy was revised.

Units 1, 2 and 5 reactor pressure vessels were dismantled as a whole and placed for temporary storage. The reactor pressure vessel is dismantled after removal of its internals and its detachment from process connections (nozzle cutting). Dismantling consists in vessel lifting, using the reactor hall crane, after an additional protection (of strip type) has been installed in the reactor core zone and the reactor pressure vessel has been shipped to the storage facility.

Units 3 and 4 reactor pressure vessels were placed for temporary storage, together with their internals. Due to limited load-lifting capacity of 250t of the reactor hall crane, the reactor pressure vessel and its internals were dismantled separately. Firstly, the reactor pressure vessel was moved to the transport bay and fixed in vertical position, and then internals were placed inside it. Using special lifting equipment, the reactor pressure vessel together with its internals were put on the transport platform and sent for temporary storage.

2.1.2.3 Dismantling and fragmentation of internals

The internals were fragmented in two areas, arranged on the basis of the steam generator compartment: in wet and dry cutting areas.

The dry cutting area, in its turn, is divided into a cutting station, a sorting station and a containerization station which is enclosed by a protective wall. A transport vehicle with a rotary table moves through vertical gates in the protective wall between cutting stations. The dry cutting area is equipped with a control system.

The wet area is designed to dismantle components under a water layer. The equipment similar to tools used in the dry area was applied in this area; the equipment for thermal cutting was additionally used. All transport and preparatory operations are similar to those that were done in the dry area. During work performance, the accumulated waste resulting from cutting is drawn off from the cutting area and purified through the filters. Fragmentation of internal structures was performed in the wet area, as these components are just the most activated. The core basket has the highest activity. The core basket metal has maximum specific activity (as to Co^{60}) of $7{,}5 \cdot 10^{8}$ Bq/g.

2.1.2.4 Annular tank dismantling

Due to its geometric dimensions, it was not deemed possible to dismantle the annular tank as a whole. The annular tank was dismantled in its location together with its heat insulation.

Prior to dismantling, the annular tank was filled with cement, and a protective container was welded to its inner shell.

A rope saw was used for dismantling.

The annular tank was cut by segments. The cut segments were put in 20-foot containers and transported to the temporary storage facility.

2.1.3 Dismantling of contaminated large-size components

2.1.3.1 Steam generator dismantling

Dismantling of Greifswald NPP steam generators was carried out in different ways. The options were implemented for steam generator body dismantling as a whole and its fragmentation in situ (in SG compartment). The analysis of the operations performed resulted in conclusions that the optimum option is to dismantle the steam generator body as a whole with its further fragmentation at a specially equipped cutting station for large-size components.

A cutting method using a band-sawing machine was chosen to fragment the steam generator body as a whole (together with tubing).

The main problem in steam generator body fragmentation using a band-sawing machine was vibration which could only be removed due to successful selection of saw profiles.

The fragmentation and decontamination areas were arranged at the temporary storage facility of Greifswald NPP to cut and decontaminate dismantled components.

2.1.3.1.1 Pressurizer dismantling

Different approaches were employed for dismantling of pressurizers: dismantling of an item in its entirety, dismantling in large fragments (4 fragments), dismantling in small fragments (without arrangement of additional apertures).

It has been shown that all of the listed options are feasible provided radiation and technical safety requirements are observed.

After dismantling of the pressurizer bodies in their entirety they were transported and located in the temporary storage facility with their further fragmentation at stationary cutting stations.

2.2 Armenian (Metsamor) NPP

The Armenian NPP (also known as Metsamor NPP) is situated on the Armenian plain near the Metsamor town, approximately 30 km west of Yerevan. It consists of two power units with WWER-440/230, modified with seismic upgrades and sometimes referred to as Model V270. The Unit 1 was put into operation on December 22th, 1976; and the unit 2 on January 5th, 1980. The installed power of the units is 407,5 MW(e). As previously mentioned, both units were shutdown before the earthquake occurred in northern Armenia in December 1988 (unit 1 was shutdown in February 1989, and unit 2 in March 1989), but unit 2 was brought back into operation October 26th, 1995. Unit 1 remains in a long-term shutdown mode. At present, there are no plans for restart of unit 1 and it is to be decommissioned together with unit 2 at later date.

Even considering that Armenian reactors are not yet in decommissioning process, some relevant information could be taken into consideration from existing documentation about the future process, especially the Decommissioning Strategy for Metsamor NPP unit 1 included on TACIS Project No. 116328 “Support to the Energy Policy of Armenia”. In the case of Metsamor NPP unit 2, it looks very feasible the previously mentioned extension of the service life for 10 years (until 2026). As a result of the of the aforementioned analysis it is suggested for the Metsamor NPP decommissioning a compilation of the following options:

1. Safe enclosure of the highly contaminated and activated objects.
2. Immediate dismantling of the conventional part of the plant.
3. Flexible duration of the safe enclosure until the radioactive waste disposal issue is solved.

4. The possibility of considering the use of the plant buildings as a near surface storage facility for low and intermediate radioactive waste at a later stage of the decommissioning.

2.2.1 Decommissioning licensing preparation period

Prior to the final shut down of the Metsamor NPP unit 2 should apply for the decommissioning license (or permit). The overall decommissioning plan should be presented to the Armenian nuclear regulatory authority (ANRA) five years before the planned date for the final shut down.

2.2.2 Post operation stage

The duration of this stage is defined by the requirements for the removal of spent fuel from the units. The necessary decay cooling period for existing dry storage technology is at least 5 years. Taking into account the necessary time for the transfer of the fuel from the units SF cooling pools to dry storage, the overall duration of the stage is assessed as 6-7 years. In parallel, some activities for the preparation for safe enclosure can be performed.

2.2.3 Safe enclosure preparation

The activities of this stage can start during the post operation stage, but some activities can be performed only after the removal of the spent fuel, and for example, the decontamination of the spent fuel pools and racks. In general during this stage, works on system draining and isolation are performed as well as work on the removal of hazardous and flammable materials and the modification of the systems necessary for operation of the safe enclosure, e.g. ventilation and fire detection systems.

2.2.4 Safe enclosure operation

The first task is to establish the area of the safe enclosure. It is recommended to limit this to the reactor building or even to the system of hermetic compartments. In any case the ventilation centre at elevation +10.5m must remain in operation. During the safe enclosure operation period only the monitoring of a limited number of systems necessary for the safe enclosure, like that for ventilation, is required. Periodic walk-downs, e.g. once a month, will also be necessary. It should be mentioned that the duration of safe enclosure is flexible and may be changed if new circumstances arise.

The minimum time will be based on the time necessary for the dismantling of the conventional part of the plant and the equipment that can be decontaminated.

2.2.5 Dismantling

The first step to be taken prior to start of any dismantling activities is classification of the systems and equipment according to their importance during the different stages of the decommissioning process. Three major categories might be proposed: i) systems important for assuring the nuclear safety and radiation protection; ii) systems important for operation and industrial safety and iii) unnecessary systems. An additional category of new or modified systems could be added.

The dismantling activities are divided to three major stages:

- Dismantling of conventional plant. This includes the turbine hall, auxiliary systems like the water demineralization plant, emergency diesel generators, etc. and electrical plant not necessary for the operation of the safe enclosure. This stage may be carried out simultaneously with the safe enclosure;
- Dismantling of the equipment that is potentially contaminated, but can be decontaminated. This includes the equipment in the Auxiliary building, assuming that all operational backlog waste is removed, and auxiliary systems in the reactor building. This stage also might be carried out simultaneously with the safe enclosure;
- Dismantling of the equipment that is highly contaminated and/or activated and cannot be decontaminated. The examples of such equipment are the reactor pressure vessel, the reactor internals, potentially the steam generators and the pressurizer. In the majority of cases, dismantling will require techniques allowing remote operation due to the still high ambient dose rates. However at this stage, the possibility for using the remaining parts of the units as a long term storage facility for low and intermediate level radioactive waste may be considered, if the issue of the final disposal of RAW has still not been addressed.

2.2.6 Demolition of buildings and other civil structures

The next step in the decommissioning process, after the dismantling of the equipment is the demolition of the buildings and other civil structures such as cooling towers and the ventilation stack. This step is strongly dependent on the plans for the further use of the site, as well as on the funds available at the time. A decision on the possible use of the remaining part of the units as a long term storage facility for low and intermediate level radioactive waste might strongly affect the decision regarding the demolition of structures.

2.2.7 Site remediation

The last step of the decommissioning process is the identification and removal of any contaminated soil from the site. This step completes the process and allows the site to be released from regulatory control. However, part of the site, at least the dry spent fuel storage facility will remain under regulatory control until the final solution of the spent fuel issue.

The proposed option for the decommissioning of the Armenian NPP might be called “Sequential Dismantling” and has several important benefits:

- The potential for utilization of the existing qualified and correspondingly retrained personnel for the purposes of decommissioning;
- Provides time for the retrieval and conditioning of the existing operational radioactive waste backlog;
- Allows utilization of the existing radioactive waste management infrastructure and its extension in order to deal with the specific types of waste generated during the decommissioning;
- Utilises the benefit of the radioactive decay of highly contaminated and activated equipment;
- Allows refinement of the dismantling techniques for the non contaminated equipment that will help to reduce further the committed doses;
- Allows for the accumulation of sufficient financial resources in the Decommissioning Fund to cover the entire decommissioning project.

2.3 Kozloduy NPP

The Kozloduy NPP is located at a distance of 200 km to the north-east of Sofia and 5 km to the east of Kozloduy, on the Danube river bank. Include four 440 MW units with V-230 reactors (units 1 to 4) and two units with new generation WWER-1000/V-320 reactors (units 5 and 6). Units 3 and 4 were from a V-230 enhanced model with improved safety systems and stainless cladding of the reactor pressure vessels.

In 1966, the governments of Bulgaria and USSR signed an agreement on cooperation in construction of nuclear power plant. Kozloduy NPP construction began in October 1969 and was finished in December 1993 by commissioning of Unit 6. Units 1 and 2 began commercial power generation in July 1974 and November 1975 and finally shut down took place in December 2002. Units 3 and 4 were put in commercial operation in December 1980 and May 1982 and shut down took place in 2006. Units 5 and 6 (with WWER-1000/V-320 reactors) began commercial power generation in September 1988 and December 1993 and are currently generation the only remaining nuclear generation occurring at the country.

The original decommissioning strategy consists of 3 stages (4 phases):

1. Transition period for 5 years consisting of (1.1) Post-operation and (1.2) Preparation of Safe Enclosure.
2. Safe Enclosure operation, for 35 years.
3. Deferred dismantling

Original strategy included neither detailed nor outline plan for deferred dismantling. Even dismantling outside the safe enclosure has not been in the scope of the original strategy. The original decommissioning strategy assumed that 3-year post operation period was allowed for spent fuel to cool down before defuelling reactor pools. It assumed that Dry Spent Fuel Storage Facility (DSF) would be operational at the end of 2005, and thus the units 1&2 would be free of any spent fuel soon after the DSF commissioning date. However construction of DSF is delayed and foreseen deadlines cannot be met.

The entire preparation and decommissioning process according to the adopted Continuous Dismantling Alternative can be sub-divided into the following three main stages encompassing the respective activities:

a) Pre-decommissioning Stage (Transitional Stage)
b) Decommissioning Stage
c) Closure and land reclamation Stage

2.3.1 Pre-decommissioning Stage (Transitional Stage)

The activities during the Pre-decommissioning Stage include:

- Pre-decommissioning activities – including radiological backlog in order to enable removal of hazardous and other wastes generated by the Units operation;
- Activities on collection, sorting, treatment and transportation of decontamination waste;
- RAW management activities;
- Decontamination.
- Preparation of the documentation for issuance of a decommissioning permit (Decommissioning Plan, EIA Report, updated: Safety Analysis Report, Technological Specification and Operating Instructions) and
- Pre-decommissioning activities (provision and construction of suitable infrastructure for dismantling, cutting, fragmentation, sorting, volume reduction, decontamination and free release measurement; removal of flammable and hazardous materials and conventional waste, thermal insulation, operational radioactive wastes, retrieval and conditioning of spent ion-exchange resins, system isolation and draining).

2.3.2 Decommissioning Stage

This stage is subdivided in two stages:

1. Stage 1 of the Decommissioning.
    - Preparation of Safe Enclosure
    - Safe Enclosure of the Reactor Buildings (the RB of Units 1 and 2 and the RB of Units 3 and 4 and the interconnecting passageways are included in this area) and
    - Dismantling of the equipment outside the Safe Enclosure Area.
2. Stage 2 of the Decommissioning.
    - Deferred dismantling of the equipment within Safe Enclosure and
    - Release from regulatory control of the site and the buildings for use for other industrial purposes.

During the implementation of the abovementioned stages: transitional (predecommissioning) stage, Stage 1 and Stage 2 of the decommissioning, different types waste management activities will be carried out.

After sorting of the dismantled materials, depending on their contamination rate the wastes can be:

- Free released and transported outside the KNPP site without or after decontamination;
- Stored temporarily for natural decay;
- Handed over as a RAW for further treatment and conditioning.

The most important projects which are presently planned to be implemented, and for some of which the EIAR will provide an assessment concerning the probability to have or not to have impacts on human beings and on the environment are described below.

2.3.2.1 Size Reduction and Decontamination Workshop (SRDW)

It is planned to use the Workshop for size reduction and decontamination of the dismantled contaminated materials from Turbine Hall, AB-1 and AB-2 and the RB.

2.3.2.2 Facility for Treatment and Conditioning of RAW with High Volume Reduction Factor at Kozloduy NPP

This project shall provide a high volume reduction factor (HVRF) facility for the processing of low level radioactive waste currently stored on the KNPP site. The project envisages a separate EIAR.

2.3.2.3 Design and Construction of Sites for Safe Temporary Storage of Materials generated by the decommissioning activities of Units 1-4 at Kozloduy Nuclear Power Plant

By this project a safe temporary storage of solid radioactive materials (RAM), subject to clearance procedure is provided, generated by the decommissioning activities of Units 1-4 on two dedicated sites. The RAM (transitional RAW) will be temporary stored in containers on these sites over a period not longer than 5 years, where their specific activity will decrease below the free release levels. In the frame of this project the selection of a Site for conventional waste from decommissioning of the units is foreseen.

2.3.2.4 Construction of a Heat Generation Plant

The purpose of this project is the design, construction and commissioning of a Heat Generation Plant as a back-up source of steam and central heating water to the consumers at Kozloduy NPP in case of simultaneous outage of KNPP Units 5 and 6. This project requires the elaboration of a separate EIAR.

2.3.2.5 National Disposal Facility for short-lived low and intermediate RAW

This project shall provide disposal of short-lived low and intermediate RAW generated. This project is in phase of technical design and elaboration of the safety analysis report. This project has been subject to separate EIA procedure finalized with positive statement by the competent authority – MEW. The national repository is an Environmental Impact Assessment for the Decommissioning of Units 1 to 4 at Kozloduy NPP installation with multi-barrier protection for long-term storage of waste that has been preliminary processed, safeguarded and packed in reinforced concrete packages. The repository will be at the ground surface, trench type, with capacity of 138.200 m^3. The commissioning of the NDF will finalise the cycle of radioactive waste management in Bulgaria, providing their safe and permanent insulation from the environment and people.

2.3.2.6 Spent Fuel Dry Storage Facility

The KNPP Spent Fuel Dry Storage Facility (SFDSF) will store spent nuclear fuel assemblies in specially designed storage casks. The design life of the facility is at least 50 years. Fuel assemblies will be sealed into purpose-built storage casks which will ensure their safety during the storage period. For this project a separate EIAR was drafted and there is a positive decision from the MEW on it.

2.3.2.7 Liquid Radioactive Waste Treatment Facility

This project shall provide equipment for the treatment of low contaminated water from active laundry, hot showers and floor drains from KNPP Units 1 to 4, and the possible conditioning of the generated radioactive waste. Currently, this waste is being treated by the operating KNPP SWT-3 of Units 1 to 4 which will become nonoperational upon completion of the treatment of all operational liquid RAW.

2.3.2.8 Supply of Mobile Equipment for Water Decontamination and Treatment Equipment

The project shall provide the supply of mobile equipment for surface decontamination of the Reactor Refuelling Pool (RRC), Spent Fuel Storage Pond (SFSP), SFSP racks and other similar open or closed storage vessels, for tanks' water treatment and for secondary RAW conditioning. According letter Ref.No26-00-2555 of MEW the project cannot be associated to the IP listed in Annexes 1 and 2 to the EPA and subsequently is not subject to mandatory EIA.

2.3.2.9 Ion exchange Resins Retrieval and Conditioning Facility

The Project shall ensure the supply of equipment for the retrieval and treatment of spent ion-exchange resins from the existing storage facilities.

Facility for Retrieval and Processing of the Solidified Phase from Evaporator Concentrate Tanks currently stored in tanks in Auxiliary Buildings 1 and 2

This project shall provide the supply and installation of a facility for Retrieval and Processing of the Solidified Phase from Evaporator Concentrate Tanks currently stored in tanks in Auxiliary Buildings 1 and 2.

2.3.2.10 Free Release Measurement Facility

This project shall ensure the supply of equipment able to measure the γ-activity for the purpose of releasing dismantled equipment and other materials from regulatory control. This project covers the provision of equipment for radiological inventory allowing the free release of the dismantled equipment and materials.

2.3.3 Closure and land reclamation Stage

Upon termination of the decommissioning process the site and the buildings will be refurbished in order to achieve higher efficiency level and environmental indices. At the end of the closure stage the strategy foresees to reach a long-term state of the industrial site where KNPP Units 1-4 are being decommissioned defined as “brown lawn”. It will be achieved by performance of the following activities: dismantling of the equipment not intended for further use; free release of the buildings and facilities remaining in operation; processing and taking out of all RAW from the site and bringing it to a condition suitable for nuclear purposes or other economic activities.

The buildings and underground infrastructure will remain for auxiliary use by the operating Units 5 and 6.

Within this stage the site and the buildings will be refurbished in order to achieve higher efficiency level and environmental indices. Before the construction works a Concept for closure and reclamation up to a “brown lawn” state will be developed.

This means the removal from the site of the active equipment keeping it under regulatory control up to its decontamination and its final disposal. The buildings and underground infrastructure will remain for auxiliary use by the operating Units 5 and 6.

Supporting projects related to the Decommissioning of Units 1 to 4 of Kozloduy Nuclear Power Plant

During the pre-decommissioning stage in support to the decommissioning activities on the Units a group of preparatory projects is planned to be implemented, basically defined as:

- Projects for removal of the hazardous materials.
- Projects for processing of the collected operational RAW, Projects for pre-dismantling activities and Projects for construction of an auxiliary infrastructure.

3 OTHER SELECTED DECOMMISSIONING EXPERIENCES

3.1 Slovakia (A1 NPP)

In addition to the four previously mentioned nuclear reactors of WWER-440 type (EBO 1-4 marked as NPP V-1 and NPP V-2), at the Jaslovské Bohunice site there is also the NPP A-1, which was a heavy water reactor cooled with carbon dioxide (HWGCR – 150 MW). NPP A-1 was shut-down in 1977 after an accident (INES 4) and currently it is in the second decommissioning phase.

Nuclear Power Plant A-1 with heterogeneous reactor KS-150, was designed for electric output of 143 MW. Natural metal uranium was used as fuel, heavy water (D_2O) as moderator and carbon dioxide (CO_2) as coolant. The moderator was cooled by 3 loops, each consisting of 2 coolers and one D_2O pump. The primary cooling circuit (CO_2) consisted of 6 loops, while each loop comprised of one steam generator, a turbocompressor and two parallel pipes of hot and cold branches of CO2 cooling. A separate part of NPP A-1 were facilities for installation of fuel elements and facilities for transport and technological part (TTČ), which served for handling of fresh and spent fuel, its post-cooling and storage. The post-cooling and storage system for spent fuel elements included 2 short-term storages, rod cutting chamber (on which fuel elements hung in technological channels in the reactor pressure vessel) and a long-term storage. The spent fuel elements were transported with the help of loading machine into the long-term storage filled with cooling water into long-term storage cases. Initially chrompik was used as a coolant in cases of long-term storage, later on an organic coolant Dowtherm was used. The main facility of the secondary circuit of the power plant were 3 turbo-generators, 50 MW of installed capacity each.

The A-1 NPP was connected to the power distribution network in December 1972. After an operational accident in January 1976 the operation was restored, after another operational accident in February 1977 technical, economical and safety analyses were conducted and on the basis of their results, in 1979 the government decided by its Resolution No. 135/79 that the operation of NPP A-1 would not be restored.

Activities aimed at decommissioning of NPP A-1 have commenced. Due to the absence of legal regulations for decommissioning of nuclear power plants at that time any partial issues were solved on a case-by-case basis and the individual activities were approved as modifications having impact on nuclear safety. The works concentrated on:

- Removal of consequences of the operational event,
- Preparation of fuel export to ZSSR/RF,
- Development and subsequent implementation of RAW management technologies.

The first integrated documentation for decommissioning of NPP A-1 was developed in 1992. The currently valid concept and the time schedule for decommissioning of NPP A-1 were passed by the Government Resolution No. 227/92. Government Resolutions Nos. 266/93, 524/93, 877/94 and 649/95 approved this time schedule, including a comprehensive procedure. Updated documentation for the initial stage of decommissioning was elaborated during 1994 - 1996. Based on the Atomic Act No. 130/1998 Coll. I., after the assessment of the safety report elaborated in 1996 and after completion of fuel preparation for export to the RF in 1999 ÚJD SR issued an authorization for the first stage of decommissioning (until 2007), i.e. to achieve the state declared in this documentation from the current base line:

- All spent fuel is removed from the long-term storage and media representing the highest potential risk are solidified or re-stored into new tanks.
- Majority of liquid operational RAW is conditioned in a form enabling safe disposal.
- Other RAW is treated into a form enabling safe disposal or their storage.
- Essential decontamination is performed aimed at further reduction of potential sources of RA material leakage.

Since in particular the implementation works showed significant time delays, either due to deficient inputs regarding estimates of RAW amounts and capacities of technologies for RAW management during its planning, due to failed solutions or due to putting the works aside on positions with lower priority, the scope of works of the first stage, on the basis of request from SE – VYZ, was revised by the Decision of ÚJD SR No. 144/2003, which indicated that not even in the prolonged deadline until the end of 2008 the basic activities focusing on safety improvement and reducing the risk level would not be completed and will have to be preferentially performed at the beginning of the next stage of decommissioning focusing on disassembly of external objects. In order to continue in the activities to improve safety and reduce the risks ÚJD SR Decision No. 337/2008 was issued, allowing continuation in the decommissioning activities until the time when the authorization for commencing the second stage is obtained.

On 18 June 2009 an authorization was issued by means of ÚJD SR Decision No. 178/2009 for the second stage of decommissioning of NPP A-1 in accordance with the Plan for the Second Stage of Decommissioning of NPP A-1, which enabled to continue with a continual alternative in the process of decommissioning of NPP A-1. The period of years 2009 and 2010 focused in particular on decommissioning of external objects of the nuclear installation of NPP A-1, on the issue of handling contaminated soil and RAW management produced by the main generating Unit of NPP A-1.

The current status of NPP A-1 can be characterized as follows:

- Export of spent fuel to the Russian Federation was completed in 1999 (based on an intergovernmental treaty from 1956).
- Media for after-cooling of spent fuel were partially treated, and partially restored: chrompik (water solution of chromate and potassium bi-chromate) was vitrified or re-stored into new tanks, the sludge in enclosures for after-cooling of fuel elements and on the bottom of the DS pool is solidified into geo-polymers, dowtherm (organic liquid mixture of biphenyl and biphenyl-oxide) is gradually repurified and incinerated. More than 99 % of water activity of the long-term storage pool was captured on special sorbents. Liquids from the DS pool was processed by concentration on the evaporator. Bottom sediments are re-stored into a new re-storage tank of the reactor hall of NPP A-1.
- Liquid operational waste (concentrates) was bituminized, liquid waste from decommissioning of NPP A-1 and together with other waste from Jaslovské Bohunice site are gradually conditioned and disposed at the repository.

- Storage of solid RAW, object 44/20, was reconstructed, waste removed, sorted and stored in a controlled manner. Part of this waste was conditioned and disposed.
- The original, currently not operated storage tanks, object 41, represent the highest potential risk for the environment. Waste from this object located outside of reactor building was re-stored into tanks of object 44/10. Liquid RAW is gradually conditioned by concentration and cementation for the purpose of further conditioning and disposal.

Technological facilities with induced activity or with higher level contamination will be dismantled only in the following decommissioning stages.

3.2 Germany

3.2.1 Stade NPP

The Stade nuclear power plant (KKS), located in the northern part of Germany close to the city of Stade at the river Elbe, was in operation during 30 years, from 1972 (first criticality date) to 2003. The KKS is furnished with a pressurized water reactor with an electric gross output of about 670 MW. The plant is owned 33% by the Hamburgische Electricitätswerke AG (HEW), the utility of the city of Hamburg, and 77% by E.ON Kernkraft GmbH (EKK) in Hanover. E.ON Kernkraft GmbH is also the operator of the KKS.

The goal of the decommissioning plan is the green or brown field at the site of KKS. The plan is divided into 5 phases, 4 under nuclear licensing and supervision (dismantling of the nuclear part of the plant), and one under conventional supervision.

1) The first stage will consist, mainly, of the dismantling of contaminated material, mostly those outside the secondary containment. Right after the removal of this material the decommissioning infrastructure will be installed in this area. The decommissioning infrastructure will contain all equipment necessary for dismantling, cutting, cleaning and decontamination as well as clearance measurements. The infrastructure will be able to deal with the many categories of material such as concrete, metal, insulation and others.
2) Within the second phase of the dismantling, we are going to tackle the large components such as the steam generators. The steam generators need special attention, because of their complexity, weight and inner construction. Especially the large internal surface, which is highly contaminated, will be in the focus when planning for decontamination techniques.
3) During the third phase of dismantling, all activated components including the reactor pressure vessel, its internals and the biological shielding will be

removed. In this phase a large fraction of the radioactive waste will need to be transported into the intermediate storage facility.

4) The fourth phase of dismantling will cover all residual systems and components inside the controlled area. The controlled area will eventually be cleaned and released.
5) According to the decommissioning plan the whole site can be cleared by around 2013. The conventional pull down of the buildings at the end (phase 5) will lead to a green field.

Graph No. 5. Decommissioned and dismantled nuclear power stations in Germany

***SOURCE**: E.ON. "Decommissioning and dismantlement of the Stade nuclear power plant – from nuclear power plant to green fields"*

A final repository for low- and medium-level radioactive waste has been licensed in Germany but it not yet accessible. The operator of Stade has thus decided to construct a facility for intermediate storage. The waste will be packed in casks that will be later suitable for the national repository. As soon as the final repository will be receiving waste, the Stade waste will be moved to the repository.

3.2.1.1 Nuclear licensing

The decommissioning activities need to be licensed by the competent authority of the Land. The plan can be subdivided in several licensing steps. However, according to the German Nuclear Act the full decommissioning plan has to be presented to both the authorities and the public.

The first license for KKS will cover the following items:

1) The decommissioning of the plant and the residual operation until final removal of all components of the nuclear plant.
2) The dismantling of contaminated parts of the plant (phase 1).
3) Construction and operation of an intermediate storage facility for low- and medium-level radioactive waste.

In addition to the nuclear licensing, an environmental impact assessment needs to be performed according to both European and German law. Within this impact assessment the whole process, namely the full decommissioning plan, needs to be considered and assessed as to what effects are expected on the environment.

Both, the nuclear licence and the environmental impact assessment will be communicated to the public within a formal public information and public hearing process. In the case of KKS, the safety report, the environmental impact assessment, a short description of the project and the application for nuclear license will be openly accessible for the public. For a period of two months, every citizen will have the opportunity to read all documents, either in the city of Stade or at the Environment Ministry in Hanover. Everybody will have the chance to submit questions or comments on the decommissioning plan.

Finally, a public hearing will take place in late autumn this year. The public hearing is a platform for all citizens concerned to discuss the questions that they have submitted during the months before.

Besides the formal public involvement, the competent authorities contracted independent experts in order to assess all the details of the decommissioning plan. According to the time schedule, this assessment will be accomplished in due time before issuing the license.

3.2.1.2 Preparation for decommissioning

Besides preparing the licensing procedures, all the detailed planning needs to be done. A fairly large team of engineers and technicians has already started right after the conception phase with the detailed planning of especially the first dismantling phase. Soon the planning of the second phase will start.

The team of engineers consists mainly of people from the plant and some from the central administration. External experts are also involved. People from the central administration will make sure that all experience will be transferred from one plant to the other, which is between KWW and KKS in the case of EKK. Especially for E.ON Kernkraft, it is necessary to combine forces from the twoongoing decommissioning projects in Würgassen and Stade. The evaluation of all experience will be an ideal starting point for an effective future decommissioning project.

3.2.1.3 Dismantling of the RIS

Dismantling of the RIS was carried out remotely under water. Packaging was also done under water. To speed up the cutting operations works were carried out in 3 separate zones.

The weight of the dismantled equipment has totaled 85 tons (RIS only). The main condition observed during cutting was characterization of generated waste and their separation with the aim of reducing the cost of disposal.

Dismantled and fragmented parts of RIS were packaged into containers for final disposal.

The RIS were separated into 3 main parts which were the internal barrel of the reactor, structures supporting the core (core basket), and the upper block.

A separate sealed chamber with an opening on top for transporting dismantled equipment and drums with RAW by means of an overhead crane was erected in the central hall of the NPP for the purpose of cutting the RIS. This chamber held a band saw, a water basin with a water purification system, RAW drum (MOSAIK type container) and a storage rack. A space for dismantled structures (upper block and such) was also provided.

The reactor pressure vessel was also filled with water and connected to a purification system. There was a separate rack for storage, a drum for RAW (MOSAIK) and a turntable.

Apart from the band saw the RIS were cut with a plasma burner, CAMC device, and hydro-abrasive cutting.

3.2.2 Wuergassen NPP

Wuergassen NPP is a nuclear power plant in Germany with one first generation boiling water nuclear reactor (BWR) with capacity of 670 MW.

The power plant was in operation from 1975 until August 26, 1994. In the beginning of September a scheduled inspection has identified cracks of up to 60 mm in length in the steel cladding of the reactor core. The NPP was completely closed down in April 14, 1995 and is currently being dismantled.

3.2.2.1 Dismantling of RIS

Preparation for dismantling (arrangement of necessary infrastructure, procurement of licenses) of RIS took 8 years after reactor shut down (09.1995-11.2003). First, the upper block of reactor control rods and jet pumps was dismantled. Works on site NPP were carried out over the course of 3 months (09.2004-12.2004).

Then the separator was dismantled by parts. Starting from April 2006 operations for dismantling of removable RIS were commenced. Operations took 32 months. High segments of pipes Ø300 mm and 800 mm were cut off using band saw and nippers. Then they were emplaced inside 200 l drums. In total 22 tons of pipes were dismantled.

Operations directly related to RIS were separated into 2 parts - dismantling of RIS that are easy to remove from the reactor pressure vessel in a pool arranged underneath (1) and dismantling of RIS anchored in their regular position inside the reactor pressure vessel under water (2).

Operations with the first type of RIS took 11 months, second type, 10. In total 55 tons of RIS were removed.

A sawing safety platform was added into the RPV for loading of the materials being dismantled and performing interim operations.

3.2.2.2 Dismantling of the reactor pressure vessel

Total weight of the reactor pressure vessel is 320 tons, height, 15 m. It was proposed to separate the vessel into 252 parts packaging it into 19 containers of the Konrad II type and 10 containers of the Konrad III type.

2 technologies were employed in dismantling of the reactor pressure vessel. At the top a band saw was used to cut the flange zone with wall thickness of 425 mm on both sides simultaneously covering 1100 mm of height.

The rest of operations were done with a high pressure water jet (200 MPa), nozzle diameter of 0.8 mm, cut metal thickness of 137 mm, cutting rate of 20 mm/min.

3.3 USA

3.3.1 Connecticut Yankee NPP

Connecticut Yankee NPP, Haddam Neck, is located on the eastern bank of the Connecticut River about 21 miles south-east of Hartford. In December 1996 the Board of Directors of Connecticut Yankee NPP voted for complete shutdown of the power plant. The decision was based on an economic study that concluded that due to changing market conditions, customers would save money if the plant were closed. Decommissioning funding came from regional electric customers and owners of the plant. Changes in industry and nuclear power control in USA of the 1970s caused the initial decommissioning scenarios designed by NRC to be revised.

The revised scenarios differ from the then scenarios in two fundamental ways. One is that the main decommissioning activities should be delayed until at least 5-7 years after reactor shutdown due to the requirement of the Department of Energy (DOE) towards cooling of spent fuel in a spent fuel pit for the purpose of preventing cladding damage during dry storage. Another change is based on the modern day requirement of regulatory authorities to undertake decommissioning after 60 years. As a result this delay causes decommissioning costs to increase over the short period of mothballing while spent fuel pits continue to operate. The scenario changes also affect the radiation dose accumulated by plant employees. The option of immediate dismantling was chosen for Connecticut Yankee as it was the most practicable and environmentally suitable for this power plant. Among other significant arguments in favor of immediate dismantling were:

- Possibility for use of available organization and trained personnel with knowledge of the power
- Elimination of long-term maintenance expenses;
- Availability of facilities for storage of low level waste.

Presently Connecticut Yankee personnel focus their efforts on decommissioning activities and demonstration of compliance with national and federal criteria for free release of the site. No final decision on management of the 500 acres (2 km^2) of the site and assets has been made so far. A small part of areas and structures shall be retained for dry storage of fuel inside containers until such time as the federal government shall perform its legal obligation regarding removal of nuclear fuel from the Connecticut Yankee site.

As of May 2003 Connecticut Yankee NPP decommissioning was about 65% complete. Main activities revolved around reactor decontamination and transfer. Extraction of the reactor vessel was complete by 2001 whereupon dismantling of the turbine hall commenced (removal of the main components, heat exchangers, pipelines and cables). By May 2003 five of the seven storage tanks were dismantled.

In January 2002 Connecticut Yankee NPP administration and administration of the town of Haddam where the plant is located have signed a settlement agreement enabling construction of a facility for dry storage of fuel inside containers with regard for mutually accepted conditions of environmental safety and control.

Construction of the storage commenced at Connecticut Yankee in March 2002. Forty three vertical concrete containers were built, spent nuclear fuel pits were modified, and preparation for fuel transport of operations was carried out. Starting with autumn of 2003 when transportation began 1019 spent nuclear fuel assemblies were emplaced for storage inside the dry containers.

Planning of Connecticut Yankee power plant dismantling required disposing the reactor vessel at the low level waste site in Barnwell, South Carolina. Connecticut Yankee reactor vessel assembly activity had to be lowered by almost 2.775×10^{16} Becquerel in accordance with the Barnwell storage requirements (maximum permitted limit of 1.85×10^{15} Becquerel per equipment unit). In the case of Connecticut Yankee it was decided that the GTCC material (classed above C) would be cut in such a way as to fit into receptacles sized as the Connecticut Yankee fuel assembly (FAS containers). Upon being packaged in such a way the FAS containers would be emplaced inside transport containers (holding 26 FAS containers) and transported to the concrete storages. Transport receptacles and containers are of the same size as the ones used for fuel storage at the ISFSI. As the GTCC material could not be transported to any of the currently operating storage sites it was decided that the spent fuel storage to be constructed in the future by the DOE was to be the final disposal site for the GTCC waste.

The key safety issues in the process of segmentation involved preventing any inadvertent extraction of high activity components from the vessel. Pollution and aerosol propagation control was also an important issue in segmentation planning. Most of the segmentation was done by means of abrasive water jet. Garnet was used for abrasive. Metal disintegration machining (MDM) was used to cut bolts of the support plate of the bottom part of the core from the upper internal part.

The cutting was carried out in a lodgment specially designed for the purpose of isolating the cutting process from the rest of the body. Submerged filtration system included a cyclone separator, reverse circulation filters, and an ion exchange vessel with a tank for accumulation of debris. Segmentation of the reactor internals took about 29 months with the radiation dose absorbed by personnel totaling 205 person- rems. Excessive radiation doses absorbed by the personnel, schedule issues and expenses in excess of established expense norms require detailed analysis.

Possibly the biggest issues arose regarding the equipment for pressure water jet cutting with abrasive material. Overall 550 m of cladding metal were cut this way resulting in 600 pieces which were loaded into 64 FAS containers. The FAS containers were in turn loaded into vertical concrete containers and sent to ISFSI generating about 200 m^3 of cutting refuse (delivered to Barnwell for storage) and 183 m^3 of filter and resin refuse (delivered to Barnwell for storage).

On November 1, 2001 the upper part of the reactor was taken from the power plant on a 19-axis platform towed by a trailer to a waste disposal enterprise in Utah. The main transformer of Connecticut Yankee power plant was dismantled over the course of January 2002 and in February 2002 it was transported to Texas on a barge. All components in primary circuit, auxiliary and storage buildings were dismantled and removed.

3.3.2 Maine Yankee NPP

Maine Yankee NPP (owned and operated by Maine Yankee Atomic Power Company) was a three- circuit power plant with installed capacity of 860 MW built based on a design by Combustion Engineering. It was commissioned into operation in 1972 and shutdown in 1997. Over the years of its operation the power plant significantly contributed to provision of the power grids of Maine, New Hampshire, Rhode Island, Vermont, Massachusetts, and Connecticut with electricity.

The company's board of directors approved the decision to commence decommissioning of the power plant and soon thereafter its complete shutdown. Having studied the decommissioning practices within the industry the owner arranged a tender for implementation of decommissioning operations based on a fixed price. Stone & Webster Engineering won the tender and was to act the contractor for decommissioning. The power plant personnel prepared it for handover to the contractor in a state of cold shutdown and performed decontamination of the primary circuit system. Having discussed the fixed price contract for segmentation of reactor internals Stone & Webster Engineering handed it over to Framatome (now AREVA). In this case, despite its contract having a fixed price, Stone & Webster Engineering allowed the operating personnel to substantially contribute to development of specifications, designing of tools and testing prior to site mobilization. This approach differed significantly from the one Stone & Webster Engineering initially adopted regarding Maine Yankee NPP.

Prior to implementation of segmentation operations on the contractor's site Stone & Webster Engineering was experiencing serious financial difficulties that were not related to the Maine Yankee contract, however Maine Yankee took steps towards assuming all risks related to decommissioning. Due to involvement of Maine Yankee in the process of transfer from the contractor to independent implementation this stage was completed over a short period of time. One of the requirements of the contract for work with a contractor was a provision on "the possibility for the operating organization to assume subcontracts". This was a very important aspect of transition to the project of segmentation of reactor internals as this transition occurred during final tests directly before implementation of operations on site.

Decommissioning of Maine Yankee NPP commenced in August 1997 and was completed in 2005. Decommissioning involved dismantling buildings and other structures and rehabilitating the site to the state complying with national and federal requirements towards elimination of radiological and non-radiological materials.

By 2005 the three of the main structures of the site were dismantled to 1 meter below the ground level. The only building remaining on site was the Independent Spent Fuel Storage Installation (ISFSI) where spent nuclear fuel for Maine Yankee NPP will be stored until the Department of Energy takes it from the site or another opportunity for its disposal presents itself.

It was during decommissioning of Maine Yankee that explosives were used for the first time for safe demolition of the containment building. About 400 tons of waste were safely transported from the site by railroad or water ways with cars and barges. From the radiological point of view the site was decontaminated to the level substantially lower than the 0,1 mSv required by the rules of the US Nuclear Regulatory Commission for classing the site as radiologically safe.

Planning of the earlier stages of decommissioning involved construction of Independent Spent Fuel Storage Installations (no such installation was available at the plant before) aimed at satisfying the need for packaging and storage of GTCC materials. ISFSI is an outdoors facility covering 50000 m2 with an adjacent security and operation building. The installation holds 60 air-tight sealed steel containers for spent nuclear fuel and four for GTCC waste. These air-tight containers are arranged inside massive concrete and steel containers resting upon a concrete pad. The air circulates through ventilation valves at the base and top of each container mitigating heat generation from spent fuel. Each container is remotely monitored from the operation center. In fact, the first containers to be stored in the ISFSI held materials resulting from segmentation of the reactor internals. Spent nuclear fuel and waste whose class is higher than C (GTCC) (irradiated steel extracted from the reactor vessel) were stored in the dry storage containers. Removal of GTCC waste is an obligation of the federal government, same as removal of spent nuclear fuel. Cold internal tests in the ISFSI dry storage were completed in June 2002; by the end of July 2002 cold tests were conducted by the Nuclear Regulatory Commission (NRC). By May 2003 20 canisters of spent nuclear fuel had been transferred to the ISFSI. 1434 spent fuel assemblies were transferred to the newly built dry containers of the storage from the cooling pits. Upon final removal of spent fuel to the storage in February 2004 the cooling pits were emptied, dismantled and removed complete with the rest of the NPP structures.

Transferring spent fuel from wet storage to a dry one is practicable for a number of reasons. First, emplacement of fuel inside containers prepares it for transportation when the time for it arrives.

Second, without dry storage inside containers it is impossible to complete decommissioning. Moreover, dry storage in containers is a passive system with air cooling which means that it is simpler and more economical than wet storage.

Dismantling of the reactor vessel was, of course, the main task which involved a number of subtasks. The internal part of the reactor vessel consisted of welded structures with a unique structure of the core cap (which consisted of eight cast stainless steel structures). After characterization of the internals segmentation planning was based on transporting an untouched reactor vessel as a package with activity of 1.85x1015 Becquerel. This necessitated separating the top and bottom of the internal part of the core from the thermal protection and removal of the core cavity and cap for emplacement of top and bottom assemblies - components with higher activity - back into the reactor vessel for the purpose of packaging and transportation on a barge after completion of the segmentation project.

Thermal protection and core cavity had to be packaged into 3-5 containers for transfer to Barnwell while the cap and support slab of the core had to be cut into relatively circular pieces for storage inside four special containers built for storage on the ISFSI site.

Activity of the internal part of the reactor of Maine Yankee NPP was the highest among all power plants where segmentation was undertaken so far. Due to long operation and the decision to proceed with dismantling soon after shutdown, calculated activity of the internal part of the reactor totaled 7.2668x1016 Becquerel.

This required construction of 4 GTCC containers necessary for long-term storage inside the ISFSI. Other projects with PWR reactors using cap assemblies that were completely welded ran into the same issues later on.

The operator has approached the issue of supplier selection with particular care developing very detailed specifications. When selecting a supplier the main criteria were as follows: equipment capability, experience and tests/test benches. These attributes were essential for project’s success. Framatome has proposed to carry out operations where most of the segmentation would be done by means of a pressurized water jet with an abrasive additive. Yankee Row NPP plasma arc experience would hardly fit this choice. The specifications considered many test data obtained in dismantling of equipment at the Row power plant. Although initially the specification was developed for the purposes of conducting a tender it subsequently became the basis for the contract between the contractor and subcontractor, Framatome, who performed the project of reactor internals segmentation. The specification did not directly prohibit the supplier from employing any cutting technologies. It is impossible to overestimate the importance of such a specification for implementation of a project on the scale in question.

A multi-axis manipulator is the centerpiece of the tool system involved in the process of cutting by pressurized water jet with abrasive additive. Separation of the support slab of the core (GTCC material) from support columns was performed by a purpose built milling tool that included visual equipment and collection of milling waste. To separate the GTCC materials from the GTCC-free internal structure, cutting under the support slab of the core had to be done in 261 points. Arrangement of this separation required custom designed and built hoisting appliances with a number of devices for handling of internal equipment when packaging.

Cutting of pipe stubs was completed in July 2002. The reactor weighing 598 tons was successfully transferred into a transportation container in August 2002.

On May 6, 2003 the reactor was sent from site to the Barnville storage, South Carolina on a barge.

GTCC waste (unfit for disposal in a near-surface storage according to US rules) is irradiated stainless steel extracted from the reactor vessel. For the purposes of disposal the GTCC waste was treated in accordance with the same technology as applied to fuel and emplaced into four ISFSI containers for storage.

The general program was based on the ALARA principle. Personnel exposure dose reached 0.25 man-Sv and totaled less than 0.52 man-Sv for the entire project. These doses are indicative of the work done: starting with preparation of the vessel prior to commencing operation (0.055 man-Sv) to final decontamination including all of the personnel. In assessing these results it is important to understand that there was almost 7.4x1016 Becquerel inside the reactor of the Maine Yankee NPP.

The Maine Yankee operator would provide Eaton Farm with 200 acres (80 ha) of land for conservation and ecology studies free of charge as part of the agreement with the Federal Nuclear Regulatory Commission of 1999. Recently Maine administration conducted a radiological inspection of Eaton Farm and found the site to be radilogically sound. State inspection confirmed the results of previous inspections performed by the Maine Yankee itself and the NRC. Creating a higher ground over a swamp and arrangement of 400 acres of land for future economic development became a completely new operation.

3.3.3 San Onofre NPP

436 MW (electricity) designed by Westinghouse and owned by the Southern California Edison Co. Commercial operation of the unit commenced in 1968 and was suspended in 1992 for economic reasons related with requirements for modernization of safety relevant equipment. The last reassessment showed that, were the SONGS1 reactor decommissioned immediately, it would result in lesser costs and allow using the knowledge of plant personnel who knew the SONGS1 reactor directly. Active decommissioning of SONGS1 commenced in 1999. It was expected that most of the structures would be decontaminated, dismantled and removed from the site by 2008.

First, SONGS1 was separated from neighboring operating generating units 2 and 3 whereupon auxiliary systems and buildings were dismantled to provide space for arrangement of containers for dry storage of spent nuclear fuel of generating unit 1. Storage inside a dry container is required for decommissioning of the cooling pit of SONGS1, RAW handling systems and cooling.

The project of segmenting reactor internals for removal of components with high induced activity dose from the vessel commenced in February 2001 and was soon successfully completed. This was done for the purpose of creating a LLW package suitable for transportation to the Barnwell storage, South Carolina. To comply both with the federal requirements and requirements of the state of South Carolina disposal of the SONGS reactor will require:

Removal of parts of reactor internals with activity above class C (GTCC) and their packaging in a way that is suitable for long-term storage and final disposal at the Department of Energy enterprises.

A package of reactor internals shall contain no more than 1.85x1015 Becquerel worth of radioactive materials total.

Normally, decommissioned reactor internals contain radioactive materials at the level of 1.85x1016 to 3.7x1016 Bq. To meet these conditions regarding reactor internals of the SONGS1 NPP it was necessary to carefully characterize the reactor vessel and reactor internals which was followed by the high-tech process of segmentation and packaging.

SONGS1 segmentation project benefited from the experience obtained in earlier reactor internals segmentation projects:

- Yankee Row – October 1993;
- Big Rock Point – 1999 – 2000;
- Connecticut Yankee – 2000 – 2002;
- Maine Yankee – 2001 – 2002.

Using purpose built tools for remote underwater cutting the methods of abrasive water jet and metal disintegration machining were employed.

Particularly these methods were successfully used for cutting reactor internals in accordance with the segmentation plan for emplacement into waste containers. Local capture hoods, secondary confinements and underwater decontamination systems were used to sustain activity within the limits of specification requirements by capturing and filtering the smallest abrasive particles (granet) and metal particles from the process of cutting. Due to very precise handling and planning and careful waste handling a smaller number of receptacles were required for the GTCC waste. Receptacles holding GTCC waste were transferred from the containment cavity to the spent fuel cooling pit building.

On-site work totaled a little more than a year with 54.094 work hours spent in the radiological control zone. Initially a dose of 0.772 man-Sv was planned for implementation of the project however the project of extracting reactor internals was completed at 0.22262 man-Sv. The project was implemented without accidents, injuries, and downtime as would be identified in accordance with the Work Safety Law. These results surpass the standards for previously implemented segmentation projects of the industry. Decrease in the dose absorbed by personnel on SONGS1 is due to careful planning and control, efficient use of the shielding system, and inspections of material and component activity levels.

Extraction of reactor internals still remains the most important part of the power plant decommissioning project. This task represents the highest risk in terms of safety, personal dose load, and generation of secondary waste during decommissioning of SONGS1. Contaminated materials inside the reactor vessel that are believed to be GTCC waste were extracted from the vessel and emplaced into the reactor cavity. Then they were segmented by means of underwater cutting with abrasive jet or metal disintegration machining.

Generated GTCC waste was subsequently packaged into modified fuel containers for long-term storage in an ISFSI. To capture active particles released while cutting as well as maintain water purity and dose level during the process in compliance with the ALARA standard employed at SONGS1 a secondary waste handling system was established. All spent nuclear fuel extracted from SONGS1 were first placed into the cooling pits of SONGS 1, 2 and 3 following which an ISFSI storage was built on the site. Transnuclear Inc. designed horizontal storage units and dry containers for use in the highly seismic seaside and coastal zone. SONGS1 storage shall hold 19 horizontal storage units (2 horizontal storage units with GTCC, each of the other seventeen shall hold a container filled with 24 fuel assemblies).

The reactor vessel was removed as a whole through a specially arranged aperture in the containment shell of the reactor building.

3.3.4 Trojan NPP

A complete set of decommissioning operations for PWR-type reactor was performed at the Trojan NPP. The information on Trojan NPP used in this report is based on Trojan NPP decommissioning project (TDP) presented to the US Nuclear Regulatory Commission (NRC) in January, 1995 and approved in April, 1996.

Trojan NPP was completely decommissioned in April, 1996, including unit building demolition (as well as control, reactor, fuel and turbine buildings).

For several separate types of activities performed at Trojan NPP a method completely different from the one initially described in TDP is employed. These activities include reactor pressure vessel (RPV) removal, spent fuel disposal and special treatment of contaminated ground water.

The most significant difference between the practical activities of decommissioning and dismantling and the Trojan NPP decommissioning project was that the license was issued for disposal of the reactor vessel and associated reactor internals instead of subjecting them to fragmentation and on-site storage as components of primary circuit equipment. The project proposed to perform fragmentation with regard for the following considerations:

- The reactor cannot be disposed on a low level waste (LLW) site unless it meets the waste classification requirements specified in regulations or any other specific site requirements listed in licentiate’s prescriptions.

- Trojan NPP staff performed an analysis to determine if the reactor internals and reactor vessel would meet the long-term disposal requirements on low level waste site in Hanford. The analysis returned positive results and a request for licensing and permission for disposal was filed. The average volumetric activity of the reactor vessel and reactor internals was used in the analysis.
- Averaging of radioactivity of the whole reactor volume is based on the position of reactor internals and future vessel filling with concrete.

3.3.5 La Crosse NPP

La Crosse boiling water reactor (LACBWR) is part of the nuclear power plant located near La Crosse, Wisconsin, in the small village of Genoa, Vernon County, approximately 17 km south of La Crosse along the Mississippi River.

LACBWR was built in 1967 within the framework of the federal project demonstrating sustainability of nuclear power engineering in the time of peace. The project was partially financed by the Atomic Energy Commission (AEC) in cooperation with Diaryland authorities. LACBWR had the electrical capacity of 50 MW. It was a direct cycle forced-circulation reactor. In 1973 the reactor and fuel were transferred completely to the Diaryland authorities.

In April 1987 LACBWR was shut down because the plant's small size made it no longer economically viable. On August 7, 1991 a safe storage plan, SAFSTOR, was adopted as an alternative to decommissioning.

The reactor's containment building consists of three layers: 230 mm of concrete, small gas clearance and 25 mm steel plate. An 18 meter high and 5 meter wide aperture was made in the containment in order to dismantle reactor vessel. The cutting was done with the use of a diamond string saw. The aperture surface area was divided into 8 separate sections.

The upper reactor protection consisted of prestressed concrete and three 380 mm thick cover layers with diameter of 4570 mm each. The layers were cut into 6 fragments with a diamond string. Central hall beams and floors had to be dismantled to access the reactor.

Concrete reactor shielding was dismantled into 20 ton weight units with a circular saw.

It was necessary to remove all stub tubes, pipes and other welded joints extending from the vessel with precise tolerances before extracting the reactor vessel because it fitted into transporting package tightly. All in all, there were 10 pairs of circulation stub tubes of inlets and outlets, 29 stainless steel pipes for control rods of the control and protection system, 2 big component supports and 25 other small heads of different size and material.

It was extremely difficult to remove the circulation stub tubes of inlets and outlets as well as control and protection system actuators because of access constraints, and high radiation and contamination level. Special supports were made to direct diamond saws through the labyrinth of pipes. The controls were arranged remotely, away from the work area, to minimize the exposure.

The diamond saws successfully cut each nozzle and armature, eliminating the need for thermal cutting. Presently limited step-by-step dismantling is underway. It is planned to temporarily store spent nuclear fuel in dry containers on the site until the federal storage is put in operation. In May of 2007 the reactor vessel was dismantled and shipped to the very low-level radioactive waste (VLLW) disposal facility in Barnwell, South Carolina. The shipment weighted approximately 310 tons and required a purpose built railway car.

3.4 France

3.4.1 Brennelis NPP

Starting in 1962, the Commissariat à l'Energie Atomique of France commenced actions for construction of this experimental reactor with heavy water moderator and gas coolant (type HWGCR). The reactor was supposed to have 70 MW capacity. Its construction was started in 1967.

Brennelis NPP unit with HWGCR reactor was permanently shut down in 1985. The cost of decommissioning work was estimated to 482 mln. euro.

Brennelis NPP is an example of the first complemely decommissioned NPP in France. EDF and CEA announced their intention to make the process transparent in order to have a possibility to use it as a decommissioning model for similar facilities later.

The whole decommissioning process is divided in 3 phases.

- **Phase 1**. This phase was started in 1985. It consisted in gradual fuel unloading, its transfer to spent fuel pool followed by spent fuel shipping to reprocessing factory. The work result is the unit transfer to nuclear safe condition and obtaining a corresponding statement from regulatory authority.

- **Phase 2**. In 1996 a feasibility study was performed for “green field” decommissioning option. The phase was started in 1997. The main phase activities included the following:
  - Decontamination and dismantling of auxiliary buildings and structures, except the reactor building.
  - Shipping out the accumulated waste.
  - Reactor pressure vessel enclosure. In 2005 phase 2 was officially completed.
- **Phase 3**. Phase 3 consisted mainly in work related to containment and reactor pressure vessel. Large-size components dismantling performed include:
  - Steam generator dismantling.
  - Reactor pressure vessel dismantling.
  - Containment building demolition.

The main mostly contaminated components were identified in the reactor hall: the control rods, pipelines, moderator tank, galleries, fuel pin guiding tubes, concrete containment.

Based on the architectural drawings, the 3D unit model was built in CAD, and component-by- component reactor model.

Dismantling of contaminated components was decided to be performed remotely using robotics, therefore the assessment was performed of radiation effect on mechanisms according to dismantling phases.

The key system became the robotic system directly connected to transportation systems and tools. The following requirements were imposed on the robotic systems: minimization of dimensions, maximal increase of working ranges, high developed forces, easily decontaminatable surfaces, use of radiation-resistant materials, software with open control, high technological flexibility. Such popular systems as Motoman from Yaskawa and Kuka Roboter GmbH were not suitable by these criteria.

The main requirements to specialized robotics were related to the lifting height by the vertical axis – to half of the reactor core height. Installed on horizontal rails, the robot had to perform the dismantling work from the end point (floor surface horizontally, core middle vertically) in the farthest core points.

The robot gripping device had to be made for different types of fittings, in particular:

- Hacksaws.
- Hydraulic shears.
- Hydraulic expander.
- End milling cutters.
- Radius cutters.

3.4.1.1 Tools

Three different plasma arc cutting tools and hot wire cutting equipment were used as thermal cutting. Prior to field testing, the virtual simulation of dismantling processes was performed, that allowed checking the possibility of working in limited space conditions, and improving the systems interactions and reducing the development cost.

Later the installed railways were extended to the full length of floor at the reactor hall elevation (at the core bottom).

By the present time a large scope of work has been performed in France for dismantling of gas- cooled graphite-moderated reactors. A special department was established at EDF for CIDEN NPP units decommissioning work planning and management.

3.4.1.2 Project planning structure

During work planning all decommissioning projects are divided in 4 review levels:

1. Basic design review (AP).
2. In-depth basic design review (APC).
3. Contract preparation studies (EPC)
4. Performance (by contractor) analysis (EX).

The following methodology was followed by CIDEN during dismantling scenarios selection and analysis:

- Dismantling work break-down in phases (with priority given to performance of work in the most contaminated areas).
- Location and nature of confinement system.

The following was defined for each phase:

- Working conditions (manual, remote systems, local pumping-out, methods used, etc.);
- Remote systems: access, tools to be used;

- Ways and methods of dismantled components and waste removal from their generation location to storage or disposal locations.

The following actions were performed when several possible dismantling scenarios were available:

- Development of detailed criteria in different areas (dates, costs, safety, waste management, feasibility).
- Selection of "weight" for each group.
- Assessment of each scenario.
- Proposal of the "basic" (optimal) scenario. Main comments.

Scenario assessment and comparison by reasonable aspects include two different levels of approach:

a) Technical aspects:
    - Feasibility.
    - Industrial and nuclear safety.
    - Radiation protection.
    - Environmental effects.
    - Waste management.
    - Planning.
    - Costs.
b) Project management may add another aspect (procurement policy, synergetic possibilities).
    - Identification of possible weaknesses in one aspect;
    - Definition of the "weight" of each technical aspect in accordance with design characteristics;
    - A certain balance shall be maintained between the technical aspects and components related to licensing.

3.5 Spain

3.5.1 Vandellòs NPP

The Vandellós I nuclear power plant, located at Vandellòs i l'Hospitalet de l'Infant in the province of Tarragona, was first coupled to the electricity grid on March 6th 1972. This facility was the only Spanish plant to use natural uranium and graphite-gas technology, which was developed mainly in Great Britain and in France. The nuclear power plant was retired from service as a result of the fire that occurred in the second turbine-alternator set on October 19th 1989. Although this incident had no radiological consequences and damaged only conventional areas of the facility, the Ministry of Industry and Energy suspended the plant's operating licence, thus putting an end to its activities after 17 years of operation. The high cost involved in recovering the plant led the owner company to shut it down definitively. As a result, in July 1990 the Ministry of Industry and Energy issued a Ministerial Order establishing the conditions under which to keep the plant in the safe shutdown mode, undertake the first level of decommissioning and subsequently transfer ownership of the site.

The decommissioning was to be to level 2, as established in the terminology of the International Atomic Energy Agency (IAEA), which consists of the decommissioning and removal of all the structures and components external to the reactor box, with the exception of those ensuring its confinement. On January 28th 1998, the Ministry of Industry and Energy, following a favourable report by the Nuclear Safety Council (CSN) and an environmental impact statement by the Ministry of the Environment, approved the Decommissioning Plan for Vandellós I NPP.

Vandellós I was the first nuclear power plant to be dismantled in Spain and constituted one of the first experiences at world level of the decommissioning of a high power commercial facility.

In accordance with the directives of the International Atomic Energy Agency, the Vandellós I nuclear power plant dismantling and decommissioning project is broken down into the levels which description is as follows.

3.5.1.1 Level 1. Preliminary conditioning activities

Following the definitive shutdown of the plant, the owner company Hifrensa unloaded the reactor, removed the spent fuel, conditioned the operating wastes and removed the wastes stored in the graphite silos.

In addition, the carbon dioxide tanks and main turbine-alternator groups were disassembled.

These tasks were completed between 1991 and 1997.

3.5.1.2 Level 2. Dismantling of structures

ENRESA carried out the Level 2 dismantling of Vandellós I in two phases:

- Phase one (February 1998-February 1999)
  - Conditioning of the site for dismantling.
  - Removal of unnecessary conventional structures.
- Phase two (March 1999-June 2003)
  - Performance of the Active Parts Dismantling Plan, including the disassembly of all the structures, components and systems except the reactor shroud, which remained confined and covered by a newly constructed protective structure.
  - Continuation of the dismantling of conventional components.
  - Performance of the Declassification Plan, in order to ensure that the conventional materials were not contaminated and could be managed as such.
  - Transfer of conventional wastes to recycling centres and specialised tips.
  - The low and intermediate level radioactive wastes were sent to the El Cabril centralised disposal facility.
  - Most of the site was released.

3.5.1.3 Dormancy period

The reactor shroud must remain as a regulated area, restricted and under surveillance for 25 years, the time required for its radioactivity to decay sufficiently for complete dismantling to be addressed.

3.5.1.4 Level 3. Dismantling of the reactor shroud

The last phase of decommissioning of the plant will be carried out by Enresa on completion of the dormancy period, around 2028, and will consist of removing the reactor shroud and all the internals. The site will then be completely released.

3.5.2 José Cabrera NPP

The José Cabrera NPP, also known as Zorita NPP,

In the Dismantling and Decommissioning Project approved for the José Cabrera nuclear power plant priority is given to the safety of the personnel performing the work, the general public and the environment. All the activities are subject to strict controls in which consideration is given to both the occupational risks present in any conventional industry and to radiological risks.

3.5.2.1 Preparatory activities

Initiation of the dismantling tasks requires a series of auxiliary systems and facilities that have to be constructed or modified beforehand. The preparatory activities will be carried out in accordance with the following Plans:

- Systems Modification Plans.
- Auxiliary Facilities Conditioning Plans.

In addition, the following will be applied with a view to eliminating risks and interferences during performance of the works:

- Definitive Tagout Plans.
- Risk Reduction / Elimination Plan.

3.5.2.2 Dismantling of conventional elements

This heading includes the dismantling of those plant buildings and facilities that have no radiological connotations. The most significant installations included in this group are as follows:

- Turbine building.
- Diesel generator building.
- Cooling towers.
- Workshops.

3.5.2.3 Dismantling of radiological elements

This is the activity that requires the highest levels of protection and the participation of the most highly specialised companies, and will be undertaken in accordance with the following plans:

- Radioactive Elements Disassembly Plan, this includes the disassembly and decontamination of the following elements:
  - Reactor building.
  - Auxiliary building.
  - Evaporator building.
  - Temporary waste stores.
- Major Components Disassembly Plan. One of the most complex activities to be undertaken is the disassembly and segmentation of the major components of the primary system, located inside the containment building. This task is

expected to last more than three years and includes the disassembly and segmentation of the following items:

- Reactor internals.
- Reactor vessel.
- Major primary circuit components, in the following order: coolant pump, pressuriser and steam generator.

3.5.2.4 Decontamination and demolition of buildings

The following Plans will be applicable to this group of activities:

- Walls and Structures Decontamination Plan, which will be carried out following the removal of the components from the different buildings and on completion of any activity that might imply new contamination.
- Activated Concrete Chopping Plan.
- Demolition and Backfill Plan.
- Decontamination and demolition of buildings

3.5.2.5 Management of waste materials

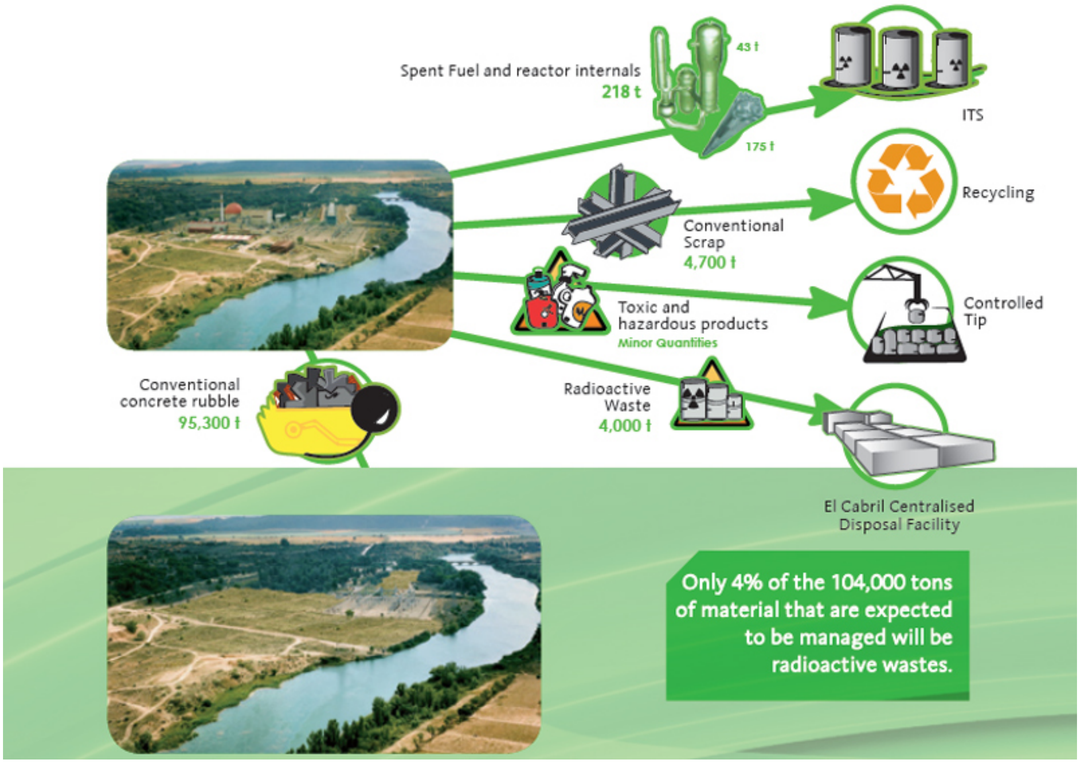
Like radiological characterisation, the management of materials entails activities that are performed during all the phases of the project. Performance of this activity is broken down into four major areas of management:

- Conventional wastes.
- Hazardous wastes.
- Materials open to declassification.
- Radioactive wastes and spent fuel.

The dismantling of the plant will generate a large quantity of waste materials, and it will be necessary to determine which may be recycled and which are to be treated as wastes. These waste materials will be as follows:

- Clean concrete rubble, which may be reused on the site.
- Conventional ferritic materials, which will be recycled.
- Toxic and hazardous products, which will be deposited and treated at appropriate facilities by authorised management organisations.
- Radioactive wastes. It is estimated that the radioactive wastes will account for only 3.88% of the total quantity of materials generated during dismantling.

Graph No. 6. Management of waste materials from the José Cabrera nuclear power plant dismantling project



3.6 Lithuania

3.6.1 Ignalina NPP

The Ignalina NPP was not build to meet Lithuania's needs, but as part of the Soviet Union's North-West Unified Power System. The two RBMK-1500 reactors were put in operation in 1983 and 1978, with a design lifetime 2010 - 2015. Originally it was planned four units, but construction of the third unit was terminated in 1989 due to public protests. In 1993 it was decided to dismantle this partially completed unit. This work is not yet completed.

Decommissioning of the Ignalina plant will raise serious economic problems for Lithuania and social problems for the region. The area around Ignalina plant was recently estimated as the least economically developed region in the country. In the nearest town Visaginas ethnic minorities (mainly Russain speaking) make up 86 % of the residents.

More than 80 % of incomes of the Ignalina district consist of incomes from the nuclear plant. Visaginas has around 33 800 inhabitants and about 5 100 of them are employed by the Ignalina plant. Most of the other working people of Visaginas are employed in services related to the plant.

In June 2000 the Lithuanian government, in co-operation with the European Commission and the EBRD organised a Donor's Conference for the decommissioning of Unit 1 of Ignalina NPP. During the conference the donors committed over EUR 216 million to the Decommissioning Fund and certain long-term financial assistance. A special international fund for the decommissioning of the Ignalina plant, administered by the European Bank for Reconstruction and Development (EBRD), was set up in 2001. The European Union is the main contributor to the fund. In addition, EU agreed to include Community financing in the 2007 - 2013 financial perspective. It should be noted here that on 29 September 2004 the Commission adopted a proposal for a regulation to implement this financing (COM 2004).

Unit 1 was closed in 2005. Lithuania has undertaken to close Unit 2 by no later than 31 December 2009. These closure commitments were included in Protocol No 4 to the Act of Accession, which entered into force on 1 May 2004.

3.7 Italy

Although Italy has been a pioneer country in the use and development of nuclear energy, following a referendum in November 1987 work on the nuclear programme was largely stopped. In 1988, the government resolved to halt all nuclear construction (two new nuclear BWR plants were almost complete and six locally-designed PWR plants were planned), to shut down the remaining three reactors and to decommission all four NPPs from 1990. ENEA also closed various fuel cycle facilities. As a result of this development, there is currently no operating nuclear power plant in Italy.

3.7.1 Latina NPP

The 153 MWe Latina Nuclear Power Plant, consisting of one Magnox reactor and operated from 1963 until 1987, is located at the Lazio Region. Construction started in 1958, first criticality occurred in December 1962, and the first connection to the distribution grid in May 1963. Commercial operation took place starting from January 1964.The plant was originally rated at 210 MWe, but the danger of significant oxidation of mild steel components by the high temperature carbon dioxide coolant required (in 1969) a reduction in operating temperature from 390 to 360 °C, which reduced power by 24%, down to 160 MWe.

3.7.2 Garigliano

The Garigliano NPP, in operation since 1964, has been one of the four power reactors for the production of electric energy in Italy. Using a boiling water reactor (BWR), it produced an electric power of 160 MW. It was fed by 208 elements of enriched uranium, every 18 months they were replaced. The exhausted fuel was stored in a special tank of 600 m^3 filled with demineralised water.

During 1979 it was stopped for maintenance and in 1982 started the operation for passive safety storage. In 1986, after Chernobyl accident, the Italian Nuclear Plants were stopped definitively and the procedures for safety storage started. In 1998 the Italian government decided to completely dismantle all nuclear power plants to release the sites without radiological bonds. The Garigliano was the first power plant, managed by SoGIN, which started the program for decommissioning.

The immediate dismantling type "DECON" foresees, in general, to reach the unconditional release of the site in a time period of ten or twenty years; according to this method, the three phases of decommissioning were performed all at once.

The actual situation of the Garigliano NPP sees the isolation of the reactor building from the rest of the plant, while the components and the pipes have been drained and sealed. The atmosphere inside the building is kept under control. The releases toward the outside are prevented by three barriers of containment. The buried tanks containing radioactive wastes have been emptied and decontaminated and the places have been cleared. All the radioactive wastes have been conditioned through concrete matrices and put inside qualified metallic drums, preventing releases toward the outside. Around 1800 drums have been produced, currently stored in the temporary deposits of the NPP.

Going on from the SAFESTORE strategy to the DECON has brought to the realization of an activity program with the definition of objectives that represent the temporal deadlines in the planning and in the realization of the restitution of the site to green lawn within December 2016.

The program of the activities is divided in five big phases:

- Activity around of the nuclear island (reactor building) and preparation to the dismantlement of the same nuclear island (from 2000 at 2008).
- Starting of the decommissioning activity of the nuclear island (January 2009).

- Waste transport to the national storage site (from 2010 at 2015).
- Dismantlement completion of the reactor components in the sphere (December 2011).
- Release of the site (December 2016).

The whole work developed and discussed in this thesis concerns planning activities and therefore it is included in the first phase of the decommissioning program. This program initially foreseen into the period 2001-2016 have suffered a time extension. At now it is suppose starting during the 2005, so all the phase will be shifted of about 5 years.

Annex 18. Current status of V1 NPP units

(***REMARK****: Official detailed information from Javys, a.s. about current status of V1 NPP is only available in Slovak*)

1 POPIS STAVU SYSTÉMOV A ZARIADENÍ 1. BLOKU

Manipulácie na zosumarizovaný stav jednotlivých systémov a zariadení primárneho a sekundárneho okruhu 1. bloku v režime D1 v tejto informácii sú uvedené v príslušných technologických prevádzkových predpisoch pre dané jednotlivé systémy a zariadenia primárneho a sekundárneho okruhu 1. bloku.

1.1 POPIS STAVU SYSTÉMOV A ZARIADENÍ STROJNEJ ČASTI PRIMÁRNEHO A SEKUNDÁRNEHO OKRUHU 1. BLOKU

1.1.1 Hlavné výrobné zariadenie primárnej a sekundárnej časti

Prvý reaktorový blok JE V-1 (a s tým súvisiace zariadenie) je odstavený z prevádzky od 31.12.2006 na základe Vyhlásenia Slovenskej vlády č. 801/1999 zo dňa 14. septembra 1999.
Tomuto rozhodnutiu je prispôsobený stav, prevádzkyschopnosť a prevádzkovanie ešte potrebných zariadení pre režim D1 na 1. bloku JE V-1, ktoré sú popísané v nasledujúcom texte.

1.1.1.1 Zariadenia strojnej časti PO

Názov systému	Stav systému	Zaplnené médiom	OaB
PO	RE10Z-1 – vyvezené palivo, utesnený, tlak podľa stĺpca hladiny v KO. HCČ, PCČ, VHCČ el. zaistené. HUA otvorené, el. zaistené. Trasy HOP zatvorené, el. zaistené.	ČK	nie
KP	Armatúry vstreku zatvorené, el. zaistené. PVKO prevádzkyschopné. Odvzdušnenie KO DR30A-1 otvorené. BN prázdna, odsávanie zatvorené, trvale na drenáži. Armatúry prívodu N do KO a PVKO zatvorené.	KO zaplnený ČK	nie
ŠOV-1	Odpojená od PO. Armatúry el. zaistené. Otvorené odvzdušnenia filtrov RE11-16A-3,4 zatvorené, el. zaistené. Stav armatúr rovnaký ako pre Režim 7 podľa 1-TPP-261, Príloha č.9.1.	Ionexy a ČK	nie
PG	PG zaplnené na max. hladinu, otvorené odvzdušnenia. Armatúry odluhov a odkalov zatvorené a el.zaistené. Čerpadlo PG30Č-1 el. odistené. Prevádzkyschopný len chladič PG20T-1. Stav armatúr podľa 1-TPP-256, Príloha č.8.	Demivoda	nie
ND	Čerpadlá ND el. zaistené. Prevádzkyschopné pre dopĺňanie PO.	ČK	nie
SA	SA10Č-1 el. zaistené. Nádrž SA10N-1 prázdna. Systém odstavený z prevádzky.	prázdny	nie
BA	Systém BA zdrenážovanýČerpadlá el. zaistené.	prázdny	nie
BK	Systém BK30 zdrenážovaný. Čerpadlo el. zaistené. Armatúry zatvorené.	prázdny	nie
MČ	Čerpadlá el. zaistené. Armatúry zatvorené a el. zaistené.	prázdny	nie
MS	Čerpadlá el. zaistené. Armatúry zatvorené a el. zaistené.	prázdny	nie

Názov systému	Stav systému	Zaplnené médiom	OaB
HD	Nádrž HD10N-1 je prázdna. Čerpadlá HDV, HDN el. zaistené. Armatúry HOPO zatvorené, el. zaistené. Armatúry HDV, HDN zatvorené.	prázdne	nie
SS	Čerpadlá SS el.zaistené. Armatúry zatvorené.	prázdny	nie
HNÚ	Čerpadlá HD45, ŠH10 el. odistené. Systém prevádzkyschopný podľa 1-TPP-252.		nie
TV	TV v prevádzke na BA30,40Č-1,ČD11,12Č-1, ČN30,40. TV na ostatné spotrebiče zatvorená.	TV	nie
TVD	TVD v prevádzke na ND čerpadlá. TVD na BA chladiče odstavená. TVD na systém HD a SR-65 odstavená. TVD v R045/1 z dôvodu podchádzania klapiek v prevádzke.	TV	nie
SV11	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z RS, BV, BS.	-	áno
SV12	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z hermetických priestorov.	-	áno
SV14	Prevádzkyschopné. Systém odsáva vzduch z hermetických priestorov (opravárenská ventilácia). Podľa potreby prevádzkovať podľa 5-TPP-265	-	nie
SV16	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z miestnosti R045/1.	-	áno
SR11	Motory ventilátorov odstavené, el. zaistené. Klapky TV20A-30,31 zatvorené.	TV	nie
SR12	V prevádzke podľa 5-TPP-265. Systém zabezpečuje prívod vzduchu na BV.	-	nie
SR13	V prevádzke podľa 5-TPP-265. Systém zabezpečuje prívod vzduchu na BS.	-	nie
SR14	Motor ventilátora SR14Č-1 odstavený z prevádzky, el. zaistený. Ručne ovládané klapky TV20A-41,42,49,50 zatvorené.	TV	nie
SR15	Motory ventilátorov SR15Č-1÷ 6 el. zaistené. TVD na chladiče odstavená – sú zatvorené ručné klapky TVD12A-1÷ 12.	TV	nie
SV03	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z miestností technologického zariadenia 1. a 2. bloku.	-	áno
SV05	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z ventilačného centra 1. a 2.bloku.	-	áno
P9	V prevádzke podľa 5-TPP-265. Systém slúži na klimatizáciu dozorne reaktorovne.	-	áno
P6	Systém je prevádzkyschopný. Systém slúži na prívod vzduchu do skafandrov, podľa potreby prevádzkovať podľa 5-TPP-265.	-	áno
V14	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z miestností určených pre prevádzkový personál.	-	nie

Názov systému	Stav systému	Zaplnené médiom	OaB
Pozn.	Ostatné vzduchotechnické systémy pre BPP a KRAO zostávajú v prevádzke podľa 5-TPP-265.		
ČS	Systém odstavený z prevádzky. Uzatvorené hraničné armatúry. (1-TPP-256).	Demivoda	nie
ČD	Systém v prevádzke bez zmien podľa 5-TPP-270	Prevádzkové médiá	áno
ČN	Systém v prevádzke bez zmien podľa 5-TPP-269	Prevádzkové médiá	áno
ČB	Systém v prevádzke bez zmien podľa 1-TPP-257, 2-TPP-257	Prevádzkové médiá	áno
RB	Systém v prevádzke bez zmien podľa 5-TPP-267	Prevádzkové médiá	áno
PR	V prevádzke (podľa 5-TPP-271) – okrem: -odstavené zaistené čerpadlá: PR27Č-1 PR26Č-1 -vyprázdnené nádrže: PR14,15,17N-1, PR26N-1,2,3, PR27N-1	Prevádzkové médiá	áno
ČP	Systém v prevádzke bez zmien podľa 5-TPP-266	Prevádzkové médiá	áno
DZ	Systém rozvodu DZ v prevádzke bez zmien.	Médium podľa potreby	áno
ČK	Systém v prevádzke bez zmien podľa 5-TPP-258	áno	áno
TC13	DEKONTAMINÁCIA Systém dekontaminácie zostáva v prevádzke v plnom rozsahu. Dekontaminačné práce sú vykonávané dodávateľsky na základe zmluvy.	Dekontaminačné roztoky, prípadne ČK	áno
TC24	ZLOŽISKO PEVNÝCH A KVAPALNÝCH RAO Stáčacia stanica KRAO – v nominálnej prevádzke podľa 5-TPP-268.	-	áno
RČA	Na vretenách RČA (1.07.1.101.11÷66) namontované po 1 ks zaisťovacích segmentov, ponechané po strate tlaku oleja v medzipolohe vymedzenej osadenými segmentami. Servopohony RČA el. zaistené.	Demivoda	nie
RBA	Armatúry ponechané v otvorenom stave. Servopohony RBA (1.07.1.103.1-6) el. zaistené.	Demivoda	nie
SHN do PG	Armatúry (1.0 7.1.105.1÷6) ponechané v zatvorenom stave. Servopohony SHN do PG el. zaistené.	Demivoda	nie
PSA PG	Uzatváracie armatúry (1.07.1.106.1-6) a regulačné ventily ponechané(1.07.1.350.1-6) v zatvorenom stave. Servopohony uzatváracích armatúr a regulačných ventilov el. zaistené.	Demivoda	nie
IPV PG	Uzatvorením armatúr 1.07.2.521.1 a 1.07.2.521.2 odstavený zaistený vzduch na napájanie riadiacich prístrojov 1RP701.1-6 a 1RP702.1-6. IPV PG 1.07.1.701.1-6, 1.07.1.702.1-6 a 1.07.1.703.1-6 ponechané v tzv. pružinovom režime.	Demivoda	nie
HZ	Uzatvorená, nezahermetizovaná. Prácou SV12Č-3 (SV12Č-1,2) udržiavaný podtlak cca 180 Pa. V odôvodnených prípadoch je možné vykonávať potrebné činnosti (kontrola, údržba, priemyselné čistenie zariadení, atď.).	-	

Zariadenia strojnej časti sekundárneho okruhu
Parné turbíny TG11, TG12 s príslušenstvom

Názov systému	Stav systému	Zaplnené médiom	OaB
Turbogenerátor TG11, TG12	odstavené z prevádzky, vychladené, zrušené vákuum, odtlakované - otvorené EA 1.04.1.162.1,2 – rušič vákua, vypustené	-	nie
Poznámka	Zariadenie namanipulované podľa technologického prevádzkového predpisu 1-TPP-351 Turbosústroj TG 220 MW manipulačných predpisov 1-TPP-351/O06.1 a 2 – Parná turbína TG11 a TG12 po pare		
Olejový systém TG11, TG12	odstavené všetky olejové čerpadlá olejového systému TG11,12, olej z chladičov mazacieho oleja CHO TG, OH generátora, potrubí, sifónu od generátora zdrenážovaný do HON TG11,12, olej z HON TG11,12 úplne vypustený do centrálneho OH obj.621	-	nie
Poznámka	Zariadenie namanipulované podľa technologického prevádzkového predpisu 1-TPP-351 Turbosústroj TG 220 MW manipulačných predpisov 1-TPP-351/O07.1 a 2 – Olejové hospodárstvo TG11 a TG12		
Hlavné kondenzátory HK TG11,12	odstavené z prevádzky, vychladené po strane CCHV – vstupné UK 1.04.1.136.1-4 zatvorené, výstupné UK 1.04.1.137.1-4 zatvorené - HK TG11,12 po strane CCHV odtlakované, vypustené zaistené na Z-príkazy na otvorenie vrát vodných komôr HK TG11,12 na vysušenie (pasivácia trubkových zväzkov prirodzenou cirkuláciou vzduchu)	-	nie
	odstavené z prevádzky, vychladené, odtlakované po strane kondenzátu – zostatkové prevádzkové hladiny v K1 a K2 HK vypustené	-	nie
Kondenzátne čerpadlá KČ TG11, TG12	odstavené z prevádzky, 6kV elektropohony elektricky zaistené, odtlakované, vypustené	-	nie
Systém hlavného kondenzátu TG11, TG12	odstavené z prevádzky, odtlakované, vypustené	-	nie
Čerpadlá vodoprúdových vývev ČVV TG11, TG12	odstavené z prevádzky, 6kV elektropohony elektricky zaistené	-	nie
Jamy vývev TG11,TG12	odstavené z prevádzky, vypustené	-	-
Vákuový systém TG11, TG12	odstavené z prevádzky, odtlakované, vypustené	-	nie
Ventilátory komínkovej pary VKP TG11, TG12	odstavené z prevádzky	-	nie

Názov systému	Stav systému	Zaplnené médiom	OaB
Upchávkový systém TG11, TG12	odstavené z prevádzky, odtlakované, vypustené	-	nie
Komínkový systém TG11, TG12	odstavené z prevádzky, odtlakované, vypustené	-	nie
Systém separácie a prihrievania pary SPP TG11, TG12	odstavené z prevádzky, prirodzene vychladnuté, odtlakované, vypustené	-	nie
Podávacie čerpadlá separátu PČS TG11, TG12	odstavené z prevádzky, elektromotory PČS elektricky zaistené, odtlakované, vypustené	-	nie
NT-regenerácia TG11, TG12	odstavené z prevádzky, prirodzene vychladnutá, po strane hlavného kondenzátu vypustená, po parnej strane odtlakovaná, vypustená	-	nie
Podávacie čerpadlá kondenzátu PČK TG11, TG12	odstavené z prevádzky, elektromotory PČK elektricky zaistené, odtlakované, vypustené	-	nie
VT-regenerácia TG11, TG12	odstavené z prevádzky, prirodzene vychladnutá, po strane napájacej vody vypustená, po parnej strane odtlakovaná, vypustená	-	nie
Kolektor pre spotrebiče CCHV TG11, TG12	odstavené z prevádzky, odtlakované, vypustené UK 1.07.2.174.1-4 do kolektorov spotrebičov TG11,12 zatvorené, potrubia prívodov CCHV za UK174 vypustené, chladiče CHVO GEN G1 a G2 po strane CCHV - vstupné armatúry zatvorené, výstupné armatúry zatvorené, chladiče po strane CCHV vypustené, chladiče CHO mazacieho oleja TG11,12 po strane CCHV - vstupné armatúry zatvorené, výstupné armatúry zatvorené, chladiče po strane CCHV vypustené, všetky chladiče CHVO GEN G1 a G2, chladiče CHO mazacieho oleja TG11,12 zaistené na Z-príkazy na otvorenie viek chladičov na vysušenie (pasivácia trubkových zväzkov prirodzenou cirkuláciou vzduchu).	-	nie

Napájacia stanica 1. bloku

Názov systému	Stav systému	Zaplnené médiom	OaB
ENČ 11-15	odstavené z prevádzky, 6kV elektropohony elektricky zaistené čerpadlá ENČ po strane napájacej vody odtlakované, vypustené olej z olejových nádrží OH ENČ prečerpaný do centrálneho OH obj.621	-	nie
Poznámka	Zariadenie namanipulované podľa technologického prevádzkového predpisu 1-TPP-352 Napájacie zariadenie bloku manipulačných predpisov 1-TPP-352/O03.1 až 5 – ENČ 11 až 15 1-TPP-351/O04 – Spoločné zariadenia ENČ 1. bloku		

Názov systému	Stav systému	Zaplnené médiom	OaB
HNČ 11,12	odstavené z prevádzky, 6kV elektropohony elektricky zaistené, čerpadlá HNČ po strane napájacej vody odtlakované, vypustené	-	nie
Systém dávkovania čpavku DČ NH_3 1. bloku do sania ENČ	odstavené z prevádzky, odtlakované, vypustené	-	nie
Potrubia CCHV pre ENČ 1. bloku	odstavené z prevádzky, odtlakované, vypustené EA 1.07.2.168.1,2 prívodu CCHV pre ENČ 1. bloku zatvorené. EA 1.07.2.169.1,2 odvodu CCHV z ENČ 1. bloku zatvorené. Prívodné potrubia CCHV pre ENČ, ENČ po strane CCHV, odvodné potrubia CCHV z ENČ vypustené	-	nie

Dochladzovanie PO 1. bloku

Názov systému	Stav systému	Zaplnené médiom	OaB
Dochladzovanie PO 1. bloku	odstavené z prevádzky, elektromotory DČ elektricky zaistené, odtlakované, vypustené	-	nie

Centrálna čerpacia stanica CČS V-1 – terciárny okruh CCHV

Názov systému	Stav systému	Zaplnené médiom	OaB
Čerpadlá cirkulačnej chladiacej vody 6DR č.1-4	odstavené z prevádzky, 6kV elektropohony elektricky zaistené	Zavodnené CCHV	nie

Chladiace veže CHV V-1 – terciárny okruh CCHV a vratná TCHV z dochladzovania

Názov systému	Stav systému	Zaplnené médiom	OaB
Chladiace veže CHV č. 1-4	odstavené z prevádzky 3 CHV - armatúry na sprchy a obtoky do bazéna CHV č.1,2,4 zatvorené, **Po trvalom odstavení 2.bloku na dochladzovanie prepnúť CHV č.3 - v prevádzke zostane chladiaca veža č.3 z dôvodu vratnej TCHV do terciárneho okruhu CCHV.**	zaplnené CCHV	áno

1.1.1.2 Ostatné zariadenia sekundárneho okruhu

Popisuje ostatné zariadenia na sekundárnom okruhu JE V-1 hlavne na vonkajších zariadeniach.

Nábehová a rezervná kotolňa NaRK V-1

V prevádzkyschopnom stave podľa TPP. Rozdeľovač pary v NaRK V-1 slúži na distribúciu dodávanej pary z JE V-2 do CZT – VS pre JAVYS, a.s., do prevádzok VYZ a prípadne do prevádzok V-1.

Ak budú parné kotle K-1, K-2, K-3, K-4 odstavené, trvale ich držať v horúcej rezerve na cudziu paru z parovodu V-1/V-2.

Kondenzáty z odvodnení spoločných parovodov a zo spoločných prevádzok V-1

Kondenzáty z odvodnení prepoja kolektorov 0,7 MPa medzi blokmi, para na ŠOV 3,4 odvedené do ZNK 1. bloku.

Kondenzáty zo ŠOV-3,4 (ČN30,40) odvedené do ZNK 1. bloku.

Kondenzát z kondenzátneho potrubia parovodov z PK-11,17, vratný kondenzát zo špeciálnej práčovne, kondenzát z odvodnení parovodu NaRK – HVB V-1 v obj.490 V-1 na 1. bloku a z parovodu do CHÚV v obj.490 V-1 na 1. bloku, RS 1,2/0,7 MPa a odvodnení VS490/1, vratný kondenzát o ohrievačov VS490/1 trvale odvádzať cez zbernicu odvodnení TG11, TG12 cez otvorené uzatváracie dve rA 1.07.2.964.1,2 na potrubiach DN200 spoločného prívodu kondenzátu zo zberníc odvodnení parovodov TG11,TG12 do expandérov ZNK 1. bloku. Zatvorená bude rA 2.07.2.851.1 prepoja zberníc odvodnení 1. a 2.bloku do ZNK

(od 2.bloku).
Kondenzát zo ZNK 1. bloku prečerpávať novými kondenzátnymi čerpadlami ZNK 1. bloku 1.07.2.22.1,2 do JE V-2. Diaľkovo v automatickom režime ovláda TP-VZ z touch-panela (dotykový panel) na BD 1. bloku. Núdzovo môže ovládať miestne SEZ - zariadení SO - zmenový, pričom treba brať do úvahy nepôsobenie automatík z miesta.

Kolektor 0,7 MPa 1. bloku

Kolektor 0,7 MPa 1. bloku bude v štandardnom režime v studenej rezerve príp. v náhradnom režime v prevádzke pre transport pary od NaRK V-1 cez pôvodnú RS 1,2/0,7 MPa na 1.bloku do prepoja kolektorov 0,7 MPa medzi blokmi. Počas prevádzky kolektora 0,7 MPa 1. bloku budú v prevádzke cez odvádzače kondenzátu všetky odvodnenia z kolektora 0,7 MPa 1. bloku, ktoré majú odvod kondenzátu do ZNK. Odvodnenia s odvodom kondenzátu do HK TG11,12 budú odstavené.
Zariadenie prevádzkované podľa technologického prevádzkového predpisu 1-TPP-357 – Pomocné okruhy TG 220 MW, kapitola IV.8.4 - kolektor 0,7 MPa 1. bloku.

Prepoj kolektorov 0,7 MPa medzi blokmi

Prepoj kolektorov 0,7 MPa medzi blokmi v štandardnom režime napájaný parou od NaRK V-1 parovodom okolo ČS TVD cez novú RS 1,2/0,7 MPa na 2.bloku, v náhradnom režime napájaný parou od NaRK V-1 parovodom v potrubnom kanáli PK-11,17 cez pôvodnú RS 1,2/0,7 MPa na 1.bloku, kolektor 0,7 MPa 1. bloku.
Z prepoja kolektorov 0,7 MPa medzi blokmi dodávať paru do:
- parovodu pre ŠOV-3,4,
- parovodu do CHÚV (malá RS v strojovni na 1. bloku zatvorená),
- parovodu do špeciálnej práčovne,
- parovodmi do PO na dekontamináciu (v prípade potreby).

Výmenníková stanica VS490/1

Zberač a rozdeľovač obehovej vykurovacej vody VS490/1 prerobený na odovzdávaciu stanicu OS490/1 vetvy č.9 obehovej vykurovacej vody.

Ostatné zariadenia 1. bloku v strojovni V-1

Po trvalom odstavení 2.reaktorového bloku JE V-1 prevádzkovať odvod TCHV na riedenie odpadných vôd v socomane z technologického kondenzátora TK č. 1, príp. TK č. 2 cez rA 1.07.2.609.1 (2). Uzatváracie rA odluhov CCHV z TG12 a TG21 trvale zatvorené.
TP-VZ V-1 spolu s Technikom radiačnej bezpečnosti – vedúcim zmeny V-1 ekonomicky riadiť riedenie nízkoaktívnych odpadov do Socomanu a hlavne trvalý prietok cez čerpadlá dozimetrickej kontroly OV do SC.
TP-VZ V-1 spolu s Technikom radiačnej bezpečnosti – vedúcim zmeny V-1 ekonomicky riadiť riedenie nízkoaktívnych odpadov, príp. iných odpadových vôd do Socomanu. Prietok cez čerpadlá dozimetrickej kontroly OV do SC je tvorený odpadovými vodami z ČOV – Bioclár a sanačným čerpaním vrtov A-1. V čase, keď nie je vypúšťanie nízkoaktívnych odpadovz JE V-1, odvod TCHV na riedenie odpadných vôd v socomane z technologického kondenzátora TK č. 1, príp. TK č. 2 cez rA 1.07.2.609.1 (2) je odstavený.
Vychladzovacia nádrž a čerpadlo VN 1. bloku k dispozícii v automatickom režime pre prípad prepadu kondenzátu zo ZNK 1. bloku.

Chemická úprava vody CHÚV V-1

Spoločná prevádzka – použitie pre 1. a 2.blok aj spoločné prevádzky JE V-1 podľa TPP na výrobu demi-vody.

Superhavarijné napájanie PG - SHNČ

Spoločná prevádzka – systém odstavený, vydrenážovaný.

Vzduchotechnické systémy VZT 1. bloku

Bez obmedzenia trvale alebo podľa potreby v prevádzke podľa TPP.

Chladiaca stanica havarijnej vzduchotechniky TRANE 1. bloku

Bez obmedzenia podľa potreby v prevádzke podľa TPP.

Dieselgenerátorová stanica pre 1. blok – DG 2,DG2R

Podľa KUP-dieselgenerátory DG 2R, DG2 v studenej rezerve.

TVD 1. a 2. podsystém

Bez obmedzenia podľa potreby v prevádzke podľa TPP.

Okruh TCHV JE V-1

Bez obmedzenia v prevádzkyschopnom stave podľa TPP 1. a 2.vetva TCHV pre 1. a 2.blok JE V-1 aj spoločné prevádzky.

Prevádzkovať len jedno čerpadlo technickej vody.

AT-stanica a rozvod požiarnej vody JE V-1
Bez obmedzenia podľa potreby v prevádzke podľa TPP.

1.2 POPIS STAVU SYSTÉMOV A ZARIADENÍ ELEKTROČASTI PRIMÁRNEHO A SEKUNDÁRNEHO OKRUHU 1. BLOKU

Prvý reaktorový blok JE V-1 (a s tým súvisiace elektrické zariadenie) je odstavený z prevádzky od 31.12.2006 na základe Vyhlásenia Slovenskej vlády č. 801/1999 zo dňa 14. septembra 1999.
Tomuto rozhodnutiu je prispôsobený stav, prevádzkyschopnosť a prevádzkovanie ešte potrebných elektrozariadení pre režim D1 na 1. bloku JE V-1, ktoré sú popísané v nasledujúcom texte.

1.2.1 Rezervné napájanie (T1R)

Systém rezervného napájania 1. bloku je hlavným zdrojom elektrickej energie pre všetky spotrebiče 1. bloku, aj keď sú požiadavky na rezervné napájanie značne redukované. Napájaný je z rezervného transformátora T1R alebo T2R.
V prípade napájania VS 1. bloku z transformátora T1R a VS 2. bloku z transformátora T2R sú spojky rezervných prípojníc 6 kV A1-A2, B1-B2 rozopnuté, AZR je obojstranný a navolený.
V prípade napájania VS obidvoch blokov súčasne len z jedného transformátora T1R alebo T2R sú príslušné spojky rezervných prípojníc 6 kV medzi 1. a 2. blokom zopnuté, to znamená, že rezervné prípojnice 6 kV 1. a 2. bloku sú prepojené

1.2.2 Zaistené napájanie II. kategórie 6 kV

Pod napätím ostávajú obidve sekcie rd6-08.11 a rd6-08.12 z dôvodu zaistenia napájania úsekových rozvádzačov 0,4 kV. Navyše sekcia rd6-08.12 zabezpečuje napájanie sekcie r6-08.12b, ktorá napája rezervný transformátor 2. bloku T30R pre rozvádzače 0,4 kV.
V prevádzke sú nasledovné zariadenia:

- zopnuté spínače N02.11d a N02.11b (sekcia r6-08.11b pod napätím),
- zopnuté spínače N02.12d a N02.12b (sekcia r6-08.12b pod napätím),
- zopnuté spínače na transformátore A.T21d (rozvádzač A.rd0,4-08.11 pod napätím).
- zopnuté spínače na transformátore B.T22d (rozvádzač B.rd0,4-08.12 pod napätím).

Prevádzkyschopná pod napätím zostáva aj sekcia r6-08.13 so všetkými príslušnými vypínačmi.
Sekcie rd6-08.11,12 a r6-08.13 sa prevádzkujú v zmysle predpisu 1-TPP-451.Dieselgenerátory DG1R, DG2R, DG2 a DG4 sú v režime revízia podľa 1-TPP-450 a ich 6 kV vypínače sú zaistené.

1.2.3 Nezaistené napájanie 6 kV

Po konečnom vyvezení jadrového paliva z 1. bloku zostáva naďalej v prevádzke systém 6 kV nezaisteného napájania, potrebný zväčša pre napájanie rozvádzačov 0,4 kV.
Systém 6 kV nezaisteného napájania je v prevádzke nasledovne:

- **Sekcie rg6-08.11 a rg6-08.12** sú vypnuté a zaistené.
- **Sekcia r6-08.11a** v prevádzke v štandardom režime, napájaná z prípojnice rezervného napájania A1. Hlavnou úlohou tejto sekcie je napájanie transformátora T55 pre pomocnú kotolňu.
- **Sekcia r6-08.12a** v prevádzke v štandardom režime, napájaná z prípojnice rezervného napájania B1. Hlavnou úlohou tejto sekcie je napájanie transformátora 9CT01 pre MSVP.
- **Sekcia r6-08.11b** v prevádzke v štandardom režime, napájaná zo sekcie rd6-08.11. Hlavnou úlohou tejto sekcie je napájanie transformátora vonkajších objektov, svetelných a úsekových rozvádzačov.
- **Sekcia r6-08.12b** bude pokračovať v prevádzke v štandardom režime, napájaná zo sekcie rd6-08.12. Hlavnou úlohou tejto sekcie je napájanie transformátora T30R pre rezervné napájanie systému 0,4 kV 2. bloku.

Systém 6 kV nezaisteného napájania 1. bloku je v prevádzke v zmysle predpisu 1-TPP-452.
Napájanie systému 6 kV nezaisteného napájania je zabezpečené z rezervného transformátora T1R.

1.2.4 Zaistené napájanie I. kategórie

Systém I.kategórie zaisteného napájania je v prevádzke okrem motorgenerátorov A.MG-08.11 a B.MG-08.12 v nasledovnom rozsahu:

1. Systém zaisteného napájania I. kategórie A. redundancie t.j.:

- úsekový rozvádzač SYZAN I. kategórie 0,4 kV (A.rz0,4-08.11),usmerňovač A.US11,
- úsekový rozvádzač 220 V = (A.ru220-08.11, ru 220-08.11)
- batériová napájacia skriňa A.BES11,
- akubatéria AKU11

2. Systém zaisteného napájania I. kategórie B redundancie t.j.:

- úsekový rozvádzač SYZAN I.kategórie 0,4 kV (B.rz0,4-08.12),

- usmerňovač B.US12,
- úsekový rozvádzač 220 V = (B.ru220-08.12, ru220-08.12),
- batériová napájacia skriňa B.BES12,
- akubatéria AKU12

Podružné rozvádzače systému 0,4 kV zaisteného napájania zostávajú prevádzkyschopné. V prípade elektrického zaistenia (znefunkčnenia) všetkých spotrebičov patriacich k príslušnému rozvádzaču bude príslušný rozvádzač (vrátane úsekového) zaistený a označený v súlade s prevádzkovým predpisom 1-TPP-453.

1.2.5 Zaistené napájanie II. kategórie 0,4 kV

Úsekové rozvádzače II. kategórie zostávajú napájané z príslušných 6 kV sekcií. V prípade výpadku nadradenej sekcie 6 kV je možné obnovenie napájania úsekových rozvádzačov Ard0,4-08.11 a Brd0,4-08.12 ručne, z rezervného prívodu alebo z príslušného DG.
Systém 0,4 kV zaisteného napájania zostáva v prevádzke v rozsahu, potrebnom pre prevádzku zostávajúceho zariadenia.
Systém pracuje v nasledovnom režime:

- Rozvádzač Ard0,4-08.11 je napájaný zo sekcie rd6-08.11 s možnosťou prepnutia na rezervný prívod z r0,4-08.11,
- Rozvádzač rd0,4-08.12 je napájaný z pracovného prívodu z rd6-08.12 s možnosťou prepnutia na rezervný prívod z r0,4-08.12.

Podružné rozvádzače systému 0,4 kV zaisteného napájania zostanú prevádzkyschopné. V prípade elektrického zaistenia (znefunkčnenia) všetkých spotrebičov patriacich k príslušnému rozvádzaču bude tento rozvádzač (vrátane úsekového) zaistený a označený v súlade s prevádzkovým predpisom 1-TPP-451.

1.2.6 Nezaistené napájanie 0,4 kV

Systém 0,4 kV nezaisteného napájania je v prevádzke ako hlavný rozvodný systém pre 0,4 kV spotrebiče 1.bloku JE V1.
Rozvádzače r0,4-08.13 a r0,4-08.14 sú vypnuté a zaistené.
Podružné rozvádzače systému 0,4 kV nezaisteného napájania zostanú prevádzkyschopné. V prípade elektrického zaistenia (znefunkčnenia) všetkých spotrebičov patriacich k príslušnému rozvádzaču, bude tento rozvádzač (vrátane úsekového) zaistený a označený v súlade s prevádzkovým predpisom 5-TPP-462.

1.2.7 Rezervné napájanie na úrovni 0,4 kV medzi blokmi

Systém rezervného napájania rozvádzačov 0,4 kV medzi blokmi je v prevádzke z dôvodu zabezpečenia rezervného napájania spoločných rozvádzačov 0,4 kV.
V prevádzke zostávajú oba transformátory T20R (napájaný z r6-08.22b) a T30R (napájaný z r6-08.12b) a všetky spoločné rozvádzače 0,4 kV. Tieto budú napájané štandardne z príslušných sekcií 6 kV cez transformátory 6,3/0,4 kV. V prípade výpadku základného zdroja bude napájanie týchto rozvádzačov zabezpečené z transformátorov T30R a T20R.
Systém rezervného napájania na úrovni 0,4kV medzi blokmi prevádzkovať v zmysle
predpisu 5-TPP-462.

1.2.8 Rozvodňa R713

Z dôvodu zabezpečenia napájania r6-08.23, III. sieťového prípoja V2 a vonkajších objektov je nutné ponechať rozvodňu R-713 pod napätím pre prevádzku zostávajúceho zariadenia.
Rozvodňu R-713 prevádzkovať podľa predpisov 5-TPP-460, 5-TPP-454 a 5-TPP-471.

1.2.9 Penohasenie

Systém penohasenia zostáva v plnom rozsahu v prevádzke a jeho obsluha sa vykonáva podľa prevádzkového predpisu 5-TPP-474 Penohasenie.

1.3 POPIS STAVU SYSTÉMOV A ZARIADENÍ SKR PRIMÁRNEHO A SEKUNDÁRNEHO OKRUHU 1. BLOKU

Meracie obvody (tlaku,tlak.diferencie, teploty, hladiny, prietoku atď) sú udržiavané v prevádzkyschopnom stave ak je v prevádzke príslušná technológia

1.3.1 Zariadenie SKR PO

V nasledujúcom popise je uvedený stav SKR systémov :

Názov systému	Stav
Meranie hladín v nádržiach systému ZT	v prevádzke - funkčný
Meranie koncentrácie H_3BO_3 v ČN30(40)Z-2	v prevádzke – funkčný
Systémy SOTN,SOTH	nefunkčné, odpojené výstupy, RS pod napätím
Meranie hladiny v TNR reaktora – PAMS	nefunkčné, odpojené od napájania
Meranie n-toku KNI	nefunkčné, odpojené od napájania
Meranie teplôt na výstupe palivových kaziet VRK	nefunkčné
Merania systému PAMS – panely zapisovačov	panel pod napätím, vybrané merania funkčné
Meranie vodíka v barbotážnej nádrži	v prevádzke – funkčné
Meranie vodíka v nádrži nečistého kondenzátu, v jímke únikov	nefunkčné
Systémy SKR umiestnené na DR, m.č.V113	v prevádzke – funkčné
Meranie na VZT systémoch v KP na +10,5m (V-centrum)	v prevádzke – funkčné
Meranie n-toku 1. a 2. redudancia TXS	neprevádzkovaný
Riadiaci systém ochrany reaktora /RTS, ESFAS, ROM/ 1. a 2. redudancia TXS	neprevádzkovaný
Regulátor výkonu /ARM/	neprevádzkovaný
Reaktimeter	neprevádzkovaný
Systém ochrany a riadenia reaktora /SORR/	neprevádzkovaný
Zariadenie na meranie doby pádu HRK /PPK-HRK/	neprevádzkovaný
Regulačné obvody PO ako v R7	neprevádzkovaný
SKR pre reguláciu VZT systémov a požiarnych klapiek	prevádzkovaný
SKR odparky ČN-30	prevádzkovaný
SKR odparky ČN-40	prevádzkovaný

1.3.2 Zariadenie SKR SO

Meranie hladiny nafty a monitorovanie únikov nafty	v prevádzke – funkčný
Ochrany turbogenerátora TG11,12	nefunkčné, odpojené od napájania
Diagnostický a monitorovací systém chvení a predĺženi rotorov TG –systém BENTLY NEVADA	nefunkčné, odpojené od napájania
Systém meraní teplôt ložísk TG – DIAMO	nefunkčné, odpojené od napájania
Filtračné zariadenie cirkulačnej vody–TAPROGGE –riadiaci systém	zdemontované
Meranie axiálneho posuvu ENČ –WEIR	nefunkčné, odpojené od napájania
Meranie čistoty vodíka v generátore CALDOS	nefunkčné, panel pod napätím
Meranie úniku vodíka v strojovni SIEGER	nefunkčné
Aparatúra BIAS-4 v objekte SO644-vodíkové hospodárstvo	v prevádzke – funkčné
Meranie chemických veličín v expreslaboratóriach -1bl.	nefunkčné, odpojené od napájania
Meranie L a vodivosti v ZNK- v prevádzke	funkčné, využíva projekt A5B1
Systém penohasenia-1.blok	v prevádzke – funkčné
Regulátor výkonu TVER pre TG11 a TG12	neprevádzkovaný
Regulačné obvody SO ako v R7	neprevádzkovaný

1.3.3 Zariadenie SKR - diagnostické systémy

ALÜS - Diagnostický systém dozorovania únikov PO	neprevádzkovaný
SMÚ-V - Diagnostický systém dozorovania únikov PO meraním vlhkosti	prevádzkovaný obojblokový systém
Dakel-LMS-2 - Diagnostický systém pre dozorovanie netesnosti parovodov PG a HPK	neprevádzkovaný
Dakel-Xedo-9 - Diagnostický systém dozorovania netesností potrubia HOPO	neprevádzkovaný
SVČ - Diagnostický systém pre detekciu voľných častí	neprevádzkovaný
SHCČ - Diagnostický systém HCČ	neprevádzkovaný
SÜS - Diagnostický systém monitorovania vibrácií	neprevádzkovaný

SVRD - Diagnostický systém vnútroreaktorovej diagnostiky	neprevádzkovaný
SNŠD - Diagnostický systém neutrónovo - šumovej diagnostiky	neprevádzkovaný
CÚZKPO - Diagnostický systém cyklického a únavového zaťaženia komponentov PO	neprevádzkovaný
Dakel-Xedo-3 - Diagnostický systém akustickej emisie	neprevádzkovaný

1.3.4 Zariadenie SKR - TPS

Pracovná stanica TIS – OSO	neprevádzkovaný
Pracovná stanica TIS - panel 10 BD1	neprevádzkovaný
Pracovná stanica TIS - panel 13 BD1	neprevádzkovaný
TOPRE QNX	neprevádzkovaný
TOPRE PC hlavný systém	neprevádzkovaný
TOPRE PC záložný systém	neprevádzkovaný
Technologický informačný systém (TIS) pre 1.blok	prevádzkovaný
Aktívne prvky TIS	prevádzkovaný
SYSCOM	prevádzkovaný
Ručné ovládanie pohonov bezp. systémov	

2 ZÁVER

Popísaný stav jednotlivých systémov a zariadení primárneho a sekundárneho okruhu 1. bloku v režime D1 je namanipulovaný zmenovým personálom podľa príslušných prevádzkových predpisov

3 POPIS STAVU SYSTÉMOV A ZARIADENÍ 2. BLOKU

Manipulácie na zosumarizovaný stav jednotlivých systémov a zariadení primárneho a sekundárneho okruhu 2. bloku v režime D1 v tejto informácii sú uvedené v príslušných technologických prevádzkových predpisoch pre dané jednotlivé systémy a zariadenia primárneho a sekundárneho okruhu 2. bloku.

3.1 POPIS STAVU SYSTÉMOV A ZARIADENÍ STROJNEJ ČASTI PRIMÁRNEHO A SEKUNDÁRNEHO OKRUHU 2. BLOKU

3.1.1 Hlavné výrobné zariadenie primárnej a sekundárnej časti

Druhý reaktorový blok JE V-1 (a s tým súvisiace zariadenie) je odstavený z prevádzky od 31.12.2008 na základe Vyhlásenia Slovenskej vlády č. 801/1999 zo dňa 14. septembra 1999.
Tomuto rozhodnutiu je prispôsobený stav, prevádzkyschopnosť a prevádzkovanie ešte potrebných zariadení pre režim D1 na 2. bloku JE V-1, ktoré sú popísané v nasledujúcom texte.

3.1.1.1 Zariadenia strojnej časti PO

Názov systému	Stav systému	Zaplnené médiom	OaB
PO	RE60Z-1 – vyvezené palivo, zmontovaný, neutesnený, zaplnený demivodou pod HDR. HCČ, PCČ, VHCČ el. zaistené. HUA otvorené, el. odistené. Trasy HOP zatvorené, el. zaistené.	Demivoda	nie
KP	Armatúry vstreku zatvorené, el. zaistené. PVKO prevádzkyschopné. Odvzdušnenie KO DR80A-1 otvorené. BN prázdna, odsávanie zatvorené, trvale na drenáži. Armatúry prívodu N do KO a PVKO zatvorené.	prázdny	nie
ŠOV-1	Odpojená od PO. Armatúry el. zaistené.Otvorené odvzdušnenia filtrov RE61-66A-3,4 zatvorené, el. odistené. Stav armatúr rovnaký ako pre Režim 7 podľa 2-TPP-261, Príloha č.9.1.	Ionexy a ČK	nie
PG	PG zaplnené na max. hladinu, otvorené odvzdušnenia. Armatúry odluhov a odkalov zatvorené a el.zaistené. Čerpadlo PG80Č-1 el. odistené. Systém odluhov,a odkalov PG odstavený z prevádzky podľa PP 2-TPP-256. Prevádzkyschopný len chladič PG70T-1.	Demivoda	nie
ND	Čerpadlá ND el. zaistené. Prevádzkyschopné pre dopĺňanie PO.	ČK	nie
SA	SA60Č-1 el. zaistené. SA60N-1 prázdna. Systém odstavený z prevádzky.	prázdny	nie
BA	BS zaplnený na nom. hladinu s demivodou, v BS 2. bloku sú uložené tieniace kazety. Čerpadlá el. zaistené.	Demivoda	nie
BK	Systém BK80 zdrenážovaný. Čerpadlo el. zaistené. Armatúry zatvorené.	prázdny	nie
MČ	Čerpadlá el. zaistené. Armatúry zatvorené a el. zaistené.	prázdny	nie
MS	Čerpadlá el. zaistené. Armatúry zatvorené a el. zaistené.	prázdny	nie

Názov systému	Stav systému	Zaplnené médiom	OaB
HD	Nádrž HD60N-1 prázdna. Čerpadlá HDV, HDN el. zaistené. Armatúry HOPO zatvorené, el. zaistené. Armatúry HDV, HDN zatvorené.	prázdny	nie
SS	Čerpadlá SS el.zaistené.	prázdny	nie
HNÚ	Čerpadlá HD95, ŠH60 el. odistené. Systém prevádzkyschopný podľa 2-TPP-252.		nie
TV	TV v prevádzke na BA80,90Č-1, ČD61,62Č-1, ČN30,40. TV na ostatné spotrebiče zatvorená.	TV	nie
TVD	TVD na ND čerpadlá v prevádzke. TVD na BA chladiče odstavená. TVD na systém HD a SR-65 odstavená. TVD v R045/2 z dôvodu podchádzania klapiek v prevádzke.	TV	nie
SV61	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z RS, BV, BS.	-	áno
SV62	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z hermetických priestorov.	-	áno
SV64	Prevádzkyschopné. Systém odsáva vzduch z hermetických priestorov (opravárenská ventilácia). Podľa potreby prevádzkovať podľa 5-TPP-265	-	nie
SV66	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z miestnosti R045/2.	-	áno
SR61	Motory ventilátorov odstavené, el. zaistené. Klapky TV70A-30,31 zatvorené.	TV	nie
SR62	V prevádzke podľa 5-TPP-265. Systém zabezpečuje prívod vzduchu na BV.	-	nie
SR63	V prevádzke podľa 5-TPP-265. Systém zabezpečuje prívod vzduchu na BS.	-	nie
SR64	Motor ventilátora SR64Č-1 odstavený z prevádzky, el. zaistený. Ručne ovládané klapky TV70A-41,42,49,50 zatvorené.	TV	nie
SR65	Motory ventilátorov SR65Č-1÷ 6 el. zaistené. TVD na chladiče odstavená – sú zatvorené ručné klapky TVD62A-1÷ 12.	TV	nie
SV03	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z miestností technologického zariadenia 1. a 2. bloku.	-	áno
SV05	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z ventilačného centra 1. a 2.bloku.	-	áno
P9	V prevádzke podľa 5-TPP-265. Systém slúži na klimatizáciu dozorne reaktorovne.	-	áno
P6	Systém je prevádzkyschopný. Systém slúži na prívod vzduchu do skafandrov, podľa potreby prevádzkovať podľa 5-TPP-265.	-	áno
V14a	V prevádzke podľa 5-TPP-265. Systém odsáva vzduch z miestností určených pre prevádzkový personál.	-	nie
Pozn.	Ostatné vzduchotechnické systémy pre BPP a KRAO zostávajú v prevádzke podľa 5-TPP-265.		

Názov systému	Stav systému	Zaplnené médiom	OaB
ČS	Systém odstavený z prevádzky. Uzatvorené hraničné armatúry.(2-TPP-256).	Demivoda	nie
ČD	Systém v prevádzke bez zmien podľa 5-TPP-270	Prevádzkové médiá	áno
ČN	Systém v prevádzke bez zmien podľa 5-TPP-269	Prevádzkové médiá	áno
ČB	Systém v prevádzke bez zmien podľa 1-TPP-257, 2-TPP-257	Prevádzkové médiá	áno
RB	Systém v prevádzke bez zmien podľa 5-TPP-267	Prevádzkové médiá	áno
PR	V prevádzke (podľa 5-TPP-271) – okrem: -odstavené zaistené čerpadlá: PR76Č-1,2 PR77Č-1,2 -vyprázdnené nádrže: PR14,15,17N-1,PR26N-1,2,3,PR27N-1	Prevádzkové médiá	áno
ČP	Systém sa prevádzkuje podľa 5-TPP-266	Prevádzkové médiá	áno
DZ	Systém rozvodu DZ v prevádzke bez zmien.	Médium podľa potreby	áno
ČK	Systém v prevádzke bez zmien podľa 5-TPP-258	áno	áno
TC13	DEKONTAMINÁCIA Systém dekontaminácie zostáva v prevádzke v plnom rozsahu. Dekontaminačné práce sú vykonávané dodávateľsky na základe zmluvy.	Dekontaminačné roztoky, prípadne ČK	áno
TC24	ZLOŽISKO PEVNÝCH A KVAPALNÝCH RAO Stáčacia stanica KRAO – v nominálnej prevádzke podľa 5-TPP-268.	-	áno
RČA	Na vretenách RČA (2.07.1.101.11÷66) namontované po 1 ks zaisťovacích segmentov, ponechané po strate tlaku oleja v medzipolohe vymedzenej osadenými segmentami. Servopohony RČA el. zaistené.	Demivoda	nie
RBA	Armatúry ponechané v otvorenom stave. Servopohony RBA (2.07.1.103.1-6) el. zaistené.	Demivoda	nie
SHN do PG	Armatúry (2.0 7.1.105.1÷6) ponechané v zatvorenom stave. Servopohony SHN do PG el. zaistené.	Demivoda	nie
PSA PG	Uzatváracie armatúry (2.07.1.106.1-6) a regulačné ventily ponechané(2.07.1.350.1-6) v zatvorenom stave. Servopohony uzatváracích armatúr a regulačných ventilov el. zaistené.	Demivoda	nie
IPV PG	Uzatvorením armatúr 2.07.2.521.1 a 2.07.2.521.2 odstavený zaistený vzduch na napájanie riadiacich prístrojov 2RP07.1.701.1-6 a 2RP07.1.702.1-6. IPV PG 2.07.1.701.1-6, 2.07.1.702.1-6 a 2.07.1.703.1-6 ponechané v tzv. pružinovom režime.	Demivoda	nie
HZ	Uzatvorená, nezahermetizovaná. Prácou SV62Č-3 (SV62Č-1,2) udržiavaný podtlak cca 180 Pa. V odôvodnených prípadoch je možné vykonávať potrebné činnosti (kontrola, údržba, priemyselné čistenie zariadení, atď.).	-	

Zariadenia strojnej časti sekundárneho okruhu - Parné turbíny TG21, TG22 s príslušenstvom

Názov systému	Stav systému	Zaplnené médiom	OaB
Turbogenerátor TG21, TG22	odstavené z prevádzky, vychladené, zrušené vákuum, odtlakované - otvorené EA 2.04.1.162.1,2 – rušič vákua, vypustené	-	nie
Olejový systém TG21, TG22	odstavené všetky olejové čerpadlá olejového systému TG21,22, olej z chladičov mazacieho oleja CHO TG, OH generátora, potrubí, sifónu od generátora zdrenážovaný do HON TG21,22, olej z HON TG21,22 úplne vypustený do centrálneho OH obj.621	-	nie
Hlavné kondenzátory HK TG21,22	odstavené z prevádzky, vychladené po strane CCHV – vstupné UK 2.04.1.136.1-4 zatvorené, výstupné UK 2.04.1.137.1-4 zatvorené - HK TG21,22 po strane CCHV odtlakované, vypustené Vodné komory HK TG21,22 zatvorené	-	nie
	odstavené z prevádzky, vychladené, odtlakované po strane kondenzátu – zostatkové prevádzkové hladiny v K1 a K2 HK vypustené	-	nie
Kondenzátne čerpadlá KČ TG21, TG22	odstavené z prevádzky, 6kV elektropohony elektricky zaistené, odtlakované, vypustené	-	nie
Systém hlavného kondenzátu TG21, TG22	odstavené z prevádzky, odtlakované, vypustené	-	nie
Čerpadlá vodoprúdových vývev ČVV TG21, TG22	odstavené z prevádzky, 6kV elektropohony elektricky zaistené	-	nie
Jamy vývev TG21,TG22	odstavené z prevádzky, vypustené	-	-
Vákuový systém TG21, TG22	odstavené z prevádzky, odtlakované, vypustené	-	nie
Ventilátory komínkovej pary VKP TG21, TG22	odstavené z prevádzky	-	nie
Upchávkový systém TG21, TG22	odstavené z prevádzky, odtlakované, vypustené	-	nie
Komínkový systém TG21, TG22	odstavené z prevádzky, odtlakované, vypustené	-	nie
Systém separácie a prihrievania pary SPP TG21, TG22	odstavené z prevádzky, prirodzene vychladnuté, odtlakované, vypustené	-	nie
Podávacie čerpadlá separátu	odstavené z prevádzky, elektromotory PČS elektricky zaistené, odtlakované, vypustené	-	nie

Názov systému	Stav systému	Zaplnené médiom	OaB
PČS TG21, TG22			
NT-regenerácia TG21, TG22	odstavené z prevádzky, prirodzene vychladnutá, po strane hlavného kondenzátu vypustená, po parnej strane odtlakovaná, vypustená	-	nie
Podávacie čerpadlá kondenzátu PČK TG21, TG22	odstavené z prevádzky, elektromotory PČK elektricky zaistené, odtlakované, vypustené	-	nie
VT-regenerácia TG21, TG22	odstavené z prevádzky, prirodzene vychladnutá, po strane napájacej vody vypustená, po parnej strane odtlakovaná, vypustená	-	nie
Kolektor pre spotrebiče CCHV TG21, TG22	odstavené z prevádzky, odtlakované, vypustené UK 2.07.2.174.1-4 do kolektorov spotrebičov TG21,22 zatvorené, potrubia prívodov CCHV za UK174 vypustené, chladiče CHVO GEN G1 a G2 po strane CCHV - vstupné armatúry zatvorené, výstupné armatúry zatvorené, chladiče po strane CCHV vypustené, chladiče CHO mazacieho oleja TG21,22 po strane CCHV - vstupné armatúry zatvorené, výstupné armatúry zatvorené, chladiče po strane CCHV vypustené, všetky chladiče CHVO GEN G1 a G2, chladiče CHO mazacieho oleja TG21,22 zaistené na Z-príkazy na otvorenie viek chladičov na vysušenie (pasivácia trubkových zväzkov prirodzenou cirkuláciou vzduchu).	-	nie

Napájacia stanica 2. bloku

Názov systému	Stav systému	Zaplnené médiom	OaB
ENČ 21-25	odstavené z prevádzky, 6kV elektropohony elektricky zaistené čerpadlá ENČ po strane napájacej vody odtlakované, vypustené olej z olejových nádrží OH ENČ prečerpaný do centrálneho OH obj.621	-	nie
HNČ 21,22	odstavené z prevádzky, 6kV elektropohony elektricky zaistené, čerpadlá HNČ po strane napájacej vody odtlakované, vypustené	-	nie
Systém dávkovania čpavku DČ NH_3 2. bloku do sania ENČ	odstavené z prevádzky, odtlakované, vypustené	-	nie
Potrubia CCHV pre ENČ 2. bloku	odstavené z prevádzky, odtlakované, vypustené EA 2.07.2.168.1,2 prívodu CCHV pre ENČ 2. bloku zatvorené. EA 2.07.2.169.1,2 odvodu CCHV z ENČ 2. bloku zatvorené. Prívodné potrubia CCHV pre ENČ, ENČ po strane CCHV, odvodné potrubia CCHV z ENČ vypustené	-	nie

Dochladzovanie PO 2. bloku

Názov systému	Stav systému	Zaplnené médiom	OaB
Dochladzovanie PO 2. bloku	odstavené z prevádzky, elektromotory DČ elektricky zaistené, odtlakované, vypustené	-	nie

Centrálna čerpacia stanica CČS V-1 – terciárny okruh CCHV

Názov systému	Stav systému	Zaplnené médiom	OaB
Čerpadlá cirkulačnej chladiacej vody 6DR č.1-4	odstavené z prevádzky, 6kV elektropohony elektricky zaistené	Zavodnené CCHV	nie
Poznámka	Zariadenie namanipulované podľa technologického prevádzkového predpisu 5-TPP-366 Centrálna čerpacia stanica		

Chladiace veže CHV V-1 – terciárny okruh CCHV a vratná TCHV z dochladzovania

Názov systému	Stav systému	Zaplnené médiom	OaB
Chladiace veže CHV č. 1-4	odstavené z prevádzky 3 CHV - armatúry na sprchy a obtoky do bazéna CHV č.1,2,4 zatvorené, **Po trvalom odstavení 2.bloku na dochladzovanie prepnúť CHV č.3 - v prevádzke zostane chladiaca veža č.3 z dôvodu vratnej TCHV do terciárneho okruhu CCHV.**	zaplnené CCHV	áno

3.1.1.2 Ostatné zariadenia sekundárneho okruhu

Popisuje ostatné zariadenia na sekundárnom okruhu JE V-1 hlavne na vonkajších zariadeniach.

Nábehová a rezervná kotolňa NaRK V-1

V prevádzkyschopnom stave podľa TPP. Rozdeľovač pary v NaRK V-1 slúži na distribúciu dodávanej pary

z JE V-2 do CZT – VS pre JAVYS, a.s., do prevádzok VYZ a prípadne do prevádzok V-1.
Ak budú parné kotle K-1, K-2, K-3, K-4 odstavené, trvale ich držať v horúcej rezerve na cudziu paru z parovodu V-1/V-2.

Dusíkové hospodárstvo V-1

Dusíkové hospodárstvo nie je v prevádzke. Odstavené v rámci projektu A 5 - D

Kondenzáty z odvodnení spoločných parovodov a zo spoločných prevádzok V-1

Kondenzáty z odvodnení prepoja kolektorov 0,7 MPa medzi blokmi, para na ŠOV 3,4 odvedené do ZNK 1. bloku.
Kondenzáty zo ŠOV-3,4 (ČN30,40) odvedené do ZNK 1. bloku.
Kondenzát z kondenzátneho potrubia parovodov z PK-11,17, vratný kondenzát zo špeciálnej práčovne, kondenzát z odvodnení parovodu NaRK – HVB V-1 v obj.490 V-1 na 1. bloku a z parovodu do CHÚV v obj.490 V-1 na 1. bloku, RS 1,2/0,7 MPa a odvodnení VS490/1, vratný kondenzát o ohrievačov VS490/1 trvale odvádzať cez zbernicu odvodnení TG11, TG12 cez otvorené uzatváracie dve rA 1.07.2.964.1,2 na potrubiach DN200 spoločného prívodu kondenzátu zo zberníc odvodnení parovodov TG11,TG12 do expandérov ZNK 1. bloku. Zatvorená bude rA 2.07.2.851.1 prepoja zberníc odvodnení 1. a 2.bloku do ZNK (od 2.bloku).
Kondenzát zo ZNK 1. bloku prečerpávať novými kondenzátnymi čerpadlami ZNK 1. bloku 1.07.2.22.1,2 do JE V-2. Diaľkovo v automatickom režime ovláda TP-VZ z touch-panela (dotykový panel) na BD 1. bloku. Núdzovo môže ovládať miestne SEZ - zariadení SO - zmenový Re a VZT, pričom treba brať do úvahy nepôsobenie automatík z miesta.

Kolektor 0,7 MPa 2. bloku

Kolektor 0,7 MPa 2. bloku je odstavený z prevádzky podľa 2-TPP-357 Pomocné okruhy TG 220 MW, kapitola 3.8.7 - Prevádzka kolektora 0,7 MPa v dlhodobom režime 7.

Prepoj kolektorov 0,7 MPa medzi blokmi

Prepoj kolektorov 0,7 MPa medzi blokmi v štandardnom režime napájaný parou od NaRK V-1 parovodom okolo ČS TVD cez novú RS 1,2/0,7 MPa na 2.bloku, v náhradnom režime napájaný parou od NaRK V-1 parovodom v potrubnom kanáli PK-11,17 cez pôvodnú RS 1,2/0,7 MPa na 1.bloku, kolektor 0,7 MPa 1. bloku.
Z prepoja kolektorov 0,7 MPa medzi blokmi dodávať paru do:

- parovodu pre ŠOV-3,4,
- parovodu do CHÚV (<u>malá RS v strojovni na 1. bloku zatvorená</u>),
- parovodu do špeciálnej práčovne,
- parovodmi do PO na dekontamináciu (v prípade potreby).

Odovzdávacia stanica OS490/1

V prevádzke zberač a rozdeľovač obehovej vykurovacej vody OS490/1 napájaný z vetvy č.9 obehovej vykurovacej vody.

Výmenníková stanica VS490/2

Výmenníková stanica VS490/2 vyradená z prevádzky, kondenzátne čerpadlá zaistené, odtlakované a zdrenážované po pare a vykurovacej vode.

Ostatné zariadenia 2. bloku v strojovni V-1

Po trvalom odstavení 2.reaktorového bloku JE V-1 prevádzkovať odvod TCHV na riedenie odpadných vôd v socomane z technologického kondenzátora TK č. 1, príp. TK č. 2 cez rA 1.07.2.609.1 (2). Uzatváracie rA odluhov CCHV z TG12 a TG21 trvale zatvorené.
TP-VZ V-1 spolu s Technikom radiačnej bezpečnosti – vedúcim zmeny V-1 ekonomicky riadiť riedenie nízkoaktívnych odpadov, príp. iných odpadových vôd do Socomanu. Prietok cez čerpadlá dozimetrickej kontroly OV do SC je tvorený odpadovými vodami z ČOV – Bioclár a sanačným čerpaním vrtov A-1. V čase, keď nie je vypúšťanie nízkoaktívnych odpadovz JE V-1, odvod TCHV na riedenie odpadných vôd v socomane z technologického kondenzátora TK č. 1, príp. TK č. 2 cez rA 1.07.2.609.1 (2) je odstavený.
Vychladzovacia nádrž a čerpadlo VN 1. bloku k dispozícii v automatickom režime pre prípad prepadu kondenzátu zo ZNK 1. bloku.

Chemická úprava vody CHÚV V-1

Spoločná prevádzka – použitie pre 1. a 2.blok aj spoločné prevádzky JE V-1 podľa TPP na výrobu demi-vody.

Superhavarijné napájanie PG - SHNČ

SHNČ odstavené z prevádzky, zaistené, trasy zdrenážované.

Vzduchotechnické systémy VZT 2. bloku

Bez obmedzenia trvale alebo podľa potreby v prevádzke podľa TPP.

Chladiaca stanica havarijnej vzduchotechniky TRANE 2. bloku
Bez obmedzenia podľa potreby v prevádzke podľa TPP.
Dieselgenerátorová stanica pre 2. blok – DG1, DG3, a DG5
Podľa KUP dieselgenerátory DG1, DG3 v studenej rezerve.
TVD 1. a 2. podsystém
Bez obmedzenia podľa potreby v prevádzke podľa TPP.
Okruh TCHV JE V-1
Bez obmedzenia v prevádzkyschopnom stave podľa TPP 1. a 2.vetva TCHV pre 1. a 2.blok JE V-1 aj spoločné prevádzky.
Prevádzkovať len jedno čerpadlo technickej vody.
AT-stanica a rozvod požiarnej vody JE V-1
Bez obmedzenia podľa potreby v prevádzke podľa TPP.

3.2 POPIS STAVU SYSTÉMOV A ZARIADENÍ ELEKTROČASTI PRIMÁRNEHO A SEKUNDÁRNEHO OKRUHU 2. BLOKU

Druhý reaktorový blok JE V-1 (a s tým súvisiace elektrické zariadenie) je odstavený z prevádzky od 31.12.2008 na základe Vyhlásenia Slovenskej vlády č. 801/1999 zo dňa 14. septembra 1999.
Tomuto rozhodnutiu je prispôsobený stav, prevádzkyschopnosť a prevádzkovanie ešte potrebných elektrozariadení pre režim D1 na 2. bloku JE V-1, ktoré sú popísané v nasledujúcom texte.

3.2.1 Rezervné napájanie (T1R, T2R)

Systém rezervného napájania 2. bloku je zdrojom elektrickej energie pre všetky spotrebiče JE V1, aj keď požiadavky na rezervné napájanie sú značne redukované. JE V1 je napájaná z transformátora T1R alebo T2R.
V prípade napájania VS 2. bloku z transformátora T2R a VS 1. bloku z transformátora T1R sú spojky rezervných prípojníc 6 kV A1-A2, B1-B2 rozopnuté, AZR je obojstranný a navolený.
V prípade napájania VS obidvoch blokov súčasne len z jedného transformátora T1R alebo T2R sú príslušné spojky rezervných prípojníc 6 kV medzi 1. a 2. blokom zopnuté, to znamená, že rezervné prípojnice 6 kV 1. a 2. bloku sú prepojené.

Zaistené napájanie II. kategórie 6 kV

Pod napätím zostávajú v prevádzke obidve sekcie rd6-08.21 a rd6-08.22 z dôvodu zaistenia napájania úsekových rozvádzačov 0,4 kV. Navyše sekcia rd6-08.22 zabezpečuje napájanie sekcie r6-08.22b, ktorá napája rezervný transformátor T20R pre rozvádzače 0,4 kV 1. bloku.
V prevádzke sú nasledovné zariadenia:

- zopnuté spínače N02.21d a N02.21b (sekcia r6-08.21b pod napätím),
- zopnuté spínače N02.22d a N02.22b (sekcia r6-08.22b pod napätím),
- zopnuté spínače na transformátore X.T23d (rozvádzač X.rd0,4-08.21 pod napätím).
- zopnuté spínače na transformátore Y.T24d (rozvádzač Y.rd0,4-08.22 pod napätím).

Prevádzkyschopná pod napätím zostáva aj sekcia r6-08.23 so všetkými príslušnými vypínačmi.
Sekcie rd6-08.21,22 a r6-08.23 sa prevádzkujú v zmysle predpisu 2-TPP-452. Dieselgenerátory DG1,DG3 sú v režime revízia podľa 2-TPP-450 a ich 6kV vypínače sú zaistené.

3.2.3 Nezaistené napájanie 6 kV

Aj po vyvezení jadrového paliva z BS 2. bloku zostáva naďalej v prevádzke systém 6 kV nezaisteného napájania, potrebný zväčša pre napájanie rozvádzačov 0,4 kV.
Systém 6 kV nezaisteného napájania je v prevádzke nasledovne:

- **Sekcie rg6-08.21 a rg6-08.22** sú vypnuté a zaistené
- **Sekcia r6-08.21a** v prevádzke v štandardom režime, napájaná z prípojnice rezervného napájania A2. Hlavnou úlohou tejto sekcie je napájanie transformátorov T58 pre centrálnu čerpaciu stanicu a T60 pre prevádzkovú budovu.
- **Sekcia r6-08.22a** v prevádzke v štandardom režime, napájaná z prípojnice rezervného napájania B2. Hlavnou úlohou tejto sekcie je napájanie transformátorov 9CT02 pre MSVP a T56 pre nábehovú a rezervnú kotolňu.
- **Sekcia r6-08.21b** v prevádzke v štandardom režime, napájaná zo sekcie rd6-08.21. Hlavnou úlohou tejto sekcie je napájanie transformátora T54 kompresorovej a chladiacej stanice.

- **Sekcia r6-08.22b** je v prevádzke v štandardom režime, napájaná zo sekcie rd6-08.22. Hlavnou úlohou tejto sekcie je napájanie transformátora T20R pre rezervné napájanie systému 0,4 kV 2. bloku a svetelných a úsekových rozvádzačov.
  Systém 6 kV nezaisteného napájania 2. bloku je v prevádzke v zmysle predpisu 2-TPP-452.
  Napájanie systému 6 kV nezaisteného napájania je zabezpečené z rezervného transformátora T1R alebo T2R.

3.2.4 Zaistené napájanie I. kategórie

Systém I.kategórie zaisteného napájania je v prevádzke v nasledovnom rozsahu okrem motorgenerátorov X.MG-08.21 a Y.MG-08.22:
1. Systém zaisteného napájania I. kategórie X. redundancie t.j.:
- úsekový rozvádzač SYZAN I. kategórie 0,4 kV (X.rz0,4-08.21),
- usmerňovač X.US21,
- úsekový rozvádzač 220 V = (X.ru220-08.21, ru 220-08.21)
- batériová napájacia skriňa X.BES21,
- akubatéria AKU21
2. Systém zaisteného napájania I. kategórie Y redundancie t.j.:
- úsekový rozvádzač SYZAN I.kategórie 0,4 kV (Y.rz0,4-08.22),
- usmerňovač Y.US22,
- úsekový rozvádzač 220 V = (Y.ru220-08.22, ru220-08.22),
- batériová napájacia skriňa Y.BES22,
- akubatéria AKU22

Podružné rozvádzače systému 0,4 kV zaisteného napájania zostávajú prevádzkyschopné. V prípade elektrického zaistenia (znefunkčnenia) všetkých spotrebičov patriacich k príslušnému rozvádzaču bude príslušný rozvádzač (vrátane úsekového) zaistený a označený v súlade s prevádzkovým predpisom 2-TPP-453.

Zaistené napájanie II. kategórie 0,4 kV

Úsekové rozvádzače II. kategórie zostávajú napájané z príslušných 6 kV sekcií. V prípade výpadku nadradenej sekcie 6 kV je možné obnovenie napájania úsekových rozvádzačov
Xrd0,4-08.21 a Yrd0,4-08.22 ručne, z rezervného prívodu alebo z príslušného DG.

Systém 0,4 kV zaisteného napájania zostáva v prevádzke v rozsahu, potrebnom pre prevádzku zostávajúceho zariadenia.

Systém pracuje v nasledovnom režime:
- Rozvádzač X.rd0,4-08.21 je napájaný zo sekcie rd6-08.21 s možnosťou prepnutia na rezervný prívod z r0,4-08.21,
- Rozvádzač Y.rd0,4-08.22 je napájaný zo sekcie rd6-08.22 s možnosťou prepnutia na rezervný prívod z r0,4-08.22.

Podružné rozvádzače systému 0,4 kV zaisteného napájania zostanú prevádzkyschopné. V prípade elektrického zaistenia (znefunkčnenia) všetkých spotrebičov patriacich k príslušnému rozvádzaču bude tento rozvádzač (vrátane úsekového) zaistený a označený v súlade s prevádzkovým predpisom 2-TPP-451.

Nezaistené napájanie 0,4 kV

Systém 0,4 kV nezaisteného napájania je v prevádzke ako hlavný rozvodný systém pre 0,4 kV spotrebiče 2.bloku JE V1.

Rozvádzače r0,4-08.23 a r0,4-08.24 sú vypnuté a zaistené.

Podružné rozvádzače systému 0,4 kV nezaisteného napájania zostanú prevádzkyschopné. V prípade elektrického zaistenia (znefunkčnenia) všetkých spotrebičov patriacich k príslušnému rozvádzaču, bude tento rozvádzač (vrátane úsekového) zaistený a označený v súlade s prevádzkovým predpisom 5-TPP-462.

3.2.7 Rezervné napájanie na úrovni 0,4 kV medzi blokmi

Systém rezervného napájania rozvádzačov 0,4 kV medzi blokmi je v prevádzke z dôvodu zabezpečenia rezervného napájania rozvádzačov 0,4 kV.

V prevádzke zostávajú oba transformátory T20R (napájaný z r6-08.22b) a T30R (napájaný z r6-08.12b) a všetky spoločné rozvádzače 0,4 kV. Tieto budú napájané štandardne z príslušných sekcií 6 kV cez transformátory 6,3/0,4 kV. V prípade výpadku základného zdroja bude napájanie týchto rozvádzačov zabezpečené z transformátorov T30R a T20R.

Systém rezervného napájania na úrovni 0,4kV medzi blokmi prevádzkovať v zmysle predpisu 5-TPP-462.

Rozvodňa R713

Z dôvodu zabezpečenia napájania r6-08.23, III. sieťového prípoja V2 a vonkajších objektov je nutné ponechať rozvodňu R-713 pod napätím pre prevádzku zostávajúceho zariadenia.
Rozvodňu R-713 prevádzkovať podľa predpisov 5-TPP-460, 5-TPP-454 a 5-TPP-471.

3.2.9 Penohasenie

Systém penohasenia zostáva v plnom rozsahu v prevádzke a jeho obsluha sa vykonáva podľa prevádzkového predpisu 5-TPP-474 Penohasenie.

3.3 POPIS STAVU SYSTÉMOV A ZARIADENÍ SKR PRIMÁRNEHO A SEKUNDÁRNEHO OKRUHU 2. BLOKU

Meracie obvody (tlaku,tlak.diferencie, teploty, hladiny, prietoku atď) sú udržiavané v prevádzkyschopnom stave ak je v prevádzke príslušná technológia

3.3.1 Zariadenie SKR PO

V nasledujúcom popise je uvedený stav SKR systémov :

Názov systému	**Stav**
Systémy SOTN,SOTH RS bez el. napájania	neprevádzkované, odpojené výstupy,
Meranie hladiny v TNR reaktora – PAMS	nefunkčné, odpojené od napájania
Meranie n-toku KNI	nefunkčné, odpojené od napájania
Meranie teplôt na výstupe palivových kaziet VRK	nefunkčné
Merania systému PAMS – panely zapisovačov odpojené od napájania	zapisovače neprevádzkované -
Meranie vodíka v barbotážnej nádrži	v prevádzke – funkčné
Meranie vodíka v nádrži nečistého kondenzátu, v jímke únikov	nefunkčné - vypnuté
Systémy SKR umiestnené na DR, m.č.V113	v prevádzke – funkčné
Meranie na VZT systémoch v KP na +10,5m (V-centrum)	v prevádzke – funkčné
Meranie n-toku 1. a 2. redudancia TXS	neprevádzkované
Riadiaci systém ochrany reaktora – TELEPERM-XS /RTS, ESFAS, ROM/ technológie zaistené	prevádzkovaný – výstupy do
1. a 2. redudancia TXS	
Regulátor výkonu /ARM/	neprevádzkovaný
Reaktimeter	neprevádzkovaný
Systém ochrany a riadenia reaktora /SORR/	neprevádzkovaný
Zariadenie na meranie doby pádu HRK /PPK-HRK/	neprevádzkovaný
Regulačné obvody PO	neprevádzkovaný
SKR pre reguláciu VZT systémov a požiarnych klapiek	prevádzkovaný

3.3.2 Zariadenie SKR SO

Meranie hladiny nafty a monitorovanie únikov nafty	v prevádzke – funkčný
Ochrany turbogenerátora TG21,22	nefunkčné, odpojené od napájania
Diagnostický a monitorovací systém chvení a predĺžení rotorov TG –systém BENTLY NEVADA	nefunkčné, odpojené od napájania
Systém meraní teplôt ložísk TG – DIAMO	nefunkčné, odpojené od napájania
Filtračné zariadenie cirkulačnej vody–TAPROGGE –riadiaci systém	nefunkčné, zdemontované
Meranie axiálneho posuvu ENČ –WEIR	nefunkčné, odpojené od napájania
Meranie čistoty vodíka v generátore CALDOS	nefunkčné, odpojené od napájania
Meranie úniku vodíka v strojovni SIEGER	nefunkčné, odpojené od napájania

Meranie chemických veličín v expreslaboratóriach -2.bl. neprevádzkované, odpojené od napätia

Meranie L a vodivosti v ZNK	v prevádzke – funkčné
Systém penohasenia- 2.blok	v prevádzke – funkčné
Regulátor výkonu TVER pre TG21 a TG22	neprevádzkovaný
Regulačné obvody SO	neprevádzkovaný

3.3.3 Zariadenie SKR - diagnostické systémy

ALÜS - Diagnostický systém dozorovania únikov PO	neprevádzkovaný
SMÚ-V - Diagnostický systém dozorovania únikov PO meraním vlhkosti	prevádzkovaný
Dakel-LMS-2 - Diagnostický systém pre dozorovanie netesnosti parovodov PG a HPK	neprevádzkovaný
Dakel-Xedo-9 - Diagnostický systém dozorovania netesností potrubia HOPO	neprevádzkovaný
SVČ - Diagnostický systém pre detekciu voľných častí	neprevádzkovaný
SHCČ - Diagnostický systém HCČ	neprevádzkovaný
SÜS - Diagnostický systém monitorovania vibrácií	neprevádzkovaný
SVRD - Diagnostický systém vnútroreaktorovej diagnostiky	neprevádzkovaný
SNŠD - Diagnostický systém neutrónovo - šumovej diagnostiky	neprevádzkovaný
CÚZKPO - Diagnostický systém cyklického a únavového zaťaženia komponentov PO	neprevádzkovaný
Dakel-Xedo-3 - Diagnostický systém akustickej emisie	neprevádzkovaný

3.3.4 Zariadenie SKR - TPS

Pracovná stanica TIS – OSO	neprevádzkovaný
Pracovná stanica TIS - panel 10 BD2	neprevádzkovaný
Pracovná stanica TIS - panel 13 BD2	neprevádzkovaný
TOPRE QNX	neprevádzkovaný
TOPRE X hlavný systém	neprevádzkovaný
TOPRE X záložný systém	neprevádzkovaný
Technologický informačný systém (TIS) pre 2.blok	prevádzkovaný
Aktívne prvky TIS	prevádzkovaný
SYSCOM	prevádzkovaný
Ručné ovládanie pohonov bezp. systémov	

4 ZÁVER

Popísaný stav jednotlivých systémov a zariadení primárneho a sekundárneho okruhu 2. bloku v režime D1 je namanipulovaný zmenovým personálom podľa príslušných prevádzkových predpisov.

5 SKRATKY

BD	-	bloková dozorňa
CČS	-	centrálna čerpacia stanica
CCHV	-	cirkulačná chladiaca voda
CZT	-	centrálne zásobovanie teplom
ČVV	-	čerpadlo vodoprúdovej vývevy
DČ NH_3	-	dávkovacie čerpadlo čpavku
DG	-	dieselgenerátor
EA	-	armatúra s elektrickým pohonom
ENČ	-	elektronapájacie čerpadlo
GEN	-	generátor
HK	-	hlavný kondenzátor
HNČ	-	havarijné napájacie čerpadlo
HON	-	hlavná olejová nádrž
HVB	-	hlavný výrobný blok
CHO	-	chladič oleja
CHÚV	-	chemická úprava vody
CHV	-	chladiaca veža
CHVO	-	chladič vloženého okruhu
JAVYS, a.s.	-	Jadrová a vyraďovacia spoločnosť, akciová spoločnosť
JE	-	jadrová elektráreň
KČ	-	kondenzátne čerpadlo
KUP	-	koncepcia ukončovania prevádzky
MSVP	-	medzisklad vyhoretého paliva
NaRK	-	nábehová a rezervná kotolňa
NT	-	nízkotlaková
obj.	-	objekt
OH	-	olejové hospodárstvo
OV	-	odpadová voda
PČK	-	podávacie čerpadlo kondenzátu
PČS	-	podávacie čerpadlo separátu
PG	-	parogenerátor
PK	-	potrubný kanál
PO	-	primárny okruh
rA	-	ručná armatúra
Re	-	reaktor
RS	-	regulačná stanica
SEZ	-	strojník energetických zariadení
SC	-	socoman
SHNČ	-	superhavarijné napájacie čerpadlo
SPP	-	separátor – prihrievač pary
SO	-	sekundárny okruh
ŠO	-	špičkový ohrievák
ŠOV	-	špeciálna očistka vôd
TG	-	turbogenerátor
TCHV	-	technická chladiaca voda
TK	-	technologický kondenzátor
TPP	-	technologický prevádzkový predpis
TVD	-	technická voda dôležitá
UK	-	uzatváracia klapka
VN	-	vychladzovacia nádrž
TP-VZ	-	technik prevádzky – vedúci zmeny
VS	-	výmenníková stanica
VT	-	vysokotlaková
VZT	-	vzduchotechnika

VYZ	-	vyraďovanie zariadenia
ZNK	-	zberná nádrž kondenzátov
ZO	-	základný ohrievač
Z	-	príkaz-zabezpečovací príkaz