National Nuclear Fund for decommissioning of the nuclear installations and for handling of spent nuclear fuel and radioactive wastes

THE NATIONAL PROGRAMME FOR HANDLING OF SPENT NUCLEAR FUEL AND RADIOACTIVE WASTES IN SR

TABLE OF CONTENTS

Definitions of terms

Terms and abbreviations in this document with capital letter and noted in the left side of the following table correspond to the meaning explained in the right side of the table:

A1	corresponds to nuclear power plant A1 after shut down with the reactor of KS-150 type, was projected for electric output 143 MW and which is in the process of Decommissioning; in this document described also as „**JE A1**“
Atomic Act	corresponds to the Act No. 541/2004 Coll. on peaceful utilization of nuclear energy (Atomic Act) and on alteration and amendment of other regulations as amended ,what alters and amends the Act
BIDSF	corresponds to International Fund for Decommissioning of JE V1 (in English wording „Bohunice International Decommissioning Support Fund“)
EBRD	corresponds to the European Bank for Reconstruction and Development
EIA	corresponds to Environmental impact assessment
JE V1	corresponds to nuclear VVER power plant V1 owned by JAVYS a. s., in present in process of decommissioning located in Jaslovské Bohunice; in this document described also as „**JE V1**“ or „V1“
JE V2	corresponds to nuclear VVER power plant V2 in operation and owned by SE a. s. located in Jaslovské Bohunice; in this document described also as „**JE V2**“ or „V2“
EMO 12	corresponds to nuclear VVER power plant EMO 1, 2 in operation owned by SE, a. s. located in Mochovce; in this document described also as „**JE EMO 12**“ or „**EMO 1,2**“
EMO 34	corresponds to nuclear VVER power plant EMO 3, 4, in construction process owned by SE a. s. in Mochovce; in this document described also as „**JE EMO34**“ or „**EMO 3,4**“ or „**MO34**“
HVB A1	corresponds to main production unit of A1
IAEA	corresponds to International Atomic Energy Agency
JAVYS, a. s.	corresponds to Nuclear and Decommissioning Company, a. s.
JE	corresponds to nuclear installation designated for electricity production (nuclear power plant)
JESS	corresponds to Nuclear Energy Company Slovakia, a. s.
MW_e	corresponds to Megawatt electric (electric output unit of JE)
HANDLING OF VJP	corresponds to storage, reprocessing, transmutation, manipulation and disposal thereof
NEA	Nuclear Energy Agency of Organization for Economic Cooperation and Development
NJF	National Nuclear Fund
OECD	corresponds to Organization for Economic Cooperation and Development
PS	operation group of equipment

RAO	any not usable materials in gas, liquid or solid form, which cannot be released into environment for its content of radionuclides thereof or for level of contamination by radionuclides thereof
IRAO	corresponds to institutional RAO generated in works with sources of ionized radiation with exception of spent nuclear fuel and radioactive wastes from nuclear installations (it concerns RAO from utilization of radioactive sources basically in medicine, industry and research) and includes among others used sealed sources (**PUŽ**)
KRAO	corresponds to liquid RAO; term RAO includes among other also such types of KRAO: • **radioactive concentrates;** • **saturated sorbents;** • **sludges;** • **Chrompik A1**- corresponds to medium for aftercooling of VJP used for purposes of storage of VJP in DS A1 before using of Dowtherm A1; • **Dowtherm A1**- corresponds to medium for aftercooling of VJP used for purposes of storage of VJP in DS A1 after using of Chrompik A1.
Low-level RAO	corresponds to Low-level radioactive waste in scope pursuant to definition of § 5 letter c) of ÚJD SR regulation No. 30/2012 Coll.; in some parts of text of this document (for example in titles, in tables, in definitions of other terms) the term „Low-level RAO“ is described also as „LLW“
Low and intermediate-level RAO	corresponds to Low-level RAO a Intermediate-level RAO
PRAO	corresponds to solid RAO
Intermediate-level RAO	corresponds to intermediate-level radioactive waste pursuant to definition of § 5 letter d) of ÚJD SR regulation No. 30/2012 Coll.; in some parts of text of this document (for example in titles, in tables, in definitions of other terms) the term „Mediumlevel RAO“ is described also as „**ILW**“
Very low-level RAO	corresponds to very low-level radioactive wastes pursuant to definition § 5 letter b) of ÚJD SR No. 30/2012 Coll.;
	in some parts of texts of this document (for example in titles, in tables, in definitions of other terms) the term „Very Low-level RAO“ is described also as „**VLLW**“
High-level RAO	corresponds to Highactive RAO pursuant to definition § 5 letter e) of ÚJD SR regulation No. 30/2012 Coll.; in some parts of text of this document (for example in titles, in tables, in definitions of other terms) the term „High-level RAO“ is described also as „**HLW**“
ZRAM	corresponds to intercepted radioactive or nuclear materials, originator of which is not known
RÚVZ	corresponds to Regional Public Health Authority of The Slovak Republic
SE	corresponds to Slovak Power Stations, a. s.
Storage	corresponds to placement of RAO or VJP to compartments, objects or facilities enabling their isolation, control and environmental protection with intention to retrieve them subsequently

<table>
<tr><td rowspan="5">Repository</td><td colspan="2">corresponds to facility, compartment or object enabling isolation of RAO or VJP, control and environmental protection, whereby RAO or VJP are placed into this facility, object or compartment with intention to retrieve them subsequently;

There are these kinds of storage recorded at the territory of The Slovak Republic:</td></tr>
<tr><td>Interim spent fuel storage</td><td>corresponds to Storage of VJP in Jaslovské Bohunice site; in some parts of this document (for example in titles, in tables, in definitions of other terms) the term Interim spent fuel storage is described also as „MSVP“</td></tr>
<tr><td>Storages, which are subject of decommissioning</td><td>corresponds to following storehouses, which are subject of decommissioning:

Long term repository in A1 - corresponds to Storehouse intended for long term storage of VJP from A1 in Jaslovské Bohunice site; in some parts of text of this document (for example in titles, in tables, in definitions of other terms) the term „Long term repository A1“ is described also as „DS A1“

Short term repository in A1 - corresponds to Storehouse intended for short term storage of RAO and VJP from A1 in Jaslovské Bohunice site; in some parts of text of this document (for example in titles, in tables, in definitions of other terms) the term „Short term repository A1“ is described also as „KS A1“

Storage tank A1 – manipulating and storage tank, which is not part of A1; in some parts of text of this document the term „Storage tank A1“ is described also as „MSN“</td></tr>
<tr><td>Integral storage (planned)</td><td>corresponds to storage of RAO, which are not disposable in RÚ RAO; in some parts of text of this document (for example in titles, in tables, in definitions of other terms) the term „Integral storage“ is described also as „IS RAO“</td></tr>
<tr><td>Dry storage of VJP</td><td>corresponds to Dry Storage of VJP</td></tr>
<tr><td>Storage of IRAO and ZRAM (planned)</td><td>corresponds to Storage of IRAO and ZRAM</td></tr>
</table>

Processing of RAO	corresponds to activity focused on department of radionuclides from RAO, on change of its composition and on reduction of its volume with the objective to increase of safety and economical efficiency of its handling, pursuant to and in scope of § 7 of ÚJD SR Regulation No. 30/2012 Coll. (for example pressurized molding of RAO, combustion of RAO, concentration of RAO and so on)	
Processing facilities	corresponds to facilities intended for Classification and collection of RAO, Processing of RAO and Conditioning of RAO; at the territory of The Slovak Republic there are following facilities recorded:	
	Technologies for processing and conditioning of RAO	corresponds to nuclear installation with special permit of ÚJD, which is intended for Classification and Collection, Processing and Conditioning of RAO, which is not part of JE, which is described also as „**TSÚ RAO**“ located in Jaslovské Bohunice site; following facilities are part of the installation:
		Bohunice processing center – corresponds to facilities for Processing, Classification an Conditioning of RAO, resulting product of which are VBK commonly described as „**BSC“**; following facilities are part of these facilities: • Combustion facility (combustion of combustible KRAO and PRAO), • High pressure molding facility (molding of PRAO, especially of metal wastes), • facility for concentration (aftervaporizing of concentrates in vaporizer), • facility for conditioning of RAO by cementation into VBK, • facility for classification of PRAO.

		Bitumenation lines - correspond to bitumenation lines KRAO (line PS 44/I and line PS 100 in the object No. 809) with tanks and stores intended for processing of concentrates of ion resins and sorbents and bitumenation line for desaturated ionexes (PS 44/II); **Storage of RAO** in the object No. 723, in the object No. 32 (room No. 30/54, 97, 106) and in the object No. 34 (room No. 1); **The object No. 41** and of tank in the object No. 41 (5/1, 5/2, 5/11 up to 5/32); **Cleaning station of active waters** PS 31; **Cleaning station of active waters** PS 100 (200); **Cleaning station of waste waters** serving mostly for processing of KRAO from JE A1; **Place for classification and fragmentation of metal RAO** (PS 001-007); **Place for processing of used electric cables** (PS 008); **Place for processing of air technical filters** (PS 009); **High capacity decontamination line** (PS 24); **Cementation line KWU** (1984) originally in reserve for emergency purposes (it is shut down at present and intended for decommissioning).
	Final processing of liquid radioactive wastes	corresponds to nuclear installation for special permit of ÚJD intended for Classification and Collection, Processing and Conditioning of RAO, which is not a part of JE described also as „**FS KRAO**“ located in Mochovce site; following facilities are part of the facility: • facilities for cementation of RAO (PS 55) • facilities for concentration of RAO (thickened vaporizer of PS 55 concentrate) • facilities for bitumenation of RAO ((bitumenation line KRAO (PS 55) and discontinual bitumenation line for desaturated ionexes (PS 55)) whereby VBK are the result product of the facilities;

	Processing facilities in decommissioning	correspond to following facilities, which are the subject of Decommissioning: **Vitrification line of chrompik in A1 –** corresponds to vitrification line A1 in Jaslovské Bohunice site serving for fixation of Chrompik A1 into glass matrix of boronsilicate type (also commonly described as „**VICHR**“); **Place in A1 for handling of contaminated concrete –** corresponds to containment of the place for handling of contaminated concrete and several additional outposts for short term storage of contaminated and decontaminated concrete debris in casks and also contaminated and decontaminated concrete blocks (also commonly described as „**PNKB**“); **Manipulating chamber A1** - corresponds to manipulating chamber for manipulation with intermediate-level radioactive materials built by upgrading of hot cell;
		Place in A1 for fragmentation of caskets of nuclear storage - corresponds to place in A1 intended for fragmentation of metal parts of caskets DS A1, depositing of fragments into casks, measurement of dose rate on the surface; **Mobile equipment for handling of RAO –** corresponds to equipment for fixation of sludges (ZFK), workplace for classification of contaminated soils, mobile cementation equipment of VÚJE, facility for solidification of Ra sludges into geopolymer matrix SIAL, loop mobile system for decontamination (DEZA -OD); **Bitumenation line and combustion line of VÚJE** corresponds to experimental combustion line and experimental bitumenation line, which terminated operation and they have been in decommissioning since 2007;
	Facilities for processing of IRAO and ZRAM (planned)	corresponds to facility for Classification and Collection, Processing and Conditioning of IRAO and ZRAM
SR	corresponds to The Slovak Republic	
Sv	Sievert (equivalent dose unit)	

Classification and collection of RAO	corresponds to collection and detection of characterization of RAO and determination of appropriate system for classification of RAO pursuant to and in scope of § 6 of ÚJD SR Regulation No. 30/2012 Coll.	
Disposal	corresponds to permanent placement of RAO or VJP into RAO repository or VJP repository without intention for subsequent retrieval	
Repository	corresponds to nuclear installation allowing isolation of RAO and VJP, control and protection of environment, in which RAO or VJP without intention for subsequent retrieval is permanently depositing; at the territory of The Slovak Republic following kinds of Repositories are recorded:	
	Deep repository	corresponds to repository for VJP, Intermediate-level RAO and High-level RAO; in some parts of texts of this document (for example in titles, in tables, in definitions of other terms) the term „Deep repository“ is described also as „**HÚ**“
	Surface Repository for Very low-level RAO and Low-level RAO	corresponds to repository for Very low - level RAO and Low-level RAO in Mochovce site; in some parts of text of this document (for example in titles, in tables, in definitions of other terms) the term „Surface Repository for Very low-level RAO and Low-level RAO“ is described also as „Republic Repository“ or „**RÚ RAO**“
	Surface Repository for Very low-level RAO (planned)	corresponds to repository for Very low-level RAO
Conditioning of RAO	corresponds to activity resulting in packed form of RAO ready for safe manipulation, Storage, Transport and Disposal pursuant to and in scope of § 8 of ÚJD SR Regulation No. 30/2012 Coll. (for example cementation, bitumenation, fixation, vitrification)	
ÚJD	corresponds to The Nuclear Regulatory Authority	
ÚVZ	corresponds to The Public Health Authority	

VJP	corresponds to nuclear fuel radiated in active zone of nuclear reactor and permanently removed from there; spent nuclear fuel can be considered for usable source, which can be reprocessed, or can be intended for depositing if it is considered to be RAO
Fiber concrete container	corresponds to concrete container reinforced by fibers from amorphous alloy steels in present the only one cover of packed form of RAO acceptable for purposes of depositing in the Republic Repository
VVER	water-water energy reactor, whereby it concerns with project conception of nuclear power plant with pressurized water reactor developed in the formal Soviet Union and implemented in formal states of socialist camp and also in Finland
Decommissioning	corresponds to activities after termination of operation with purpose of exemption of nuclear installation (except for Repository) from jurisdiction of the Atomic Act
The Act on NJF	corresponds to The Act No. 238/2006 Coll. on the National Nuclear Fund for decommissioning of nuclear installations and for handling of spent nuclear fuel and radioactive wastes (the Act on the Nuclear Fund) and on alteration and amendment of other regulations, as amended
ZČJE	the final stage of nuclear power engineering (includes especially Collection and Classification of RAO, Processing of RAO, Conditioning of RAO, Storage of RAO, Storage of VJP, Disposal of RAO and VJP, Decommissioning of nuclear installations)

1. INTRODUCTION

The Act on NJF introduced in § 3 section 1 letter c) requirement to develop proposal for „The Strategy for the final stage of nuclear power engineering in SR“ is one of basic obligation for newly founded Board of Governors with deadline for its submission to the Ministry of Economy of SR 06.30.2007. Subject of this document is description of decommissioning of nuclear installations, handling of spent nuclear fuel and handling of radioactive waste.

The Strategic document „The Strategy for the final stage of nuclear power engineering in SR“, according to points 2.7 eventually 2.8 of Supplement No. 1 of the Act No. 24/2006 Coll. on environmental impact assessment and on alteration and amendment of other regulations (hereinafter referred to as „the Act No. 24/2006 Coll. “) was reviewed from the aspect of environmental impact. As it concerns strategic document with the national scope, all the process was implemented pursuant to § 17 of the Act No. 24/2006 Coll.. As a result of review process the Ministry of Environment of The Slovak Republic issued an Opinion pursuant to the Act the Act No. 24/2006 Coll. on environmental impact assessment and on alteration and amendment of other regulations No: 5131/2007-3.4/hp of 05.15.2008.

The Government of The Slovak Republic by its Resolution No. 328 approved at its meeting of May 21, 2008 „The Strategy for the final stage of nuclear power engineering in SR“ developed by the The Board of Governors of The National Nuclear Fund and imposed obligation to the Ministers of economy, environment, health and finance and also the Chairperson of UJD SR, they shall ensure its implementation until December 31, 2013.

Provision § 3 section 2 letter d) of the Act No. 238 of March 16, 2006 on NJF imposes obligation to the The Board of Governors of NJF to submit to the Ministry of Economy proposal of update of the Strategy in five year intervals. Update was elaborated entitled „The Strategy for the final stage of peaceful utilization of nuclear power engineering in SR.“ Approach to the formulation of the Strategy is in accordance with relevant requirements of Council Regulation 2011/70/EURATOM on establishing Framework of Community for responsible and safe handling of spent fuel and radioactive waste.

The Announcement on update of strategic document of national scope pursuant to § 17 section 3 of the Act No. 24/2006 Coll. was delivered to MŽP SR (Ministry of Environment of SR) of 10.30.2012 and of 12.06.2012 pursuant to § 6 section 1 of the Act No. 24/2006 Coll. was posted on the web portals of MH SR (Ministry of Economy of SR, MŽP SR, NJF and of 12.06.2012 in information mass medium of national scope (daily SME). All documentation of **„**The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic**“** was made available in above mentioned portals.

In the process of investigating observation procedure there were not delivered any comments to The Announcement on update of strategic document of national scope **„**The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic“. Public has made no special observation in investigating observation procedure. Public hearing took place of 01.22.2013 without public participation.

The Ministry of Economy of The Slovak Republic in cooperation with the Ministry of Environment of The Slovak Republic issued pursuant to § 7 and § 17 of the Act No. 24/2006 Coll. on environmental impact assessment and on alteration and amendments

of other regulations as amended based on The Announcement on update of strategic document of national scope and after completion of investigating observation procedure Decision No. MH SR 2727/2013-4100 and MŽP SR No. 2909/2013-3.4/hp of 04.30.2013: „Change of the strategic document of national scope **„**The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic" will not be further reviewed pursuant to the Act No. 24/2006 Coll. on environmental impact assessment and on alteration and amendments of other regulations as amended".

The Strategic document „The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic" was endorsed by the Government of SR 01.15.2014 by the Decision No. 26/2014.

After publication of Council Directive 2011/70/Euratom on establishing Framework of Community for responsible and safe handling of spent nuclear fuel and radioactive waste and after its transposing into the Act No. 143/2013 Coll. of 05.21.2013 „by which is altered and amended the Act No. 541/2004 Coll. on peaceful utilization of nuclear power engineering (the Atomic Act) and on alteration and amendments of other regulation as amended and by which the Act No. 238/2006 Coll. on The National Nuclear Fund for decommissioning of the nuclear installations and for handling of spent nuclear fuel and radioactive wastes is altered and amended (the Act on Nuclear Fund) and on alteration and amendments of other regulations as amended", The Board of Governors of NJF considered the way how to conform to provision of this Act concerning development of national policy and national programme for responsible and safe handling of spent fuel and radioactive waste. Variant to supplement already developed document „The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic" by separate document introducing quantities and flows of radioactive waste or finally accepted variant to develop update of the document „The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic" in accordance with the Act No. 143/2013 Coll. of 05.21.2013, which amended the Act on NJF.

The National Programme for handling of VJP and RAO is based on:

- The Proposal of the National Policy for handling of VJP and RAO,
- „Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic" endorsed by the Decision of the Government of SR No. 26/2014 of 01.15.2014,
- documents delivered by holders of license for handling of VJP and RAO and decommissioning of JZ.

The National Policy and Programme approved will replace existing „The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic".

1.1. Objectives of National Policy

The National Policy is based on policies provided for the Act on NJF. By application of such policies overall objectives are stated:

1. Safe and reliable decommissioning of JZ.
2. Minimization of wastes.
3. Selection of appropriate fuel cycle.
4. Safe storage.

5. Implementation of loop for handling of RAO and VJP.
6. Implementation of nuclear safety.
7. Application of graded approach.
8. The principle „polluter pays“.
9. Objective decision making.
10. Responsibility.

1.2. Significant partial objectives and time frameworks for achievement of these partial objectives with regard to general objectives of national programmes

Basis points

They are determined in the approved The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic [1]. They are based first of all on historical development in the field concerned, summarized in following facts:

- decommissioning of JE A1 is in progress since 1999 including handling of untypical radioactive wastes, which with regard to content of long lived radionuclides and high content of other significant safety related radionuclides can not be deposited in existing Republic Repository,
- JE V1 is in decommissioning process since 2011,
- Repository of RAO is at disposal, disposable for very low-level and low-level RAO from operation of VVER power plants and disposable wastes from their decommissioning considering planned operation life cycle,
- Deep Repository for purposes of VJP, intermediate-level RAO and high-level RAO depositing is not at disposal,
- Centralized collection of institutional RAO began; most of them is disposable in the Republic Repository Mochovce,
- adequate technological background for processing and conditioning of radioactive wastes is in operation,
- VJP is stored in Interim storage of VJP. Capacity of Interim storage of VJP is not adequate at the moment for storage of all VJP from Slovak reactors (capacity is adequate until 2023-2024) and this document expects it will be needed to build and commission new storage capacities of VJP due to lack of Interim storage capacity of VJP,
- operator of nuclear power plants announced its aim to operate existing JE for 60 years,
- Slovak programme for development of deep depositing of VJP and wastes not disposable in the Republic Repository in Mochovce was suspended for 12 years because of institutional reorganization; it seems outputs concerning especially selection of repository locality can be now utilized from all works carried out in the past in given field,
- after its establishing the company JAVYS, a. s. accepted responsibility for activities directed towards implementation of Slovak deep repository,
- preparation stage of the project for new nuclear source (NJZ) in locality Jaslovské Bohunice is in progress, operation of NJZ and term of its connection to grid is expected in horizon of 2029 and operation period is expected to be 60 years,
- all topic of the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic is at present adequately defined by legislative regulations.

Significant partial objectives and time schedules for their achievement are stated in the following table:

Cons. No.	Measure	Term	Organization
For area of infrastructure and legislation			
1.	Fundamentally amend the Act on National Nuclear Fund and other relevant legislative documents with the aim: – to ensure the state accepts responsibility for decommissioning, handling of RAO from decommissioning and long term storage of VJP, – to ensure the amendment implements safe way of transmit of nuclear installations by operator to organization authorized by state for purposes of their decommissioning, – to ensure level of contributions and payments to NJF is defined by independent authority (NJF) pursuant to legislatively stated rules, – to ensure recipient of financial means of NJF is obliged to submit justified costs to NJF in scope and terms stated in legislation, – to ensure scope and structure of justified costs for activities in ZČJE was defined in legislation, – to ensure operator of non-reactor nuclear installations will make payments to NJF for purposes of financing of its decommissioning.	2016	MH SR
For area of decommissioning of nuclear installations			
2.	To complete the II. stage of decommissioning of JE A1	2016	JAVYS, a. s.
3.	To implement next stages of decommissioning of JE A1	2033	JAVYS, a. s.
4.	To implement the II. stage of decommissioning of V1	2025	JAVYS, a. s.
5.	Maximum utilization of financial sources from BIDSF for decommissioning projects of JE V1	2025	JAVYS, a. s.
6.	To prepare decommissioning of other JZ	permanently	JAVYS a. s., SE, a. s.
For area for handling of radioactive wastes and spent nuclear fuel in general			
7.	To construct and commission Integral storage of RAO in Jaslovské Bohunice	2018	JAVYS, a. s.
8.	To construct new storage capacities of VJP	2020	JAVYS, a. s.

9.	To establish a database of all radioactive wastes from nuclear installations in SR and to ensure its continual update	2016	JAVYS, a. s. in cooperation with MH SR and relevant regulators
10.	To construct facility for remelting of metal radioactive wastes	2018	JAVYS, a. s.
11.	To construct and commission facility for handling of IRAO and ZRAM	2016	JAVYS, a. s.
For area for disposal of radioactive wastes and spent nuclear fuel			
12.	To construct Repository of Very low-level wastes	2018	JAVYS, a. s.
13.	To construct other repository structure after filling of the second double row of RÚ RAO	2018	JAVYS, a. s.
14.	To take decision on continuation or termination of double road in development of deep depositing – to review completely the idea of common international deep repository	2020	MH SR
15.	To develop plan for other stages of renew development of deep disposal	2026	JAVYS, a. s.
16.	Take decision on placement of Deep Repository of SR (in case of cancellation of double road)	2030	JAVYS, a. s.
17.	To commission Deep Repository	2065	JAVYS, a. s.
In area of research and development			
18.	To develop framework programme for development and research in area of deep disposal and create internal conditions for its implementation	2018	JAVYS, a. s.
In area of transparency			
19.	To develop and prepare implementation of system for economic stimulation of localities affected by development and operation of repositories. To focus on solution for economic stimulation of localities only is not sufficient. Complex system for information and communication with the public in the long term should be developed.	2018	MH SR JAVYS, a. s. National Nuclear Fund

Area of development of deep repository

The Direction 2011/70/EURATOM recommends to every EU state with nuclear programme to work with complex vision and plans for implementation of disposal of all kinds of RAO and VJP originated in particular state including generation of sources for implementation. Submitted material developed for disposal of VJP and RAO not disposable in the Republic Repository the double road approach:

- disposal in deep repository at the territory of Slovakia,
- following the direction and support for construction of international repository.

Partial activities:

1. Development and preparation of deep repository in geological repository constructed in SR.
2. To ensure and guarantee professional and safe solution for development of deep repository:
   - characterization of geological attributes of selected localities,
   - development of geological models of selected localities,
   - directing of geological works for selection of appropriate locality,
   - assurance of significant geological information for safety analysis solution.
3. Cooperation in development of international repository, in case of realistic possibility of international repository participation in implementation of international scientific-research projects.
4. In update of this programme to conduct a review in development of international repository and based on development to take decision if The Slovak Republic will continue in cooperation in international repository possibility.

Area of public participation

- To ensure informing public in area of handling of RAO and VJP and ensure participation of public on decision making process pursuant to applicable legislation.
- To develop and prepare implementation of system for economic stimulation of localities affected by development and operation of repositories.

2. DECOMMISSIONING OF NUCLEAR INSTALLATIONS

2.1. Decommissioning of JE A1

Basic feature of decommissioning of nuclear power plant A1 is untypical progress of decommissioning works. Main reasons of this procedure result from accident in the primary circuit in 1977 related to damage of nuclear fuel, to works in remedy of accident consequences and to damaged fuel affecting systems of storage and handling. Decommissioning process itself was preceded by relatively long period from termination of operation.

Decommissioning process was divided in stages.

Works of the II. stage of decommissioning has begun from 2009. The objective is to decommission outside active and non-active systems and objects and partially some rooms and systems in main production unit up to 2016. At the same time characterization of facility for preparation of following the III. stage will be carried out.

Pursuant to existing approach decommissioning of most significant safety related and technological most problematic objects of JE A1 – long term store and object 44/10 have no longer been considered the subject of decommissioning stages. They are associated with own material and time harmonogram, whereby milestones of particular stages are referencing to this harmonogram.

Decommissioning of Long term Store is priority activity in decommissioning of JE A1 as storage of liquid radioactive wastes does not correspond to existing legislation. As a result this submitted document is concerned with this activity in detail.

Sludges in outer tanks of the object No. 44/10 will be henceforth gradually processed at the ZFK line. In existing capacity possibilities termination of its processing is expected until 2024.

The other peculiarity of decommissioning of JE A1 will be that in line with meaning of decommissioning plans, the power plant will not be decommissioned at the level „green field“ but many objects and facilities will be gradually integrated into object structure of nuclear installation TSÚ RAO, which is from space and technology aspects connected with it.
At present TSÚ RAO consists of:

- two almost identical bitumenation lines: PS-44 and PS-100 in the object No. 809 and PS 44/II- so called discontinual bitumenation line with tanks and storages,
- Bohunice processing center for RAO,
- Storage of RAO in the object No. 723,
- Object No. 41 and some tanks in the object No. 41 (5/1, 5/2, 5/11 up to 5/32),
- technologies of lines for fragmentation and decontamination of metal RAO, fragmentation of electrical cables, processing of used air technical filters PS-009,
- storages of RAO in the object No. 32 (room No. 30/54, 97, 106) and in the object No. 34 (room No. 1).

In addition to TSÚ RAO new objects for purposes of handling of RAO will be included within the II. stage of decommissioning over time:

- Object No. 28 – Gas management of CO2,
- Object No. 44/20 – storing place of solid RAO,

and other, which are not the subject of decommissioning within the II. stage.
In the next stages of decommissioning of JE A1 (until 2033) following construction objects used for handling of RAO will be transferred into nuclear installation TSÚ RAO:

- Object No. 30 – Reactor building,
- Object No. 34 – Machine room
- Object No. 32 – Supporting machine room.

For every object there is defined status at its transfer into object structure of TSÚ RAO in decommissioning documentation.

Other peculiarity of decommissioning of JE A1 is occurrence of low contaminated soil and concrete debris. There are or there are expected in following objects [14]:

- Object No. 839 – storing place of low-level sludges contained radioactive sludges from bioklar of JE V1, contaminated soil, concrete trash and some other solid RAO (wood, glass-wool, cloths, plastics). Volume of reinforced-concrete tank up to the level of its upper edge is 3 200 m^3; in filling of all hall over the level of tank edge by pilling up wastes, expected available space is increased up to 4 000 m^3.
- Circular hall – approximately 500 m^3 of contaminated soil.
- Object No. 41/20 – storage tanks were equivalent to manipulating volume for storage of KRAO before their cleaning, in cleaning process and after cleaning before their release to environment. They were placed under free grass space between building of object No. 41 and object No. 30 and they are fenced and belonged to controlled zone. Tanks were built in 1968 - 1970, based on then valid norms for construction of similar facilities in nuclear power engineering. Because of their leakage, surrounding soil is contaminated with various grades of contamination.
- Active pipe canals – it is expected small amount of contaminated soil in excavation works (circa 30 m^3) will be indicated and it will be necessary to mined and classified them.

There are four end solutions considered for treatment with contaminated soils and concrete depended on their activity:

- soils with activities corresponded to the level for release in environment (at present up to 300 Bq/kg) will be deposited to storage pile of nonradioactive wastes, eventually part of them will be placed into building pits left after decommissioning of outer objects of JE A1, tanks 41/20, 44/10 and 44/20 or will be used for backfilling of decommissioned pipe canals: estimated amounts are approximately 12 000 t soils and 35 t of concrete,
- manipulations with contaminated soils and concrete at the Central manipulating place established at the object No. 28 and preparation for their depositing in considered

Surface Repository of very low-level wastes until its building: approximately 20 000 m^3 of soils and concrete,

- soils with the highest activities will be treated as low-level RAO: they will be inserted into casks and deposited in VBK in RÚ RAO: approximately 120 m^3 of soils and 20 t of concrete.

The fact of integration of some objects into object structure of TSÚ RAO changes original vision on time of proportioning of decommissioning funding and on own activities after termination of decommissioning of JE A1. For example costs for demolition of aforementioned objects and facilities which will become component of TSÚ RAO, will be redeployed in period of this nuclear facility decommissioning. Provided for simultaneous utilization of nuclear energy, expected decommissioning of nuclear power plants and other nuclear installations, needs for processing and conditioning of RAO, it is possible to estimate partially, that integrated objects will be gradually decommissioned from 2040 to 2070.

The Second stage of decommissioning 2009 - 2016

In the II. Stage of decommissioning works with the highest safety priorities, implementation of which was required in decision of ÚJD SR No. 144/2003 are executed, in which requirement for priority activities of JE A1 decommissioning connected inter alia to disposal of KRAO from operation of JE A1 was defined. Subject of the II. stage of decommissioning are active and non-active outer objects and some rooms and systems in main production unit. Purpose of this stage is decommissioning or partial decommissioning of technological facilities in objects or construction part of objects, eventually their subsequent integration into object structure of TSÚ RAO, with exception of HVB objects.

Some underground storage tanks of outer active objects of JE A1 with verified tightness (in objects 41/20 and 44/10) will be left out of decommissioning within the II. stage. There are considerations that they will be used as manipulation and storage tanks for treatment with KRAO and sludges from other outer tanks during their processing.

Stages of decommissioning after 2016 until termination of decommissioning of JE A1

In these stages remaining systems will be decommissioned gradually from less radioactive up to the systems with the highest radioactivity. In subsequent procedure of JE A1 decommissioning additional two 4-year stages are presumed whereby their integration is considered and concluding 9-year stage of decommissioning will follow. General plans for time, objective and financial parameters of individual stages of decommissioning of additional 10-20 years will be throughout periodical safety assessment continually updated pursuant to really achieved progress and needs what will be reflected in Conception of decommissioning. At the same time a need for continual update of objectives eventually needs for up to date series of steps in shorter time horizons of 2-5 years arises.

Based on current knowledge of systems and expected demands for dismantling technology for main systems, procedure for decommissioning pursuant to individual stages and its time schedule, description in detail follows:

- the III. stage of decommissioning (2017 – 2020):
  - remaining smaller facilities from original operational parts of transport-technological installment, which were not significantly contaminated,
  - remaining facilities of supporting systems for management of D_2O and CO_2,
  - remaining facilities for fuel transport,
  - facilities for preparation of manipulated fuel for transport,
  - facilities for preparation of manipulated fuel for transport modified for preparation of non-manipulated fuel,
  - facilities for preparation of non-manipulated fuel for transport.

  In addition to standard dismantling per rooms a specific dismantling in significant scope will be used pursuant to technological units for bigger construction units. Specific projects of decommissioning should be elaborated for many facilities listed above especially for facilities for preparation of fuel for transport.

- the IV. stage of decommissioning (2021 – 2024):
  - facilities of primary circuit in object No. 30 (reactor building) – pipe system of primary circuit, section mountings,
  - facilities of primary circuit in object No. 32 (supporting machine room) – pipe system of primary circuit, turbo compressor,
  - other facilities with higher contamination.

  Facilities of primary circuit will be dismantled especially per rooms. Radiological situation in such spaces requires specific dismantling projects and also remote controlled dismantling, what will be reflected in demands for dismantling preparation and also its implementation.

- the V. stage of decommissioning (2025 – 2033):
  - KS1 with MSN tank and dry sludges under the tank,
  - DS,
  - KS2,
  - short storage with accessories (if it will be not determined for further use),
  - steam generators with accessories,
  - reactor and other facilities in reactor shaft,
  - removal of activated component of reactor shaft.

The longest concluding stage will be the most challenging to project preparation, which will be focused especially to reactor and steam generators and main parts of transport-

technological component – DS a KS dismantling and for its technological support. A significant amount of RAO not disposable in RÚ RAO in Mochovce will be generated. This situation requires available deep repository or storage of proper type and safety parameters. Integral storage will assume this role.
Facilities of smaller dimensions or less significant will be listed in individual stages in their planning in accordance to up to day situation.

Final status after decommissioning of JE A1
In implementation of the I. stage of decommissioning a philosophy accepted by regulator authorities was adopted, which reveals two possibilities for objects or site of JE A1:

- objects will be demolished to the level provided for in documentation. It concerns relatively small areas, for which no decision of their further use has been made. In general it is assumed that areas left at places of disposed objects will be released pursuant to decommissioning plans gradually or at once from under jurisdiction of Atomic Act. Time proportion of process of release of individual areas or objects or release of all areas or objects at once at the end of decommissioning from under jurisdiction of Atomic Act will be determined by specific needs of their further utilization. One of possibilities for further utilization of these areas and objects is their integration into equity structure of the company JESS, a. s. for purpose of construction of NJZ in this locality.
- objects with unremoved, partially or completely removed technological equipment will be gradually transferred during decommissioning to the nuclear installation TSÚ RAO.

Pursuant to provisions of legislative rules is the objective and thus final status of decommissioning of nuclear installations their release from under jurisdiction of Atomic Act. Respective process will be based inter alia on representative control and review of radiation situation supported by independent verification and obligatory viewpoint of regulatory authority on radiation protection.

2.2. Decommissioning of JE V1 Jaslovské Bohunice

Basic information and objects
After definite shut down of JE V1 units in 2006 and 2008 activity of operation termination took place. Basic task in executed activities of termination of operation was to prepare the power plant for permission and implementation of the I. stage of its decommissioning.

Termination of operation of JE V1 after final shut down (not pertaining formally in decommissioning) was completed by Decision issued by ÚJD SR No. 400/2011 of July, 2011. This decision started the I. stage of decommissioning for 2011 – 2014.
Following activities are implemented within this stage:

– dismantling of unneeded non-active facilities and systems,

– demolition of unneeded non-active buildings,

- treatment with RAO from decontamination and with conventional wastes,
- treatment with non-processed RAO from operation (sludges, desaturated ionexes).

Basic object of the II. stage of decommissioning project of JE V1 Bohunice is achievement of final status of left industry locality *(brownfield site)*, i. e. termination of the license under following limited conditions:

- for compliance with Slovak legislative regulations it is necessary to further decrease of residual radioactivity as levels of residual radiation associated with limited conditions shall be kept at minimum as reasonable achievable (ALARA)
- institutional controls shall provide appropriate assurance that effective dose of residual radioactivity distinguished from the background for average individual from critical group will not exceed 0,3 mSv per year;
- residual radioactivity in locality shall be decreased in such scope that if institutional controls would not be applicable, relevant assurance exists that effective dose of residual radioactivity distinguished from the background for average individual from critical group is at minimum as reasonable achievable and will not exceed 1 mSv per year;
- if further decrease in residual radioactivity needed to keep level for value of 1 mSv/year is not technically achievable evidence shall demonstrate this fact (for example it would not be affordable or would result in net value of damage suffered for population or environment).

Before beginning of dismantling activities within the II. stage following interfaces and assumptions shall comply with:

- completed overall technical solution of the II. Stage of decommissioning, plan for needed activities,
- completed or in progress of radiological and non-radiological inventarization included dangerous materials as needed,
- completed or in progress of decommissioning of supporting facilities pursuant to the plan within the I. stage,
- completed dismantling of facilities in the object of machine room under the plan within the I. stage,
- finalizing of facilities for processing and conditioning of solid and liquid wastes or availability of alternatives (new lines for fragmentation and classification).

Success of decommissioning depends on thoughtful and systematic planning of activities. Order of disposing of facilities will be stated considering following items with the aim of development of logical procedure for decommissioning:

- observance of ALARA criteria – decrease of doses for workers,
- preservation of safety level,
- prevention of contamination spreading to uncontaminated spaces.

Procedure will be established with regard to availability of rooms and dependence on contamination level of individual spaces.

In the process of dismantling of facilities in contaminated rooms it is important facilities with highest level of radiation should be dismantled at first in order to minimize absorbed dose (at the earliest hot material).

Dismantling project of large scaled components of primary circuit located in hermetical zone of the 1. and the 2. unit is considered to be one of time-consuming projects. This will require building of special working places for fragmentation of such components, conditioning of lifting mechanisms and various construction works. For this reason activity in question should be conducted at the beginning of this stage.

Dismantling of systems and facilities in HVB of JE V1 and in the supporting operation building will be divided into more projects. Dismantling of systems, which are not necessary for the purposes of decommissioning thus begins at earliest. Remaining systems will be dismantled later. This procedure will facilitate extensively continual flow of materials, wastes and handling of them. With regard to the fact that controlled zone represents limited space it is necessary to optimize number of contractors in controlled zone.

For successful implementation of decommissioning particular works should be conducted for example construction works, modification of electrical supply and so on. As extensive amounts of material from decommissioning will be generated, logistics of material flow from decommissioning should be resolved.
After dismantling of all systems and facilities in HVB of JE and in supporting operation building take place, decontamination of construction objects begins with the aim of release of such objects from under administration control.

After decontamination of construction objects take place their demolition begins. Simultaneously decommissioning of construction objects like for example pipe cannals, cables cannals, industry, waste and waste water drainage and so on will be in progress. Following procedure of works for restoring of the site, will include removal of contaminated soils, deposits and waters as needed. The final stage of demolition of construction objects corresponds to landscaping.

Final ground survey and release of the site from under administration control will be conducted after restoration. In case it will be not possible to release all site, release will be accomplished in parts.

Projects conducted in the II. stage of decommissioning

After obtaining license for the II. stage of decommissioning, begins dismantling especially of contaminated and activated systems and facilities followed by processing of RAO, their transport and final disposal eventually storage. In the II. stage of decommissioning dismantling of other systems and facilities needed for decommissioning purposes will be gradually implemented and their need will gradually expire. Construction objects where such systems and facilities were installed, will be gradually decontaminated (if applicable) and demolished in consequence. Within demolition of these construction objects landscaping will be implemented. Final stage of the II. stage of decommissioning will be restoration and final survey and release of the site.

All these activities will be divided in more projects. Table No. 1 shows summary of these projects necessary within the II. stage of decommissioning.

Table No. 1: Projects of BIDSF to be implemented within the II. stage

Id. No. of project	**Title of the project**
A5-A3	Optimization of electrical scheme
B6.6A	Supporting research for decommissioning
D2.1	Decontamination of storage basins and other contaminated tanks of JE V1
D3.1B	Dismantling and demolition of outer objects of JE V1 – cooling towers
D3.4A	Dismantling of diesel generators – building of additional fence of AKOBOJE
D4.1	Modification of power plant and installation of new facilities
D4.2	Dismantling of large scaled components of primary circuit
D4.3A	Dismantling of isolations in controlled zone of JE V1
D4.4A	Dismantling of systems in support operation building – the I. stage
D4.4A1	Modifications of facilities in the system AKOBOJE
D4.4B	Dismantling of systems in controlled zone of JE V1 – part I
D4.4C	Dismantling of systems in controlled zone of JE V1 – part II
D4.5	Decontamination of objects
D4.6	Demolition of objects and filling of building pits
D6.1	Restoring of JE V1 site
D6.2	Final survey and release of the site
C7-A4	Facility for remelting of metal RAO
C9.4	Proposal and building of new storage for LLW and VLLW from decommissioning of JE V1 in RÚ RAO Mochovce
C14	Disposal of „RH“ wastes from „mogilnik“

With exception of projects given in the Table No. 1 some projects, implementation of which began in the I. stage of decommissioning will be finalized in the II. stage of decommissioning.

Status and utilization of objects during the II. stage

In implementation of the II. stage objects where facilities and systems assigned especially for processing of RAO, storage of RAO and release of material into environment are installed will be utilized. Some objects for storage of conventional waste (i. e. uncontaminated waste), demand for which will be gradually expired and thus will be gradually decommissioned will be further utilized.

Final status of power plant at the end of the II. stage

Overall object of site clearage is release of the site from under administration control after optimisation of radiation protection of workers, population and environment.

Construction objects will be demolished down to the level of -1 m followed by backfilling and landscaping. Dosimetric control will be conducted in space left after removal of decommissioned objects for assurance that area can be released for industry use.

In the process of decommissioning of JE V1 it is assumed the site will be released in 2025.

2.3. Decommissioning of other nuclear power plants

Nuclear power plant V2

In current time considerations of 60-year operation lifetime of power plant is discussed; final shut down would be expected in 2045. Conception decommissioning plan of JE V2 considers basically two variants. Expected beginning of all of them is the half of the century. The first preferred variant – immediate continual decommissioning – would comprise of following milestones:

- beginning of facilities dismantling in non-active objects and following object demolition (the I. stage; implementation period 6 years),
- beginning of predismantling decontamination of HVB facilities and following dismantling (the II. stage),
- predismantling decontamination of facilities of supporting active operations (the II. stage),
- termination of the II. stage of decommissioning by release of respective site from under regulatory control.

Implementation period for the II. stage is expected to be 12 years.

The second variant is protection deposition of hermetic spaces for period of 30 years. Decommissioning in this case is comprised of three stages, particular protection deposition is the second one. Termination of decommissioning in this case will be at the end of this century.

Nuclear power plant EMO 1, 2; MO34

The earliest date considered for beginning of decommissioning of the first of standard operating Mochovce power plants is 2045. In considered 60-years of operational lifetime it will be in twenty years later. In current time in connection with completion of building and preparation of commissioning of JE MO34, modification of conception plans of decommissioning of both JE in Mochovce site is considered in such a way that decommissioning of all 4 units would be implemented at once, it means after final shut down of the last operating unit. This solution presents more benefits from viewpoint of safety, economic cost saving, lower component activities in the 1. and the 2. unit, physical security and so on.

2.4. Decommissioning of non-reactor nuclear installations

It concerns practically exclusively facilities for treatment with radioactive wastes and spent fuel specifically:

- TSÚ RAO, including objects and facilities transferred here from JE A1,
- MSVP Jaslovské Bohunice,

- New storage of spent fuel (construction is expected at the end of 2020),
- FS KRAO Mochovce,
- IS RAO (construction is being prepared in this time),
- RÚ RAO Mochovce.

Specific status among these facilities is assigned to RÚ RAO – repository for very low and low-level radioactive wastes. The repository pursuant to provisions of the Atomic Act can not to be decommissioned but to be closed. Particular filled depositing structure are closing (all existing deposited boxes in RÚ RAO filled by wastes and inert material; every double row is superimposed by monolithic water-tight concrete plate and all double rows together by other superimposed layers up to grass surface), objects and facilities served for long term monitoring of impacts of filled repository on environment and for long term preclusion of access to the site are left. Other facilities and objects are dismantling and demolishing.

Decommissioning of installations for handling of RAO and handling of VJP is closely connected to operation of JE and decommissioning of JE. In time scheme of decommissioning of individual JZ, time periods for decommissioning of facilities for handling of RAO and VJP were included (in the Figure 1-1). Following assumptions applies:

- Liquid RAO generated in locality of Jaslovské Bohunice will be processed in facilities of TSÚ RAO. After processing of KRAO, decommissioning of object No. 809 – bitumenation lines can begin. Liquid RAO can be processed in facilities of BSC in locality of Jaslovské Bohunice after decommissioning of object 809.
- Liquid RAO generated in locality of Mochovce will be processed in facility FS KRAO Mochovce.
- Final product of solidified RAO takes form of VBK container, which is deposited in RÚ RAO in Mochovce. There is no technology relation between TSÚ RAO and FS KRAO. Every of above mentioned facilities supplies a final product for deposition in RÚ RAO.
- Solid RAO originated in locality of Jaslovské Bohunice are processed and conditioned in final form in VBK in TSÚ RAO in the object BSC.
- Fragments of solid RAO generated in locality of Mochovce are processed and conditioned in final form in VBK in TSÚ RAO in the object BSC. For this reason is BSC decommissioning possible only in last years of EMO 12 decommissioning (40 years of operation). Waste produced in decommissioning from EMO34 eventually EMO 12 in case of 60 years of operation will be probably processed at newly built eventually mobile lines in locality Mochovce in present view of operator.
- Decommissioning of BSC should follow after decommissioning of original objects of JE A1 enabling processing and conditioning of RAO from decommissioning of HVB and other supporting objects.
- BSC decommissioning will become the last decommissioned object (including supporting objects needed for its operation) of JZ TSÚ RAO.

- RAO generated in last stages of BSC decommissioning will be processed and conditioned in mobile lines.
- Decommissioning of both MSVP will be implemented pursuant to harmonogram in the Figure 1-1. Mobile lines will be used for handling of RAO.
- Integral storage will be decommissioned only in 2088 – 2089 and mobile lines for handling of RAO will be used similarly to MSVP decommissioning.

Above relations were applied in development of overall time scheme for decommissioning of non-reactor JZ, in relation to decommissioning of JE in localities of Jaslovské Bohunice and Mochovce. Overall scheme is depicted in the Figure 1-1.

Title	Duration
Decommissioning of JE	
Decommissioning of JE A1	- 2033
Decommissioning of JE V1	- 2025
Decommissioning of JE V2 (40 year operation)	2031 - 2048
Decommissioning of JE V2 (60 year operation)	2051 - 2068
Decommissioning of JE EMO 1, 2 (40 year operation)	2046 - 2063
Decommissioning of JE EMO 1, 2 (60 year operation)	2066 - 2083
Decommissioning of JE EMO 34 (40 year operation)	2062 - 2079
Decommissioning of JE EMO 34 (60 year operation)	2082 - 2099
Decommissioning of TSÚ RAO	
Bitumenation lines	2069 - 2074
BSC RAO	2069 - 2075
HVB JE A 1	2056 - 2066
Other objects	2062 - 2066
Integral storage	2088 - 2089
Decommissioning of MSVP	
Decommissioning MSVP Bohunice (40y operation JE V2)	2079 - 2084
Decommissioning MSVP Bohunice (60y operation JE V2)	2099 - 2104
Decommissioning Dry MSVP (40y operation JE MO 34)	2110 - 2113
Decommissioning Dry MSVP (60y operation JE MO 34)	2130 - 2133
Installation for processing of RAO in Mochovce	
FS KRAO Mochovce (40y operation JE MO 34)	2080 - 2083
FS KRAO Mochovce (60y operation JE MO 34)	2100 - 2103

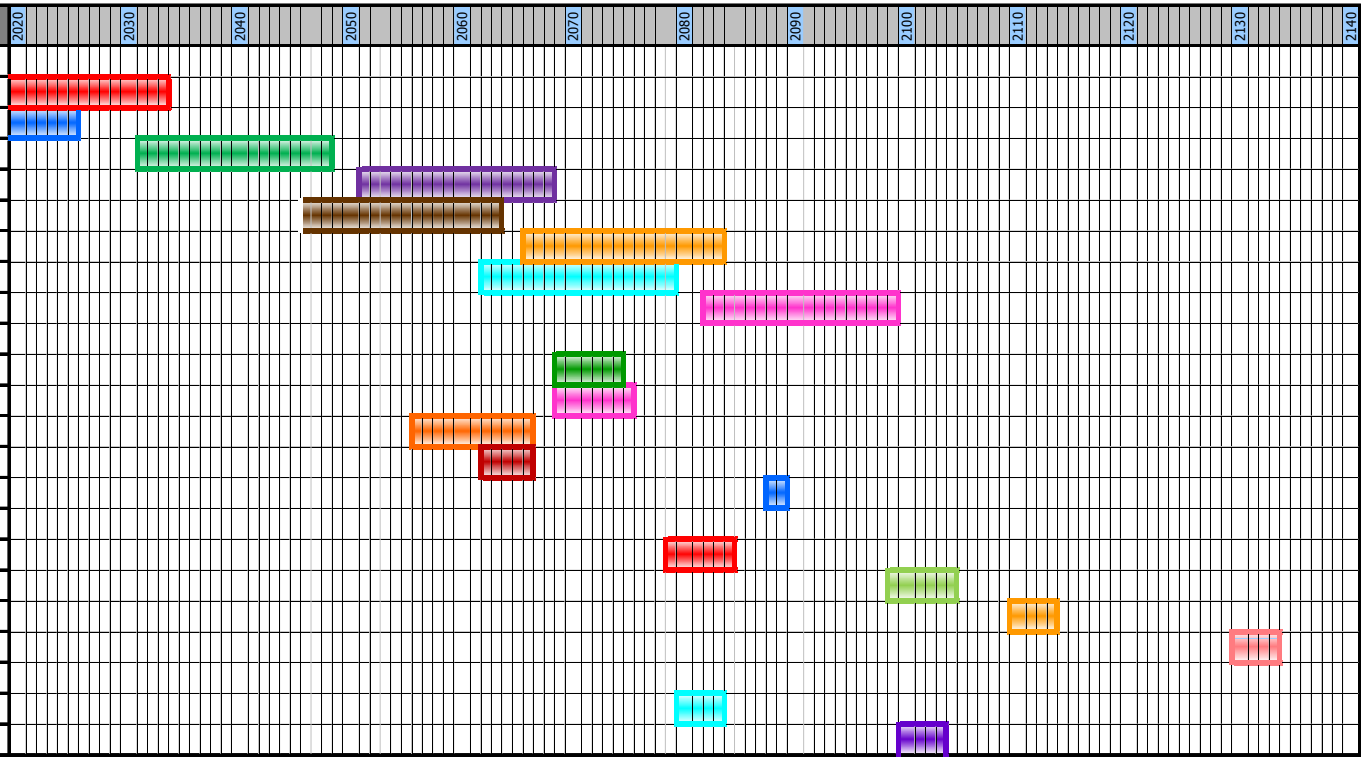


Figure 1-1 Harmonogram of decommissioning of individual JZ

The Study „Costs for decommissioning of non-reactor nuclear installations“ from 2012 considers decommissioning periods as described in Figure 1-1.

Overall costs for decommissioning of all non-reactor nuclear installations were estimated in current prices amounting to approximately 244,420 mil. € (prices of 2014). Of all almost half of that amounted to decommissioning of objects of JE A1 assigned to TSÚ RAO within and till the end of decommissioning. It is important to note, at first sight the changes will not affect in significant manner decommissioning plans of JE A1 currently in force. Basically they will not affect overall level of costs of decommissioning of JE A1 and objects assigned to TSÚ RAO. However there may be delay in drawing of financial resources for these objects for their decommissioning.

In comparison with other activities of the final stage of peaceful utilization of nuclear energy it concerns less significant activities from financial and time aspects (decommissioning of these facilities will not take place sooner than in half of this century, they will be decommissioned by immediate continual decommissioning, which will not take longer – ignoring decade of decommissioning of original JE A1 objects – than few years). Other aspects like quantities of wastes or possible environmental impact are also marginal.

NJF Act and Atomic Act do not impose a duty to holders of license for operation of non-reactor installations (storages and processing facilities) to pay contributions to NJF for decommissioning of such non-reactor installations. As final responsibility for RAO disposal rests with the state and present legislation gives advantage for operators of non-reactor installations to operators of reactor installations, it is necessary as soon as possible throughout legislation amendment to impose to operators of given installations a duty to pay contributions to Nuclear Fund for decommissioning of non-reactor installations in such amount and manner as to ensure there will be adequate amount of financial resources on time in NJF for purposes of decommissioning of non-reactor installations (including costs for Classification and Collection, Processing, Conditioning, Storage and Disposal of RAO, which will be generated as a result decommissioning of these installations). Amendment of the Act on NJF (i. e. the Act No. 550/2011 Coll.) established possibility for reimbursement of costs for decommissioning of non-reactor nuclear facilities from Nuclear Fund. It remains to define manner of collection and accumulation of financial resources from operators of non-reactor installations.

In the new Act on NJF being in preparation this issue is solved.

3. SPENT NUCLEAR FUEL AND RADIOACTIVE WASTES

3.1. Inventory of spent nuclear fuel and radioactive wastes and their development in time

Inventory of RAO was taken from following documents:

- estimation of inventory or RAO from operation and decommissioning of Slovak nuclear power plants taken from holders of permission for operation and decommissioning of JE and from project outcomes financed in 2007-2009 from „Bohunice International Decommissioning Support Fund“ labeled as C9.1 and titled „Feasibility study of enlargement of RÚ RAO Mochovce“, partially retrieved from questionnaire information [2], [3], partially based on studies occurred in some documents of IAEA [5], [6]. Input information on inventory in C9.1 is summarized in [4].
- Inventory of institutional radioactive wastes from outcomes of project in question implemented with financial support of EÚ from Transitional Fund [7], eventually from documentation of EIA process concerned building of the Installation for handling of IRAO and ZRAM in Mochovce [8].
- Information on inventory of spent nuclear fuel as was submitted from JAVYS a. s., eventually as they are recorded in “The Strategy for the final stage of nuclear power engineering in SR“ [1].

Radioactive wastes from operation and decommissioning of nuclear power plants

Quantities and activity of RAO from operation of JE established based on records of holder of permission for operation of JE can be found in the Table No. 2.

Table No. 2: Overall quantity and activity of RAO from operation of JE

JE V-2	inventory of 12.31.2013	activity (GBq)	future generation 40-year operation	activity (GBq)	future generation 60-year operation	activity (GBq)
concentrate (m^3)	1 560	167,5	1 060	113,8	2 112	226,8
sorbents (m^3)	156	5,4	80	2,8	224	0,0
compressible (t)	80	354,5	95	395,7	205	834,7
combustible (t)	106		102		216	
metal (t)	19		32		62	

EMO 1,2	inventory of 12.31.2013	activity (GBq)	future generation 40-year operation	activity (GBq)	future generation 60-year operation	activity (GBq)
concentrate (m^3)	983	447,1	1 950	886,8	3 010	1 369
sorbents (m^3)	86	3,0	228	7,9	372	13
compressible (t)	15	7,2	207	91,9	337	148,8
combustible (t)	19		268		436	
metal (t)	5		23		33	

EMO 3,4	future generation 40-year operation	activity (GBq)	future generation 60-year operation	activity (GBq)
concentrate (m^3)	3 253	1 479,8	4 313	1 961,9
sorbents (m^3)	330	11,6	474	16,6
compressible (t)	296	132	426	188,9
combustible (t)	380		548	
metal (t)	40		50	

Overall quantities of RAO from decommissioning of JE were obtained by interpretations of information from Conceptual plan of decommissioning JE V1 and studies on decommissioning of nuclear power plants V2 and EMO12 [3]. Summaries also assume together approximately 620 casks of wastes from Slovak power plants will not be disposable in RÚ RAO.

Table No. 3: Quantity and activity of RAO from decommissioning of JE A1

JE A1	**Activity (Bq)**	**Weight (kg)**
Activated components	1,63E+16	1,60E+05
Contaminated construction objects	1,54E+10	1,11E+06
Contaminated facilities	5,57E+16	2,47E+06
Contaminated soil	2,27E+11	4,02E+07
Total	7,20E+16	4,40E+07

Table No. 4: Quantity and activity of RAO from decommissioning of JE V1

JE V1	**Activity (Bq)**	**Weight (kg)**
Activated components	2,62E+17	1,58E+06
Contaminated construction objects	4,42E+10	2,30E+08
Contaminated facilities	1,17E+13	1,16E+07
Total	2,6E+17	2,43E+08

Table No. 5: Quantity and activity from decommissioning of JE currently in operation or eventually in process of completion

JE V2	**Activity (Bq)**	**Weight (kg)**
Activated components	6,19E+18	1,70E+06
Activated construction objects	2,22E+10	2,22E+06
Contaminated facilities	3,16E+13	1,65E+07
Total	6,19E+18	2,04E+07

JE EMO 12	**Activity (Bq)**	**Weight (kg)**
Contaminated components	6,86E+18	1,76E+06
Contaminated construction objects	2,19E+10	2,18E+06
Contaminated facilities	3,16E+13	1,62E+07
Total	6,86E+18	2,02E+07

JE EMO 34	Activity (Bq)	Weight (kg)
Activated components	4,21E+18	1,77E+06
Contaminated construction objects	3,80E+10	5,93E+06
Contaminated facilities	6,50E+13	1,80E+07
Total	4,21E+18	2,57E+07

Institutional wastes

Within project [7] database ARISTO has been developed in 2007, what reflects endeavor for control of sealed sources and IRAO handling before their centralized collection by JAVYS a. s. Internal database of JAVYS a. s. ARSOZ covers inter alia handling of accepted IRAO and ZRAM and database ILTRAM served in the past for management and control of activities and handling of ZRAM but in present not all new data are inserted there. New established database ARISTO was filled in data based on filled in questionnaires on closed and open sources eventually on institutional radioactive wastes stored/produced at workplaces with sources of ionized radiation supervised by Public Health Offices (ÚVZ). Out of 191 contacted organizations circa 66 % responded. Then government departments, which do not fall under ÚVZ sphere of authority were addressed namely of home, defense, traffic, post offices and telecommunications taking role of supervision of subjects having workplaces with sources of ionized radiation and falling within their scope of authority. Thus database ARISTO contained uncompleted data on circa 2 266 sources.

Justified assumption is stated in the document [8] that in present amount of sources as potential or existing institutional waste in The Slovak Republic is up to three times greater than amount recorded in database in question. It is important to note that only lesser part especially of sealed sources will demonstrate the problem within the National Programme: even with support of legislation in circa last 15 years, there is highly preferable to return them back to distributor or producer.

Summary of sealed sources as they were inserted into database ARISTO in circa 5 years ago is described in the Table No. 6 [8].

Table No. 6: Sealed sources recorded in the database ARISTO (without intermediary wastes, most of sources from fire detectors and wastes containing natural radionuclides).

Nuclide	Co-60	Kr-85	Sr-90	Ba-133	Cs-137	Ir-192	Tl-204	Ra-226	Pu-239	Am-241**	Am/Be	Cf-252	Ge-68	Gd-153	Se-75	Cd-109
A	159	9	30	8	149	124	3	2	2	22	22	3	0	0	0	0
B	16 here of 4u E+7 6u E+10 2u E+14	4	0	0	56here of 23u E+8 25u E+10 1u E+13	126 E+12	0	0	0	103 here of 40E+7 16E+10	13 hf 7E+9	0	6E +8	60E +9	4	2
C	28	11	0	0	45	8	1	198 *	0	6	11	0	0	0	2	0
Doc. 2014	494	30	64	4	370	79	0	31	0	123	46	2	0	0	0	0
D A_{tot}			4267 2E+8		18 6,5E+9					426 1,1E+7						
E A_{tot}	15 8,1E+5		5078 5,3E+9		12 2,5E+11					105 7,8E+6						

Explanatory notes:

A – amounts of sources in central registry of ÚVZ – uncompleted

B – amounts of sources in new in 2006 + recertificated in 2006 (data from HUMA – LAB APEKO) for health sector, military, Ministries of transport, construction and regional development

C – amounts of sources Banská Bystrica + Žilina – ÚVZ – complete at the end of 2006

D – amounts of PUŽ – military

E – amounts of PUŽ CO – VTU CO Slovenská Ľupča

*Radium needles – they will not be disposable, temporary storage, summary of activity at the territory of SR circa E+11Bq

**fire detectors, uncompleted records, BB RÚVZ itself recorded 22 000 units of fire detectors

Note: Activity of sources in Bq is described as for example E+9 etc.

In the next Table No. 7 data shown IRAO stored in storages of JAVYS a. s. of 06.30.2014.

Table No. 7: Quantity and activity of institutional radioactive wastes stored in storages of JAVYS, a. s. of 06/30/2014.

CATHEGORY of RAO	**Quantity**	**Activity**
SOLID IRAO and ZRAM	kg	MBq
	19 981	**79 438**
LIQUID IRAO and ZRAM	dm^3	MBq
	21	**20 310**
SOURCES OF IRAO and ZRAM	units	MBq
	133	**731 529**
Total		**831 276**

Viewpoint of disposability of institutional wastes in existing repository was analyzed within [9]. The authors concluded that assortment of institutional wastes will be from the most part (especially from volume view) disposable in RÚ RAO. From safety analysis as object of this study it follows:

- IRAO from view of homogeneity content of radionuclides have similar character like RAO from nuclear installations i. e. IRAO generated from open sources and most of intercepted materials (with exception of those containing sealed sources) can be processed, conditioned and disposed in the same way like wastes from nuclear installations, including acceptance criteria application for wastes from nuclear installations,
- unused sealed sources of beta-gamma can be with minor exception disposed in RÚ RAO while maintaining acceptance criteria, which take this fact in consideration,
- unused sealed alpha sources (with exception of sources from fire detectors) will be mostly in compliance with newly established acceptance criteria; otherwise they will be disposed together with radioactive wastes from operation and decommissioning not disposable in RÚ RAO,
- sources of fire detectors and glow tubes will be collected in JAVYS a. s. and pursuant to approved acceptance criteria for disposal of IRAO in RÚ RAO either they will be solidified in corresponding installments in individual VBK and disposed subsequently; or they will be stored in the long term and definitely disposed as other sealed alpha sources.

Spent nuclear fuel

Forecasted time dependence of spent nuclear fuel generation in The Slovak Republic in 60 year operation of nuclear power plants is depicted in the Figure No. 2 [12].

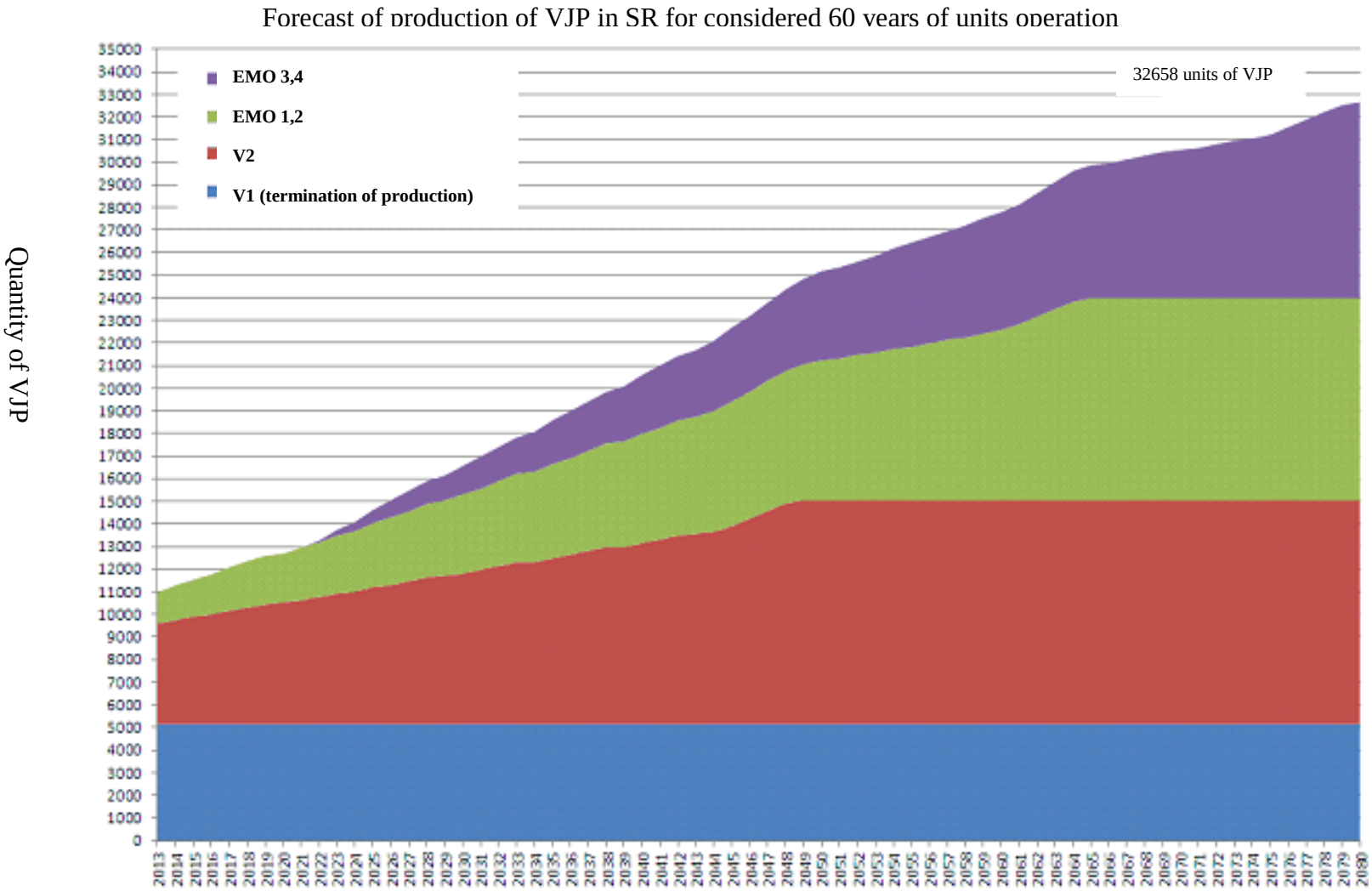


Figure No. 2: Forecast of production of spent nuclear fuel considering 60 years of operation

3.2. Conceptions, plans and technical solutions for handling of radioactive wastes

General scheme of handling of RAO resulting from general principles of nuclear safety in handling of RAO is depicted on Figure No. 3. Final stages of handling pursuant to the scheme can be either disposal of RAO in appropriate repository or release into environment.

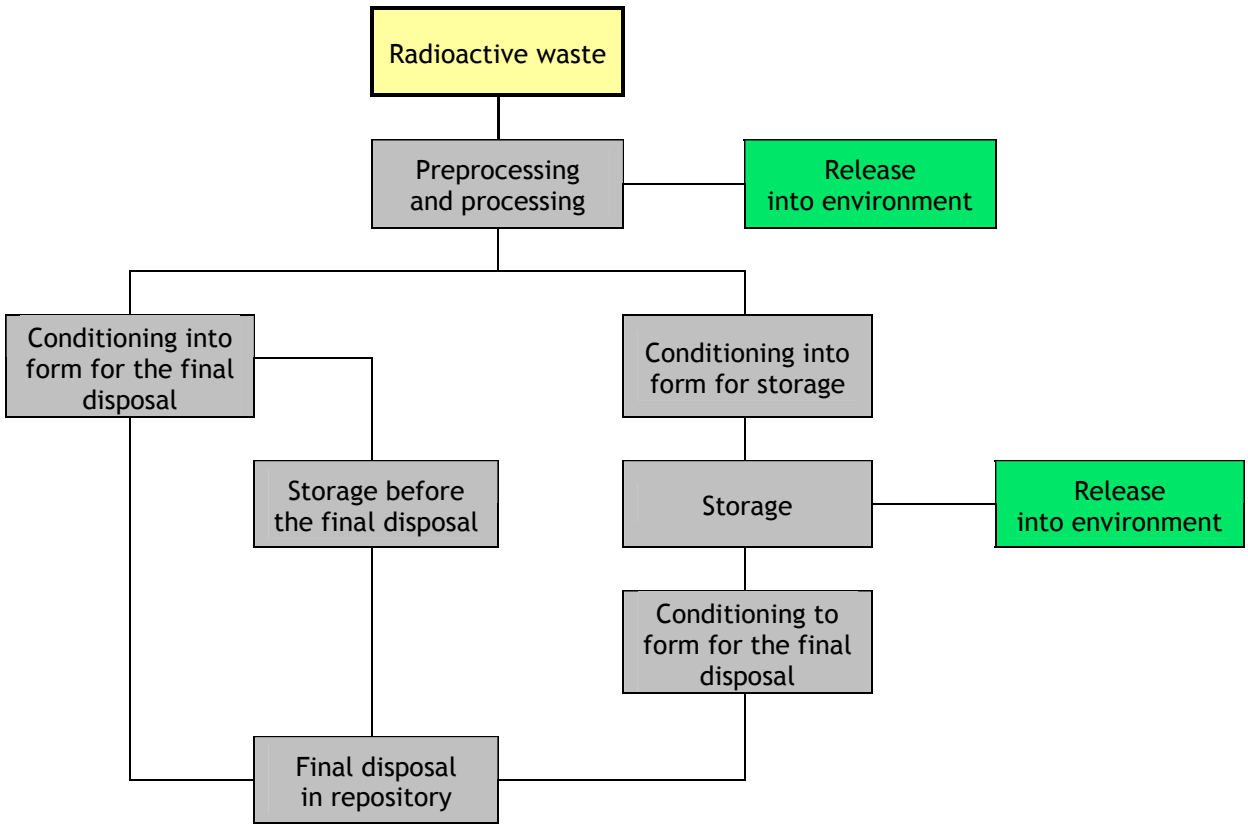


Figure No. 3: General scheme for handling of radioactive wastes

It is important to note three points to this scheme for handling:

Additional stages for storage with main objective to balance uneven capacity possibilities in technologies of individual stages are inserted among individual stages of RAO handling where appropriate. Period of storage and storage capacity are optimized. Mutual interdependency of technologies of individual stages is stressed in establishing of system for RAO handling and storage of RAO is considered only in case of time or technology necessity. All activities within system for handling of RAO in the long term are directed toward their disposal into appropriate type of repository, low and very low-level into deep Republic Repository in Mochovce and intermediate-level and high-level into deep repository, of which commissioning is estimated circa in 2065. Up to this time will RAO not disposable in RÚ RAO Mochovce be stored either at producer, processor or in the Integral storage in Jaslovské Bohunice. In case of intermediate-level RAO, which would be disposable into Surface Repository after conditioning, the decision on their handling method is and will be taken individually for individual kind of RAO based on safety and economical assessment whereby legislative requirement (§ 21 section 4 of the Atomic Act) is respected specifically

handling of RAO shall be govern by technical and organizational measures in order to keep their quantity and activity at the lowest possible reasonably achievable level.

Indirect effect of mutual interdependency of steps in handling of RAO thus in establishing of criteria – limits and conditions for respective stages, procedures are followed in reverse order i. e. from acceptance criteria for disposal is increasing meaning of RAO characterization. It is conducted adequately in all stages for handling of RAO. As long as it is conducted in initial stages of scheme for handling of RAO, the reason is defining of next handling of specific kind of RAO e. g. in classification. As long as characterization is implemented at the end steps of scheme, the reason is verification that respective authorized limits for release into the environment was met, eventually for disposal in repository. Substantial change in RAO characterization in last 15-20 years results from the fact that for safety significant radionuclides for long term inherent safety of repositories, two attributes are typical in general:

- their content in waste is not directly measured in general or it is difficult to measure,
- these nuclides in general are not interesting from safety aspect in stages preceding disposal of RAO.

Integral part of scheme for handling of RAO is also their safe transport from among individual technologies. This is solved in locally connected technologies for processing of liquid wastes by pipelines, in other instances by appropriated and approved transport means.

Legislative provisions for classification of RAO result consistently in accordance with approaches of international standards from possibility of their disposal in relevant type of repositories. Based on relevant definitions it is important to note there are no and as reprocessing of VJP is not considered will not be high-level wastes in The Slovak Republic. Provisions in legislation concerning classification of RAO do not prevent subject handling of RAO in different classification pursuant to practical needs (e. g. in solid wastes categorized under dose rate of gamma at the surface). However relation with legislative provided classification shall be evident i. e. for every type of RAO, form of its final disposal should be evident.

3.2.1. Handling of radioactive wastes from nuclear power plants before disposal

Basis

Essential stages for handling of RAO before their disposal are demonstrated by their classification, collection, processing and conditioning. Technologies for processing of RAO are often situated in facilities, where RAO are generated. Purpose of conditioning of RAO is change of their characteristics in a manner, which respects requirements for safety disposal, eventually in case appropriate repository is not available, also requirements for long term storage. The essence of KRAO conditioning is e. g. their solidification into appropriate matrix and into appropriate packed form. In practice there are often not clearly defined limits between processing and conditioning, e. g. some conditioning lines take part in processing of waste.

Basis for strategy in a given field is development in technologies for processing and conditioning of RAO. Basic technologies for processing of liquid anorganic RAO are: vaporization and processing on ionexes. Results of the first one are concentrates. Condensate

of vaporized water before release or reuse is finally treated by ionexes. Ionexes are primarily used for treatment of primary circuit waters, i. e. for removal of corrosive and fission products and activated boron acid. Special attention is paid in recent time to problematic processing of sludges. Innovated project of power plant MO3,4 has already expected fixation of sludges from tanks at place of their origin.

Every operating power plant is equipped with low pressure molding devices for processing of PRAO from operation. For PRAO from decommissioning for processing technology can be considered their decontamination whether pre-dismantling (for the purpose of smaller exposure of workers performing dismantling works) or final (dismantled components of facilities, but also construction structures before their demolition). For processing technologies in decommissioning installations can be also considered fragmentation and classification lines.

Transitory period between processing and conditioning of PRAO is combustion of combustible wastes and compression molding of solid wastes under high pressure in Bohunice processing centre. Combustion is also used for processing of organic wastes of liquid form. Development in the field of processing and conditioning of RAO led to present state with most used technologies for conditioning of RAO are their bitumenation or cementation into proper packing, most often steel casks, eventually containers – concrete cubic containers with edge of 1,7 m and internal volume of 3,1 m^3 , reinforced by amorphous fibers from alloy steel. In system for handling of RAO in Slovakia such containers are currently only packing form accepted in RÚ RAO for disposal because also casks with bitumenation waste, compressed ash from combustion chamber, pressings from high pressure compression compacting, pieces of metal wastes and other forms of solid or solidified wastes are cemented in the last stage (active or non-active sealing compound) into such containers.

Bitumenation is used for KRAO type of concentrates and for solidification of some types of desaturated ionexes. There are available also cementation lines for processing and conditioning of concentrates. Another of solidification technologies of eventually conditioning of KRAO is solidification into alumino-silicate polymeric matrices. It is appropriate for solidification of liquid wastes and also sludges. For processing and conditioning of high-level wastes of inorganic character from JE A1 (chrompik), technology of vitrification was developed and built. At the beginning of 90s management of state corporation SE decided about building of Bohunice processing centre. In this time this centre, in which full pressure compactor, combustion chamber and cementing line is located becomes a part of TSÚ RAO owned and operated by JAVYS. There is also a facility „Final processing of liquid radioactive wastes“ in operation in Mochovce. Both facilities mentioned above have available capacity reserves; their capacity is not limited factor in system approaches for handling of RAO from operation and decommissioning of nuclear installations.

It is desirable to implement approaches, which significantly improve effectivity and economics of handling of RAO at unchanging or improved level of nuclear safety. This is achieved by minimalization of wastes predominantly from view of their source, by effort for recycling of radioactive materials from operation and especially of decommissioning, which due to low radioactivity are not considered to be RAO, eventually release of such materials from under regulatory authorities and by separated depositing of so called very low-level RAO in repositories with less requirements for engineering barriers at unchanging level of nuclear safety.

Special aspect of treatment with RAO is need for treatment with contaminated soils in locality Jaslovské Bohunice. Contamination of soils is the result of past approaches to projecting, construction and operation of facilities for storage of radioactive wastes in JE A1. Some contaminated soils were excavated in past and located in spaces available at that time. Contaminated soils, which pursuant to legislative rules are considered for so called radioactive resins should be excavated, analyzed in radiological control, classified according to detected level of contamination and treated as RAO or released into environment.

Aims and requirements

Aim of RAO handling before their disposal is producing of such packing forms of wastes complied with acceptance criteria for disposal in present and in future where given type of waste will be deposited. Considering minimalization requirement decision in strategic approach to waste disposal, decision is made based on combination of safety and economical factors. In considerations on their surface or deep disposal there are always important optimization of solution and balance between activity and quantity of RAO. In case of RAO from operation and decommissioning and also in most part of IRAO planned to be deposited in Surface Repository are parameters of containment in processing and conditioning within limits and conditions of RÚ RAO in Mochovce. In case of RAO do not conform to acceptance criteria for Surface Repository it is necessary to maintain the best possible level of flexibility of their packing form in steps preceding disposal and to ensure in long term storage that no change of their characters, which would negatively affect their future deep disposal will occur.

Thesis of National Programme

Strategy for handling of RAO from nuclear power plants is based on fact there is not significant difference between handling of wastes originated during operation and wastes generated in decommissioning of nuclear installations. Naturally: their quantity, type and composition will be different. In decommissioning of nuclear power plant standard operating in standard way, there will be in general less portion of liquid wastes and larger portion of solid wastes generated from dismantling and demolition works. In wastes from decommissioning there may be different portion of safety significant radionuclides affecting further handling of them.

The Strategy does not envisage using of other technologies of processing and conditioning of RAO and other packing form than it is applicable in present. As long as new technologies for processing and conditioning or radioactive wastes will be introduced, reason would not be

capacity but improving effectivity and safety of whole system for handling. An example is implemented technology improvement of Bohunice processing center.

An exception of this statement may be considered new fragmentation and classification lines, need for construction, what reflects procedure for decommissioning of nuclear power plants A1 and V1. An example of new technologies is also introduction of technology for remelting of metal radioactive wastes. Its contribution is increase of concentration of some radionuclides from metal wastes (especially from decommissioning) into debris; thus it is possible to reach reduction of radioactivity in ingot, which will be generated from remelting containing especially ^{60}Co.

Costs for construction and commissioning of fragmentation and classification lines and also technologies for remelting of metals (including costs for their decommissioning) are complied with Conceptual plan for decommissioning for A1 and V1 and it is supposed they will demonstrate at the same time more effectivity of activities and implementation of austerity measures.

Curved line of integrated dependency for need to dispose of packing forms of wastes in RÚ RAO on time (from decommissioning of nuclear installations) shows the steepest increase from 2014 till 2026 (see Fig. No. 4). In this time expectations call for conditioning and subsequently depositing up to 460 packing forms of conditioned wastes per year. Comparison of this number with current production of packing forms of wastes and with rate of their disposal, it may be stated that in system for handling of RAO, technologies for handling before their disposal will take place have adequate capacity reserves.

Problem left is processing and conditioning of abnormal RAO situated in JE A1. From the first sight it seems that need for technologies and their utilization will be not significantly affected by new provision of last amendment of the Atomic Act on obligation of power plants to transfer its generated radioactive waste for further processing and conditioning until 12 months from their origin. As intended increase of operating life time of operating nuclear power plants is concerned it may be stated from the first sight it would not affect requirements for handling of RAO before depositing and with exception of time delay it would not come to significant changes in decommissioning, including balance of wastes from decommissioning.

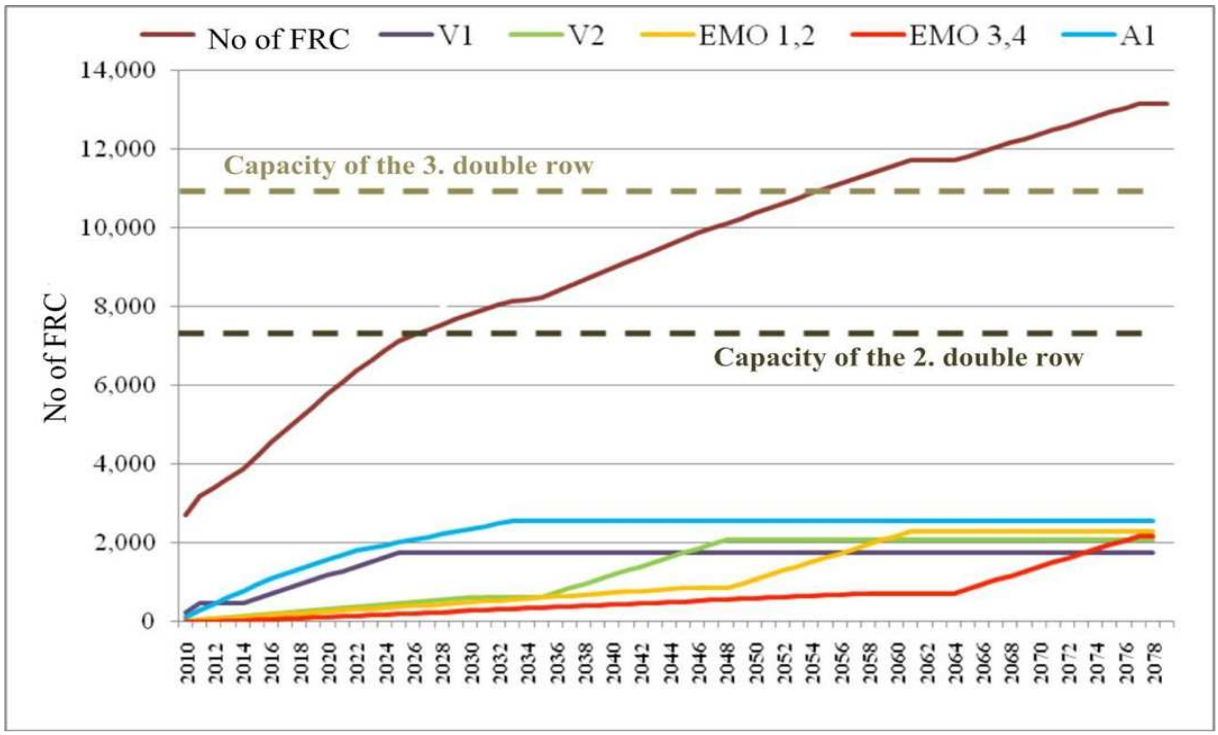


Fig. No. 4 Time schedule of the RAW production which is possible to dispose into RR Mochovce taking into account the VLLW will be disposed separately

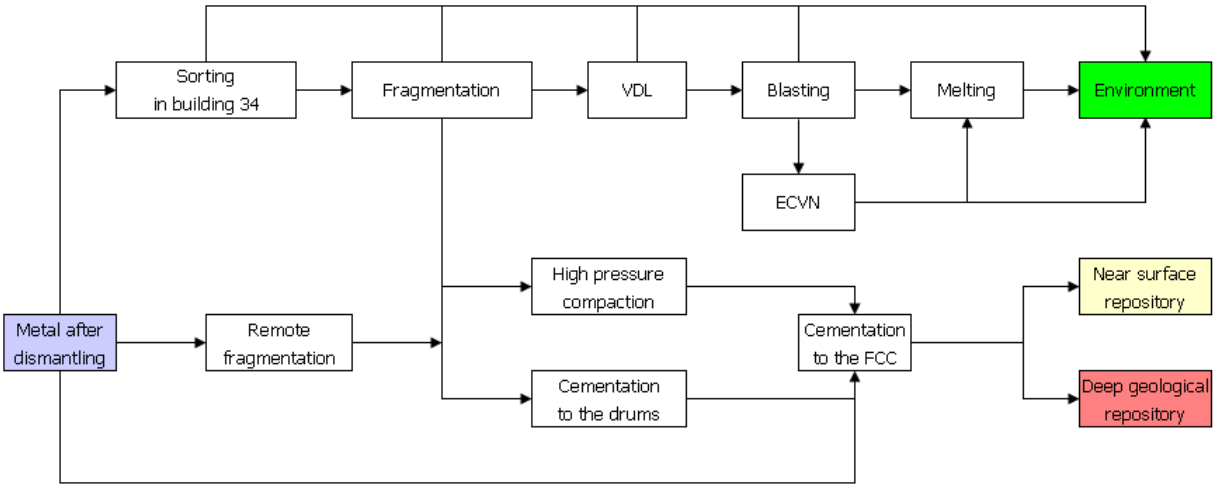
3.2.1.1. Classification of RAO from processing aspect

From processing viewpoint we divide RAO into solid, liquid and gaseous, whereby gaseous RAO are monitored pursuant to applicable rules and released into atmosphere pursuant to applicable limits.

Solid RAO

We divide solid RAO into metal RAO (carbon, stainless steel, non-ferrous metals) and nonmetal RAO (combustible, compressible, other).

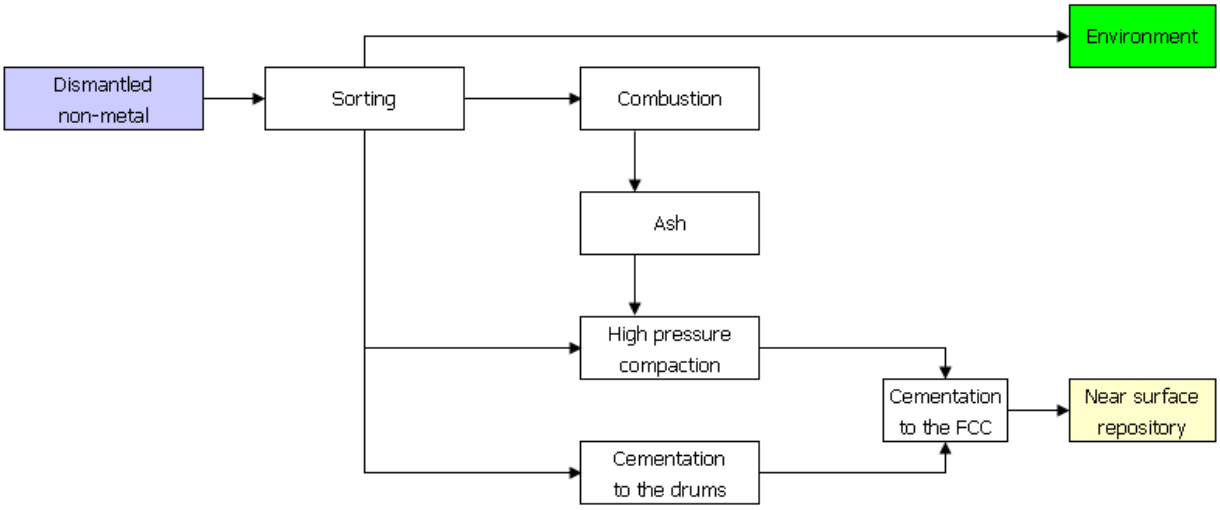
Conception for handling of metal RAO (carbon, stainless, non-ferrous metals):



Conception for handling of nonmetal RAO

Handling of nonmetal RAO we divide into:

- materials, which can be released into environment,
- combustible RAO,
- high pressure compacted RAO,
- other RAO.



Legend:
VDL - large-capacity decontamination line
ECVN - electrochemical case decontamination of anti-corrosive steel

From above mentioned topics for handling of metal and nonmetal RAO results that in case of failure to meet limits for release of materials into the environment are products of processing of such RAO deposited after processing and conditioning into VBK in RÚ RAO.

Specific feature of decommissioning of nuclear power plants in site of Jaslovské Bohunice is necessity for handling of contaminated soils.

Contaminated soils need to be excavated, analyzed in radiological control, classified and deposited according to detected level of contamination or eventually released after monitoring into the environment. After separation of material from contaminated soils, conditioning and radiological monitoring, decision will be taken on further handling of sorted material:

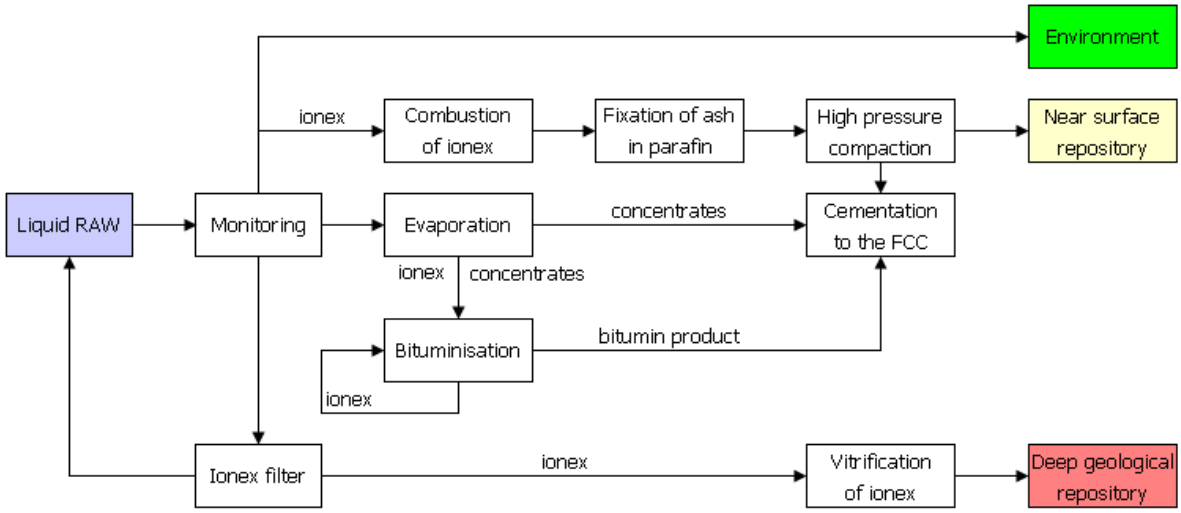
- soil suitable to be released into the environment without restriction
- soil suitable for depositing into underground tanks in locality and retain there while this variant will be accepted from nuclear safety and radiation protection point,
- soil, which will be deposited in repository for very low radioactive waste,
- soil, of which radioactivity is so high that it will be stored in steel casks and subsequently conditioned for disposal in RÚ RAO.

Next specific type of wastes generated especially from decommissioning is contaminated concrete. Blocks of concrete are decontaminated at relevant work place by dry methods in such a manner that they can be released into the environment. While concrete takes form of debris it is processed after its assortment into casks by size of fraction and measured activity, at BSC RAO or released into the environment.

Liquid RAO

Liquid RAO considering level of activity could be divided into these groups:

- liquid RAO proceeding to the process of vaporization,
- liquid RAO proceeding for reason of high activity to treatment at ionex filters
- other liquid RAO.



In process of KRAO treatment eventually in their processing at facility for vaporization and bitumenation desaturated ionex filters are generated as secondary RAO processed normally by bitumenation. In case of higher activity ionex filters could be solidified into vitrification form. At present there is technology for combustion of used ionexes in the locality Jaslovské Bohunice.

There are specific liquid RAO situated in JE A1. There are chrompik and dowtherm. Both serve as coolant of spent fuel cells with typical higher volume of contamination than in other kinds of KRAO. Dowtherm is disposed of in combustion process in combustion chamber of BSC after eventual filtration ensuring reduction of activity to acceptable level according to the applicable Limits and conditions for safe operation. Chrompik is solidified by vitrification into special caskets – cartridges stored in interim storage intended exclusively for this purpose. The most problematic category of wastes are sludges from tanks because of their high volume activity and quite difficult manipulation. Consequently, facility for fixation of sludges was developed for their treatment.

Products of processing of chrompik, dowtherm eventually sludges not disposable in RÚ RAO will be stored until their final disposal in integral storage of RAO.

3.3. Conceptions, plans and technical solutions for handling of spent nuclear fuel

3.3.1. Storage of spent nuclear fuel

Basis

Interim storage of spent nuclear fuel in Jaslovské Bohunice exploits the way of storage, where fuel cells are placed into basin filled with water (so called wet type of storage). Original purpose was to store spent nuclear fuel from operating power plant in Jaslovské Bohunice in 10 years until its safe export to the Soviet Union (see also Chapter 12), what corresponded to original storage capacity of 5 040 units of spent fuel cells. After suspension of export management of SE, a. s. has decided to expand the capacity of Interim storage. After reconstruction focused on change in arrangement of stored containers (gradual change of stored containers for the ones of new design, still in progress), MSVP will reach higher final storage capacity (14 112 units of spent fuel cells, i. e. circa 1 700 t of toxic metals). Reconstruction also fulfilled requirements for seismic reinforcement. Operator achieved approval of prolongation of operating lifetime of storage to 50 years by this reconstruction. Capacity of storage is then adequate for storage of all spent nuclear fuel produced by power plants of type VVER in the locality Jaslovské Bohunice provided 40-years of operational lifetime. To the date of 12.31.2014 there were stored in MSVP in total 11 285 units of fuel cells, of this 5 143 units from JE V1, 4 606 units from JE V2 and 1 536 units from JE EMO 12.

Construction of dry storage based on principle of double purposed transport-storage containers was expected for nuclear power plants in Mochovce. Projecting studies, eventually feasibility studies were developed and all process of EIA implemented and finalized by release of concluding opinion of the Ministry of Environment. Management of owner/operator of EMO 12 decided then to postpone this investment and utilize capacity of Bohunice storage released as a result of preliminary shut down of units of nuclear power plant V1. The first transport of spent nuclear fuel from locality Mochovce to MSVP Jaslovské Bohunice took place in April 2006; to the date 06.30.2013 1 296 units of fuel cells were transferred to storage in this manner. At present pursuant to respective provision of amendment of the Atomic Act No. 143/2013 Coll. for storage of spent fuel in separate nuclear installations – stores is authorized a. s. JAVYS.

Objectives and requirements

The objective is to ensure uniform acceptance of fuel assembly from operating Slovak nuclear power plants for long term storage until the period of their safe disposal in deep repository or

transport for reprocessing. Originator of VJP has power to decide on its re-utilization during its storage at its own expense.

Thesis of National Programme

It is necessary still in this decade to ensure adequate long term storage capacities for spent nuclear fuel from Mochovce nuclear power plants. JAVYS, a. s. develops investment intent focused on building Dry Interim Storage of VJP. It is expected that new storage capacities for spent nuclear fuel will be available until 2020.

4. APPROACHES TO REPOSITORIES OF RADIOACTIVE WASTES AND SPENT NUCLEAR FUEL AFTER THEIR CLOSING

4.1. Surface repository for low-level radioactive wastes

In case of Surface Repository in Mochovce after termination of operation and termination of placement of packed form of RAO in its segment intended for disposal of low-level RAO, stage of closing and institutional control will follow. Objective of activities for period of closing will be implementation of backfilling with purpose of long term stabilization of the system of disposal boxes, implementing of so called the I. stage of covering and subsequently also definite covering. Advantage of change of the conception of Mochovce disposal is the decision on building of separate halls over the I. and the II. double row of disposal boxes, which demonstrates protective element against atmospheric effects during disposal of VBK within operation of repository and at the same time they provide flexibility and time coordination at closing of such double rows and implementation of the I. stage of covering. This procedure is expected after 2026.

Definitive covering in principle can be implemented after complete termination of depositing in given locality, thus in the second half of this century and it will be preceded by removal of protective halls. Definite covering of all site will become topic for a separate project and its the most thickest part will consist of clay layer. Further it will consist of geotextile, drainage layers, and soil cover with appropriate vegetation. After complete covering, the repository will look like moderately elevated grass plateau. It is expected that at the place of site so called „permanent marker“ will be built what would represent object – monument „for ever“ warning of radioactive waste deposited at the place. It is important to note that analysis for long term (inherent) safety of repository, conservatively do not consider this object.

From legislative point of view activities of repository closing and institutional control are subject of special permission process pursuant to the Atomic Act. Based on fact that implementation of backfilling has already represented activity falling under the definition for repository closing, this process may be expected in a short time. The Atomic Act in this context explicitly introduces documentation necessary for issue of permission for closing of repository, which should include inter alia submitted plan for closing and also overall state assessed before closing and inventory of waste disposed including update of safety analysis.

Concept for the stage of repository existence after its closing is accordingly defined in preoperational safety documentation and is and will be updated in every safety documentation arising from periodical safety assessment. It is based on so called institutional control of repository i. e. on continual monitoring of repository environment and control and maintenance of functioning of its barriers (active institutional control) and on long term

prevention of entrance and any activities on covered site (passive institutional control). The concept includes archivation of information concerning repository and wastes disposed within by method corresponding to technical level in a given time. Defining of scope of keeping given records and also scope and form of implementing institutional control will become part of above mentioned permission for closing of repository and institutional control. Thereto the holder of this permission will be obliged to ensure execution of eventual remedial measures and interventions if necessary in case of unplanned release of radioactive substances.

For analysis of long term safety based on approaches to topic of institutional control in development of their methodology was legislatively originally stated period of institutional control for this type of repositories to 300 years, today they are views on *"period of institutional control from closing of repository required for continual maintenance its safety functions and on procedure pursuant to § 22 section 4 of the Atomic Act (keeping of records, execution of institutional control itself, in case of need execution of remedial intervention)"*.

Implementation of particular activities of period of institutional control especially its passive stage will begin at some time at the end of this century. Important from present-day view is especially estimated duration of institutional control as it concerns important parameter of analysis of long term safety of repository; eventually calculations deriving acceptance criteria for wastes for disposal. Safety analysis eventually deriving of acceptance criteria for wastes are based inter alia on (conservative but possible) vision that loss of information on existence of repository may once occur and even in this case the repository shall be inherently safe. In other words in present it is possible to place into repository only wastes from such activities, which will not cause loss of information in time of repository existence non-accepted (in present view) exposure of people even in case when they not informed on its existence enter in its site to live, execute various construction activities and so on.

4.2. Surface repository for very low-level radioactive wastes

It should be noted that at repository with very low-level wastes in case of The Slovak Republic advantages of shorter duration of institutional control is logically lost (shorter because of very low level of disposed activities, thus from the fact that radionuclides of very low-level wastes will sooner become product of radioactive decay to negligible level), because placement of this repository in the site of existing Surface Repository in Mochovce. Next disadvantage of this solution is accumulation of activity contribution of individual radionuclides from both types of repositories, which occur in scenarios of standard development within safety analysis as common inventory of all locality. However, existence of both types of repositories in one locality provides other advantages, what supports selection of this alternative one of which is coordination in solution for definitive covering.

Proposal of method and scope of closing and institutional control of repository for very low - level radioactive wastes is at present in developing phase within documentation, which will be

submitted in the procedure for issuance of construction permission. This applies again that concept of solution for existence of repository in a stage after its closing given in safety report will be subject of documentation update at every process of periodical safety assessment during operation period thus every 10 years.

From legislative viewpoint activities of repository closing and institutional control are the subject of special permission process pursuant to the Atomic Act connected with submission of required documentation.

There is assumption that building of the Surface Repository for very low-level RAO will lead to more effective and safety method of RAO disposal.

4.3. Deep repository for intermediate-level and high-level radioactive wastes and for spent nuclear fuel

When deep disposal is concerned, it is obvious from the fact that there are no operating deep repositories that even worldwide unified approach to the philosophy of termination of operation of such repositories has not been developed up to the present day. It is not clear which form will take institutional control in case of deep repositories after its closing in the context discussed above. At present opinions exist on the need for possibility to retrieve deposited fuel from deep repository, so it is not clear which time-space relation will be between termination of disposal itself and its closing, eventually whether the condition of retrievability will be met merely during operation of repository, or possibility for technical implementation assurance of retrievability will be met also in the period after closing. At the moment rather the rule proceeds that already after definite closing of deep repository any further control has not needed to be considered: the repository shall be placed, built, operated and after some time closed in a manner (i. e. it should possess such characteristics) that possibility of unintended entrance into disposal spaces is practically excluded and the same is applied also in case of loss of information on existence thereof.

It was obvious in development of the Republic Repository of RAO from the eighties of last century that not all RAO generated in operation and especially in decommissioning of nuclear power plants will be appropriate for depositing in this surface type of repository from the viewpoint of nuclear safety. Likewise as a result of geopolitical changes in the region of central and east Europe from the nineties it has been obvious that The Slovak Republic will have to implement disposal of spent fuel from Slovak nuclear power plants at its own expense. Works on programme for development of deep geological repository in The Slovak Republic began in 1996. A whole dossier and studies was developed concerning:

- selection of locality,
- approaches to the project of deep repository,

- demonstration of repository safety from viewpoint of method and analyze of processes and phenomena concerning migration of radionuclides from disposed fuel up to the biosphere,
- public participation,
- coordination, planning, assessment and cross-sectional activities (system for quality management, legislative issues, international cooperation, etc.).

While carrying on working within the program itself The Slovak Republic participated actively in international activities, which would lead to implementation of deep repositories shared by more states of Europe – firstly by participation in scientific-research projects of framework programs of the EU, later by participation in relevant work teams.

From 2010 pursuant to relevant legislative proposals and delegations company JAVYS, a. s., which resumed the Programme for development of HÚ in SR has become the implementator of deep disposal in The Slovak Republic. Programme, which is implemented at present under the title "Deep repository – selection of locality, the I. stage", is conceived for the period 2013 – 2016. Firstly it is based on assessment of existing activities with the aim to utilize knowledge acquired in past. It was demonstrated that inter alia there is knowledge from the field of locality selection, in which it is still possible to consider 5 study and 2 candidate localities selected for further survey and research.

In updated Feasibility study, which is being prepared within the project for development of HÚ (2013-2016) the term of HÚ commissioning – 2065. Considerable working time for project implementation was reviewed in technical and especially safety aspect (safety assessment, analysis and operation of underground laboratory before commissioning of actual HÚ).

Increased time demands are caused by change in approach to public. Experience from whole world demonstrates that political acceptance of repositories in public (eventually its elected representatives) and local community is necessary for implementation of repositories. Obtaining consent of affected communities with placement of repository looks to be bigger problem than finding appropriate locality based on geological and other requirements. Consequently the topic of Strategy for communication with the public is treated within the project for development of HÚ in SR (2012 – 2016) and in compliance with developing National Programme for handling of VJP and RAO is necessary up to 2018:

- To form and develop implementation of the system for economic stimulation of localities affected by development and operation of repositories,
- To form complex system for information and communication with the public for the long term.

5. NEED FOR RESEARCH, DEVELOPMENT AND DEMONSTRATING ACTIVITIES

The National Programme implements the Directive 2011/70Euratom based on the need to ensure safe disposal of all generated RAO and/or VJP. Basic aim and requirement is significant change in approach of all concerned parties to the need for research, development and demonstration activities.

More organizations for example JAVYS a. s., VUJE a. s., AMEC Nuclear Slovakia s. r. o., State Geological Institute of Dionýz Štúr, DECOM a. s., ZTS VVÚ Košice a. s. work in a given field in Slovakia, which deal also with research and development.

Slovakia has at disposal also several established and internationally recognized scientific-research institutions, of which scientific-research potential is applicable for addressing problems connected with the field of decommissioning of nuclear installations or VJP and RAO. They include STU Bratislava, UK Bratislava, TU Košice or SAV Bratislava. Research in these institutions is implementing usually in cooperation with domestic and foreign grant agencies but also for needs of actual subjects from industry practice.

As far as infrastructure of equipment is concerned, it is distributed at workplaces of individual organizations, whereby most of it is placed at workplaces enabling work limited to simulated and not real radioactive materials and wastes.

In the field of handling of RAO in Slovakia, there is more than 30 year of experience above all in existing institution VUJE, a. s.

The first necessary step is to achieve the level of disposal of RAO and/or VJP at the side of implementator, which corresponds to requirements of the Directive. It is connected to continuing education of internal experts in such a manner that study of individual fields will be conducted for them at renowned workplaces, eventually intensive courses in abroad. Necessary step is also participation at international projects of scientific-research type within framework programs of the European Union and in initiatives explicitly mentioned in preamble of the Directive.

Fields for possibility of utilization of science and research

For decommissioning of nuclear installations

- safety aspects of disposal of RAO from decommissioning (surface repositories),
- specific questions of processing of RAO in Nuclear power plant A1 (chrompik and other high-level RAO),
- streamlining of decommissioning of nuclear installations (minimization of wastes).

For VJP and RAO

- long term storage of VJP,
- disposal into repositories of VJP,
- transport of VJP, RAO,
- processing and conditioning RAO for storage or disposal,
- mechanisms of generation of gases in filled VBK after their disposal (for example radiolysis of water, radiation decay of bitumen, corrosion of metal RAO, anaerobic biodegradability of organic RAO etc.) and assessment their possible impacts on mechanical characteristics of VBK determining its integrity in relation to gas permeability.

For repositories

- closing and institutional control,
- monitoring of long term behavior of matrices used for fixation of RAO with the aim of possible influence on assumptions of safety analysis of RÚ RAO Mochovce,
- verification of operating life time of VBK in chemical environment and real conditions of disposal boxes in RÚ RAO Mochovce,
- specification of intrusion scenarios in order to declare long term safety of repository for disposal of IRAO characterized as pointed and quasipointed sources, eventually RAO with inhomogeneous distribution of activity.

Field of demonstration activities

In the field of demonstration activities it is the existence of model for covering in the site of RÚ RAO required by ÚJD SR in relevant decision authorizing operation of the repository. Based on significant meaning of characteristics of covering for total long term safety of the repository, long term experiments in real model for covering and measurements of characteristics for covering in real conditions are executed.

It is necessary still to replace and retrain scientific-research pool supporting approaches to disposal of RAO on the side of implementator. In cooperation with scientific-research workplaces of universities activities usable also for need for disposal may be identified, for example research of bentonites, general behavior clay rocks etc. It is further necessary to deal with the fields supported in original Programme for development of Slovak deep repository in 1996-2001 by Czech institutions, especially:

- study of source element for needs of verification of safety of deep repositories,
- study of interactions in near field for needs of verification of safety of deep repositories.

Analogical studies for needs of verification of safety of the repository in Mochovce were in the past conducted ad hoc in case of necessity, for example the research of carbonation of concrete, migration and other characteristics of clay.

6. RESPONSIBILITIES, MONITORING OF IMPLEMENTATION

6.1. Legislative and supervisory framework

As regards authorities conducted supervision on nuclear installations for handling of RAO and VJP, we will look here at major ones:

- Nuclear Regulatory Authority
- Public Health Authority of The Slovak Republic
- Authorized department of head hygienist of Ministry of Transport, Construction and Regional Development of The Slovak Republic.

Naturally this mission in the field of supervision of activities and facilities based on rather uniquely determined legislative provisions is fulfilled also by other state authorities e. g.: National Labour Inspectorate, authorities for water protection, authorities for waste management, building authorities etc.

The first of major state regulatory authorities acts in the field of nuclear safety of nuclear facilities and nuclear materials. The other two act in the field of radiation safety, eventually protection against the effects of ionizing radiation. Definitions of nuclear safety and radiation safety in general are mutually overlapped, eventually they are mutually supported or connected. It follows competencies and activities of major supervising authorities to some extent can not be overlapped. Legislative provisions were amended many times from 1993, the year of establishing of Nuclear Regulatory Authority after The Slovak Republic was established, often with the aim to separate competencies of both supervising authorities especially in the field with handling of RAO.

Current conditions in competencies in conducting of supervising functions (put simply: agreement procedure, issuance of opinions, approvals, permissions and control/inspection activity) in the field with handling of RAO and VJP is as follows:

❖ **Nuclear Regulatory Authority**

- conducting state regulation on nuclear safety of nuclear installations, which involve under the definition also installations for handling of RAO and VJP; handling of RAO is consequently for these needs *("for the purposes of this – Atomic – Act"*) defined as follows:

"under handling of radioactive wastes radioactive wastes collection, classification, storage, processing, conditioning, manipulation and placement of RAO from nuclear installation, institutional radioactive wastes, orphan sources, RAO of unknown origin, unused radioactive sources, if such activities are conducted in one installation at the same time with activities with radioactive wastes from nuclear installations; for handling of RAO is not considered its

transport (it is defined under the scope of provisions on transport of radioactive materials).”

- informs the public on facts concerning nuclear safety of nuclear installations, including handling of RAO and VJP,
- provides coordination to National Nuclear Fund in providing explanations or information for the European Commission on revision of the National Programme,
- submits in cooperation with the Ministry of Economy, National Nuclear Fund and with holders of permission the report on implementation of the Directive to the European Commission, firstly as late as the August 23, 2015 and subsequently every 3 years, whereby assessment process pursuant to international agreement, of which The Slovak Republic is bound, is used (Common Agreement on safety of spent nuclear fuel handling and on safety of radioactive waste handling),
- may impose suspension of handling of RAO and VJP,
- designates new holder for handling of RAO, where originator is not known or originator is not able of safety handling thereof,
- reviews The Proposal for The National Policy for handling of spent nuclear fuel and radioactive wastes and The National Programme for implementation of National Policy for handling of spent nuclear fuel and radioactive wastes with proposal of financial plan for their implementation and issues professional opinion to these proposals,
- controls complying with obligations resulting from international agreements in the field of handling of RAO and VJP, by which is The Slovak Republic bound
- issues approval with placement of nuclear installations and with release of nuclear installations from under jurisdiction of the Atomic Act; issues permission for commissioning, operation, decommissioning stage, closure of repository and its institutional control, handling of RAO and VJP itself, return transport and import of RAO,
- constitutes competent authority for transport of RAO from nuclear installations, transport of VJP and transport of institutional wastes from place of conditioning to repository,
- issues opinion in process of EIA,
- issues generally binding legal regulations and safety instructions/methodical tools.

❖ **Public Health Authority of The Slovak Republic:**

- decides on proposals for placement, construction, commissioning and decommissioning of nuclear installations, on proposals for construction and technological changes on nuclear installations and for new procedures in decommissioning, on proposals for types of transport facilities for transport of radioactive sources and radioactively contaminated facilities,

- sets conditions for implementation of activities leading to exposure, including maximum effective doses for optimization of radiation protection (within it inter alia final doses of exposure for individuals of public was stated for verification of long term safety of Mochovce repository), activities essential from radiation protection viewpoint and for release of radioactive substances and radioactively contaminated objects and materials from under administration control; it issues directives and instructions to this,
- issues permissions for
  - activities associated with operation and decommissioning of nuclear installations
  - collection, storage and conditioning of radioactive sources, including ionized fire detector for purpose of disposal,
  - handling of radioactive resins, wastes and VJP,
  - handling of orphan sources, radioactive wastes of unknown origin and sealed radioactive sources,
  - release of radioactive substances and radioactively contaminated objects from under administration control,

  and at the same time it conducts state health inspection in these activities,
- search for workplaces and facilities, where orphan sources may occur.

❖ **Authorized department of head hygienist of Ministry of Transport, Construction and Regional Development of The Slovak Republic:**

- issues permissions for transport by road, air, rail and ship of radioactive sources, RAO, VJP and radioactively contaminated objects, which due to their activity can not be released from under administration control,
- search for workplaces and facilities in transport branch, where orphan radioactive sources, eventually radioactively contaminated objects may occur,
- solves situation resulting in connection with interception of orphan sources and non-declared radioactivity within transport or providing post services,
- at the same time it conducts consultation activity and state health inspection in these activities.

Legislative framework for the field of handling of RAO and VJP is given in the Annex No. 1.

6.2. Subjects functioning in implementation of the National Programme

Infrastructure of the final stage of peaceful utilization of nuclear energy is based on existence of following types of organizations:

- operators of nuclear installations and facilities utilizing radioactive materials in research, education, industry and medicine,
- organizations implementing decommissioning of nuclear installations,

- organizations implementing handling of RAO or VJP with exception of their final disposal,
- organization authorized for final disposal of RAO and VJP,
- supervising authorities mentioned in chapters above issuing various kinds of authorizations and permissions and executing supervision over holders of relevant permissions from viewpoint of complying with legislative requirements,
- management of financial sources from contributors intended for the final stage of utilization of nuclear power engineering (National Nuclear Fund),
- concerned ministries and other state authorities, especially ministries of Economy, Finance and Environment and their mutual relations.

Responsibilities of individual subjects

In SR handling of RAO and VJP is addressed by company JAVYS, a. s. and SE, a. s.

JAVYS, a. s. at present owns and operates, eventually decommissions:

- nuclear power plant A1,
- nuclear power plant V1,
- interim storage of VJP in Jaslovské Bohunice,
- nuclear installation "Technologies for processing and conditioning of radioactive wastes" in Jaslovské Bohunice,
- nuclear installation "Final processing of KRAO" in Mochovce,
- Republic Repository of RAO in Mochovce.

SE, a. s. at present owns and operates:

- nuclear power plant V2 in Jaslovské Bohunice,
- nuclear power plant EMO 1,2 in Mochovce,

SE, a. s. currently implements construction of nuclear power plant EMO 34 in Mochovce.

JESS, a. s. (Nuclear energy company of Slovakia, a. s.) at present provides supporting studies for new nuclear power plant in locality of Jaslovské Bohunice.

Construction of other installations in SR is being prepared, especially:

- deep repository, commissioning of which is expected circa in 2065,
- repository of very low-level wastes in the site of existing repository in Mochovce,
- so called non-nuclear installation – installation for handling of IRAO and ZRAM of The Slovak Republic in vicinity of the site of existing repository in Mochovce,
- integral storage of RAO in Jaslovské Bohunice,
- completion of storage capacities of VJP,
- building and commissioning of new fragmentation and classification lines,
- building of facility for remelting of metal RAO.

Amendment of the Atomic Act No. 143/2013 Coll. inter alia introduced new provision of the Atomic Act, which actually modifies infrastructure of handling of RAO and VJP in The Slovak Republic. New section 3 in § 10 including title shall be worded as follows:

> *"In the interest to ensure nuclear safety and prevention of unjustified accumulation of radioactive wastes and spent nuclear fuel is the holder of permission obliged during commissioning of nuclear installation and during operation of nuclear installation to transfer radioactive wastes as late as up to 12 months from their origin and spent nuclear fuel immediately after meeting requirements for its safe transport and storage to legal person established pursuant to § 3 section 9 for further handling of them."*

This legal person authorized for further handling of VJP and RAO was designated company JAVYS, a. s. Quoted provision concerns RAO originated after above mentioned amendment took effect. However, the said amendment amended also provision concerning responsibility for handling of RAO as follows:

> *"For assurance of safe handling of radioactive wastes in line with the National Programme up to their adoption to repository is liable the originator of radioactive wastes and for safety of facilities for handling of radioactive wastes the holder of permission for handling of radioactive wastes is liable. The holder of permission pursuant to § 5 section 3 points b) through d) is liable for safety aspects of nuclear facility including radioactive waste, which is handled there. If the holder of permission pursuant to the second sentence handles in nuclear installation with radioactive wastes originated in nuclear installation, in relation to which other person is the holder of permission, then in every step of handling with radioactive wastes shall be the liability established between such two holders of permission for radioactive wastes in the installation, in which they are handled."*

Infrastructure for handling of RAO and VJP, roles and liabilities of individual subjects within and also their mutual interactions are clearly depicted in the Figure No. 5. In Figure as yet is not considered new expected nuclear energy source in Jaslovské Bohunice.

New Act on NJF is expected in The Slovak Republic. The aim is to create legislative proposal defining complex of all aspects of infrastructure and distribution of rights and obligations in the field of handling of RAO and VJP and to move closer to best world practice and recommendations of European and international institutions (European Commission, IAEA, OECD, FORATOM). In connection with the amendment of the Atomic Act No. 143/2013 Coll. there is a need for optimization of provisions concerning transfer of RAO to JAVYS company.

Basic philosophy of current infrastructure

Current infrastructure and distribution of competencies in the field of the final stage of nuclear energy satisfies in number of points world practice and recommendations of

international institutions. Basic philosophy of distribution of obligations has already been established at the moment of the Atomic Act formation and divides them into two sides.

On one hand current holders of relevant permissions from ÚJD SR (JAVYS, a. s. and SE, a. s.), which are liable for handling of RAO and VJP, they produced (including Classification and Collection of RAO, Processing of RAO, Conditioning of RAO, Storage of RAO and VJP and transfer of RAO and VJP to Repository) and also for Decommissioning of all nuclear installations, they operate. These liabilities concern to company JAVYS, a. s. and company SE, a. s.

On the other hand there is a state liable for Disposal of RAO and VJP and thus also for construction and operation of Repositories. Such distribution of competencies corresponds to world standards, because ultimately it is always the state, which shall address disposal of RAO and VJP.

Commercial vs. public activities

Under above mentioned philosophy the main burden of liability up to the moment of transfer of RAO and VJP to Repository is borne by current operators (SE, a. s. and JAVYS, a. s.). The liability concerns Classification and Collection of RAO, Processing of RAO, Conditioning of RAO, Storage of RAO and VJP and Decommissioning of their installations. In any case operators cannot avoid this liability or transfer it to other person. Operators may run a business and generate profit in this field, corresponding part of which shall be paid to Nuclear Fund especially for the purposes of decommissioning of nuclear installations. Taking into account that state is not liable for these activities, such activities are especially of commercial nature.

After the moment of transfer of RAO and VJP to Repository, state assumes the liability for RAO and VJP. In this respect it is yet not commercial activity but public service based on the fact how the country in last stage of handling of RAO and VJP will address the issue (especially from costs of originators of such RAO and VJP). Activities in this field then are not of a commercial nature but public nature. Despite of the fact that services connected to processing of operating RAO and storage of VJP in operation may provide pursuant to the legislation only organization authorized by the state, these prices are not the subject of any regulation.

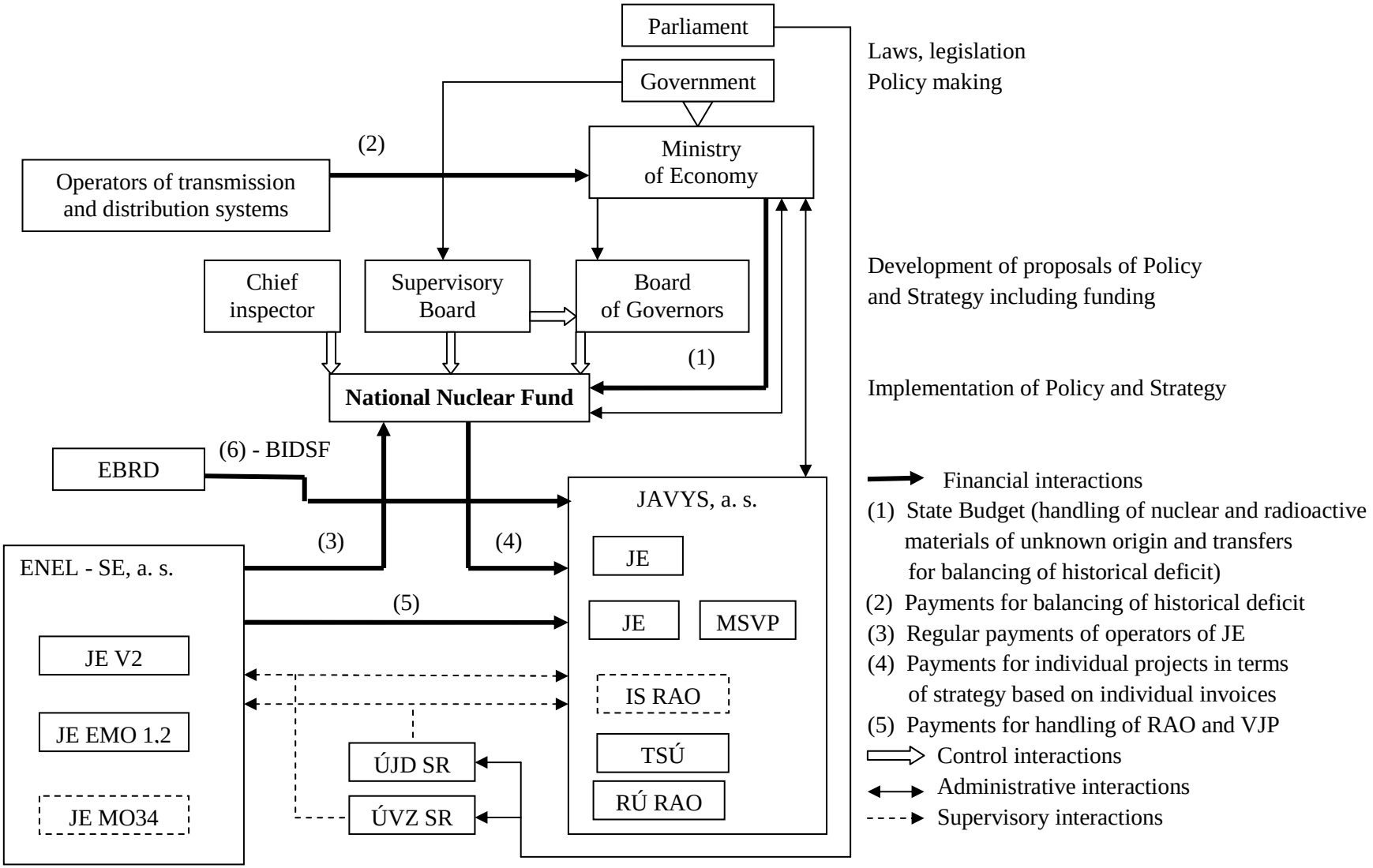


Figure No. 5: Current infrastructure for handling of radioactive wastes and spent nuclear fuel

6.3. Control and monitoring of implementation of the National Programme

Factual check and monitoring of implementation of the National Programme will conduct the Ministry of Economy of The Slovak Republic. National Nuclear Fund with its Board of Governors together with JAVYS, a. s. and SE, a. s. will develop report on implementation of the National Programme for previous calendar year supplemented by opinion of the Nuclear Regulatory Authority of The Slovak Republic. The report then will be approved by the Ministry of Economy of The Slovak Republic and submitted to the Government of The Slovak Republic.

The Slovak Republic submits in three year intervals the report on progress achieved in implementation of the National Programme for previous period after discussion by the Government of The Slovak Republic to the European Commission.

The Slovak Republic shall make use of opportunity (once in ten years at minimum) for inviting international “peer reviews” organized for assessment of the National Programme and its implementation.

7. PLAN FOR COSTS FOR DECOMMISSIONING, HANDLING, FINANCIAL SCHEME

System for financial provision for the final stage of peaceful utilization of nuclear energy in SR is based on principle “polluter pays” and respects requirements of the Act on NJF in the field of handling of spent fuel and RAO and also the Directive of the Council 2011/70/EURATOM based itself on following fundamentals:

- policy of proportional and relative distribution of financial resources,
- policy of nondiscrimination and transparency in management and distribution of financial resources,
- policy of sufficiency of financial resources.

Basic responsibility of state is creation of legislative framework and procedures, which ensure that financial resources needed for activities for the final stage of peaceful utilization of nuclear energy were available in time of their need.

The proposal of plan of financial provision states basic framework for procedure of NJF SR in management of financial resources falls in the system of public finance. It is based on the premise that asset and expenditure side of NJF in the long term horizon is set in such a manner that it will achieve overall balance in management. In operation of nuclear installation such quantity of financial resources would be accumulated that it will be adequately for its future decommissioning, including handling of RAO and spent fuel, i. e. NJF would generate neither deficit nor surplus of financial resources. Meeting the premise is exceptionally demanding, reflecting the complexity of the process with number of changing input parameters spread over the long term. For this reason demand for financial resources for the period of decades is stated based on certain assumptions or by expert guess. However, in case of SR it is necessary to consider the fact that from 01.01.1995 state by the Act No. 254/1994 Coll. on State fund for decommissioning of nuclear energy installations has imposed the obligation to owner/operator of nuclear installation to accumulate financial resources for its decommissioning and handling of RAO and spent fuel throughout delivery to the fund administered by the state. For the period from 12.25.1972 when JE A1 was phased in the grid until 12.31.1994 such financial resources had not been accumulated.

System for funding of decommissioning of nuclear installations and handling of VJP and RAO is based on current legislative rules in force and provides view of management until 2020 and rough estimate after this year. Cost estimates were stated at the price level of 2014. For this reason it is important to stress, actual expenditures of NJF in the coming years considering inflation rate, will be in fact different. In light of complying with Maastricht criteria it is expected in financial calculations that inflation rate in the long term considerations will not exceed the level of 2 % annually.

Activities of the final stage of peaceful utilization of nuclear energy take form of long term projects. Standard economy practice of preparation for financing of such projects is based on discount. In this manner it is possible to state the demand for funding of future activities more precisely.

The Ministry of Finance of SR in accordance with the Announcement of EC releases basic tariff for calculation of reference and discounting rate in SR. Based on average for period from 01.01.2010 until 12.31.2013, the rate of 1,11 % was used in discounting costs of future activities. In all tables, where costs for activities of the final stage of peaceful utilization of nuclear energy are described, values at price level of 2014, in nominal prices (adjusted for inflation) and prices after discounting as of 2014 are specified.

7.1. Bohunice JE V1 International Decommissioning Support Fund

After decision of the Government of SR on final shut down of JE V1 as a compensation from the European Union, International decommissioning support fund for units of nuclear power plant V1 in Jaslovské Bohunice was established. Manager of BIDSF fund is the European Bank for Reconstruction and Development. Funding of decommissioning projects of JE V1 from resources of BIDSF fund is implemented based on grant agreements where framework definitions of project scope are specified and grants for funding of individual projects are stated. Overall amount of pledged financial aid of EU and other contributors throughout BIDSF for decommissioning of nuclear power plant V1 and measures in power engineering in SR resulting from final shut down of JE V1 amounts to 674 mil. €.

For decommissioning projects of JE V1 from 2015 it is expected 339,732 mil € to be spent at the price level of 2014. Financial provisions from BIDSF will decrease so called historical deficit of financial provisions of NJF for decommissioning of JE V1 (see chapter 7.2.), but actual value of deficit reduction will be possible to state only after completion of project implementation funded from BIDSF. In its planning, preparation and implementation NJF takes part in form of participation of Chairman of the Board of Governors of NJF at meetings of Joint committee of BIDSF fund. Funding of relevant projects is under way directly from BIDSF to implementator of decommissioning of JE V1, which is JAVYS, a. s. Coordination of projects in line with the Strategy of the final stage is necessary condition for optimal utilization of financial resources.

7.2. Historical deficit

The Act No. 254/1994 Coll. on State fund for decommissioning of nuclear energy installations and handling of spent nuclear fuel and radioactive waste imposed delivery obligation for the owner of nuclear installation, eventually the holder of permission for operation of nuclear installation from 1.1.1995. The Act was preceded by the Resolution of

the Government of SR No. 190/1994 Coll., in which the government approved conception of disposal of RAO from nuclear power engineering installations and other workplaces with sources of ionized radiation. This conception revealed inter alia estimation of the level of historical deficit (i. e. financial resources caused by shortfall of sources within operation of nuclear power plant to 12.31.1994) and proposal of method of its solution – payments from the state budget. Despite of this conception and despite of economy consideration on manner of functioning of particular fund at the state level the Act was adopted in 1994, which introduced subsidies from the state budget only as possible source of the fund. As a result, the level of subsidies from the state budget was so low (for decommissioning of JE A1 for 1995 to 2001 was from the state budget use sum of 612 599 ths. SK, i. e. 20 334,56 ths. €), that historical deficit neither numerically nor systematic was far from being resolved. Thus solution of the problem of historical deficit was postponed. Only the Act on NJF shows system approach to solution of the problem. It results from the fact that in final result solution is always be transferred and borne to users of electricity – considered either in its prices (in case of collection from operators of systems) or in tax burden (in case of payments from the state budget).

Pursuant to § 7 section 1 point b) of the Act on NJF one of the sources of the Nuclear Fund is the delivery collected by operator of transmission system and operators of distribution systems. This source is intended for reimbursement of deficit originated in generation of sources intended to balancing the costs of the final stage of nuclear power engineering formed during operation of nuclear installations for the purpose of electricity generation, namely at the level of deficit incurred at the effective date of the Act. The delivery forms a part of the price of electricity delivered to end users of electricity. Historical deficit pursuant to relevant provision of the Act on NFJ represents shortfall of sources, which should had been accumulated within operation of nuclear power plants up to the date 1.1.1995, when the Act No. 254/1994 Coll. came into effect. The level of so called historical deficit was stated in the document “The Strategy for the final stage of peaceful utilization of nuclear power engineering in The Slovak Republic”, which was approved by the Government of The Slovak Republic in Decision No. 26 at its meeting on January 15, 2014 and its amount as of 12.31.2012 at the price level of 2012 amounts to 2 118,258 mil. €.

The Government of SR at its meeting of 10.06.2010 adopted the Government Regulation No. 426/2010 Coll., where details on delivery amount taken from delivered electricity to end users are provided and the manner of its collection for the National Nuclear Fund for decommissioning of nuclear installations and on handling of spent nuclear fuel and radioactive wastes. Pursuant to this Regulation the operator of transmission system and operators of distribution systems will pay to the NJF account for balancing the historical debt the sum equals to the product of effective rate of delivery for balancing historical deficit for respective year and quantity of electricity delivered to end users connected to the system and quantity of electricity delivered and produced in local distribution system connected to the system with exception of own consumption in electricity generation and consumption of electricity for the purpose of water pumping in pumped-fed hydroelectric plants for respective month. At the meeting of the Government of SR of 01.16.2013 modified Government

Regulation No. 19/2013 was adopted, according to which deliveries from operator of transmission system and operators of regional distribution systems intended for balancing of the historical deficit will be not paid to the NJF account but to the income budget account chapter of the Ministry of Economy of SR.

It follows from the Programme for development of deep repository in SR that its operation could commence circa in 2065 (see Chapter 4.3). Original model of stating the level of the historical deficit considered beginning of operation circa in 2040. Delay in beginning of operation of HÚ requires longer storage of VJP from JE V1, what will increase the costs of storage in 52,470 mil. €. Calculation of the amount of the historical deficit as of 12.31.2014 in relation to constantly continuing works providing for decommissioning of JE A1 and time delay of beginning of operation of HÚ is depicted in the Table No. 7.1 and it amounts to **2 068 537 mil. €** at the price level of 2014.

Table No. 7.1: Amount of historical deficit from 01.01.2013

Way of determination of amount historical deficit from 01.01.2013 [mil. €]	
Amount of historical deficit of 12.31.2012 in prices 2012 approved by government SR	2 118,258
Adjustment of amount of historical deficit to price level of 2013	2 150,032
Income from delivery of operators of transmission and distribution systems in 2013	- 67,962
Amount of historical deficit of 12.31.2013 in prices of 2013	2 082,070
Adjustment of amount of historical deficit to price level of 2014	2 086,234
Income from delivery from operators of transmission and distribution systems in 2014	- 70,167
Increase in time delay of beginning of deep repository operation in prices of 2014	50,470
Amount of historical deficit of 12.31.2014 in prices of 2014	2 068,537

7.3. System for funding of decommissioning of nuclear power installations and handling of VJP and RAO

Implementation of funding of the National Programme for handling of VJP and RAO is based on measurement of costs of all activities required by the system for handling of VJP and RAO. Specific feature of the system is the fact that demand for financial resources is required in a major way after termination of electricity production and finance accumulating. For this reason it is necessary to provide estimate of costs for handling of VJP and RAO as accurate as possible in order to ensure collected financial resources cover all the costs in time they will incur. Existing system for funding in SR was established in accordance with existing international recommendations and is based on agreed policies. For collection of financial resources in general is responsible producer of wastes in line with the policy “polluter pays”. Basic mechanism of financial resources collection is executed through contributions of electricity production from holders of permissions for operation of nuclear power plants. Stating of costs for handling of these RAO is based on actual international standard ISDC, which is released and continuously updated by OECD. Costs are continuously updated in

accordance with best international practices in this field and they are stated pursuant to individual items of ISDC and also in annual terms in individual years of decommissioning project.

At present the amount of mandatory contributions is determined and updated directly by the National Council based on amendment on NJF Act. In the interest of approach to international practice it is advisable that amount of contribution in future would be determined and updated by independent and professional authority under legislation established rules.

Costs for handling of VJP and RAO from operation

Costs for handling of VJP and RAO originated as a result from operation of nuclear power plants are considered a part of costs of the holder of permission for operation of nuclear installation and are not a subject of reimbursement of NJF, but they are reimbursed directly by operators of nuclear installations.

Sources of NJF

The Act on NJF in § 7 defines financial sources of the Nuclear Fund. Pursuant to section 1 point a) of said paragraph basic source consists of compulsory contributions from holders of permission for operation of nuclear installations. At present the company Slovenské Elektrárne, a. s., Bratislava operating nuclear power plants Jaslovské Bohunice V2 and EMO 12 has an obligation to pay contributions.

Current level of contributions

Compulsory contribution is formed as a sum of fix and variable components. The amounts of fixed and variable components have been defined from 2012 pursuant to the Act No. 550/2011 Coll., which amended the Act on NJF:

- fix contribution is stated as a sum of 13 428,26 € annually per every MW of installed electric capacity, whereby it will be adjusted yearly for inflation rate for preceding year,
- variable contribution is stated at the level of 5,95 % of the sales price of electricity generated in nuclear installation for preceding year.

Majority shareholder of Slovenské Elektrárne, a. s. company ENEL has decided to implement the project of increasing capacity in nuclear power plants V2 and EMO. Perspective of installed capacity up to 2020 in nuclear power plants V2, EMO 12 and EMO 34 is shown in the Table No. 7.2.

Table No. 7.2: Perspective of installed electric capacity of JE at the territory of SR until 2020

Installed capacity					**[MW_e]**	
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
V2 – 1. unit	500,0	500,0	500,0	500,0	510,0	510,0
V2 – 2. unit	500,0	500,0	500,0	500,0	505,0	510,0
EMO – 1. unit	470,0	470,0	470,0	470,0	470,0	470,0
EMO – 2. unit	470,0	470,0	470,0	470,0	470,0	470,0
EMO – 3. unit		235,5	471,0	471,0	510,0	510,0
EMO – 4. unit			471,0	471,0	471,0	510,0
Total	**1 940,0**	**2 175,5**	**2 646,5**	**2 882,0**	**2 936,0**	**2 980,0**

Real output of electricity production in nuclear power plants depends on various factors, which are: dispatching deployment of units in production, time for shutdowns for off-load fuelling process, gradual loading of gadolinium fuel of the second generation, number of unplanned shutdowns of units, time of operation etc. Perspective of electricity generation in individual nuclear reactors until 2020 is summarized in the Table No. 7.3.

Table No. 7.3: Expecting electricity production from nuclear power plants until 2020

Expected production				**[GWh]**		
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
V2 – 1. unit	3 701,15	3 824,80	4 025,44	4 052,22	3 992,76	4 151,87
V2 – 2. unit	4 013,06	3 704,00	4 038,52	4 054,77	4 097,06	4 052,29
EMO – 1. unit	3 687,16	3 825,40	3 522,34	3 840,71	3 851,22	3 851,10
EMO – 2. unit	3 825,18	3 836,68	3 807,25	3 516,10	3 842,45	3 853,60
EMO – 3. unit	0	838,26	3 007,60	3 480,40	4 113,40	4 157,20
EMO – 4. unit	0	0	838,26	3 068,90	3 488,80	4 121,60
Total	**15 226,55**	**16 029,14**	**19 239,41**	**22 013,10**	**23 385,69**	**24 187,66**

The term “sales price of electricity generated in nuclear facility” as indicated in § 7 section 2 of the Act on NJF causes problems in practical application of this provision. In reality seller of electricity generated in nuclear facility in this case SE, a. s. has not defined explicitly price of electricity of nuclear power plants, eventually such price is not used in business relations. Sales price of electricity from nuclear power plants can be derived only with supporting methods based on documents of SE, a. s. The clause then describes sales price of electricity achieved for preceding year. That means that if for example price of electricity is increasing every year, compulsory contributions to NJF will be based on lower price of electricity in a given year than operator of nuclear installation will achieve in reality in a given year.

In determination of sales price of electricity from nuclear power plants for need of this document, current estimations of development of market price of power electricity until 2020 are used. It is expected that in the next years sales price of electricity would be increased at the level of inflation. Based on aforementioned assumptions it is possible to define individual contributions to NJF in nominal value from holder of permission for operation of nuclear

power plants, i. e. SE, a. s. until 2020 in a manner indicated in the Table No. 7.4. For purposes of calculation after 2020 based on strategy of SE, a. s., operation of nuclear power plants V2, EMO 12 and EMO34 is expected in two variants in 40 and in 60 years.

Table No. 7.4: Contributions to NJF from holders of permissions for operation of nuclear power plants

Contributions to NJF from electricity producer [ths. €]						
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
V2 - 1. unit	7 324,63	7 496,67	7 669,09	7 845,48	8 146,32	8 366,55
V2 - 2. unit	7 324,63	7 496,67	7 669,09	7 845,48	8 146,32	8 366,55
EMO - 1. unit	6 885,15	7 046,86	7 208,95	7 374,75	7 544,37	7 710,35
EMO - 2. unit	6 885,15	7 046,87	7 208,95	7 374,75	7 544,37	7 710,35
EMO - 3. unit	0,00	3 530,93	7 247,15	7 390,45	7 873,43	8 366,54
EMO - 4. unit	0,00	0,00	3 589,27	7 390,44	7 873,43	8 366,54
Fix part of contribution	**28 419,56**	**32 618,00**	**40 592,50**	**45 221,35**	**47 128,24**	**48 886,88**
V2 - 1. unit	7 773,71	8 238,23	9 364,98	10 488,15	11 640,89	13 216,44
V2 - 2. unit	8 428,83	7 978,05	9 395,42	10 494,77	11 944,97	12 899,45
EMO - 1. unit	7 744,32	8 239,53	8 194,56	9 940,70	11 228,22	12 259,03
EMO - 2. unit	8 034,22	8 263,83	8 857,37	9 100,56	11 202,68	12 266,97
EMO - 3. unit	0,00	1 805,53	6 997,03	9 008,15	11 992,61	13 233,41
EMO - 4. unit	0,00	0,00	1 950,17	7 943,08	10 171,60	13 120,08
Variable part of contribution	**31 981,08**	**34 525,17**	**44 759,53**	**56 975,41**	**68 180,97**	**76 995,38**
Mandatory contribution to NJF per year	**60 400,64**	**67 143,17**	**85 352,03**	**102 196,76**	**115,309,21**	**125 882,26**
Mandatory contribution to NJF, adjustment in way of collection	**61 620,90**	**61 455,10**	**75 738,55**	**97 058,40**	**112 031,00**	**123 238,90**

Adjustment in manner of contribution collection implies that incomes to NJF from holder of permission for operation of nuclear installation in year “n” consist of paid compulsory contributions of holders of permission for the 4. Quarter of year “n-1” (until 01.31. of the year “n”) and compulsory contributions of holders of permission for 1. through 3. Quarters of the year “n” (until the end of first month followed after respective quarter).

Next source defined in the NJF Act are deliveries from operators of transmission and distribution systems for balancing of historical deficit. From 01.01.2013 pursuant to the Act No. 391/2012 Coll., which amended given Act, these deliveries are collected to NJF SR throughout transfer from budget chapter of the Ministry of Economy of SR. The subject of historical deficit of financial provisions is analyzed in Chapter 7.2. Reimbursement of historical deficit of financial provisions will be distributed in time interval over circa 35 years and for this reason the question of historical deficit cannot be defined in one specific constant and unchangeable number. Future costs for the final stage of peaceful utilization of nuclear energy will depend on specific development of prices of materials and services, prices of

personnel, technological solution, eventually level of technology development and form of eventual joint international access to final deposition of spent nuclear fuel eventually high-level radioactive wastes. For this reason it is considered in pragmatic way that deficit of financial provisions will be balanced continually in line with actual need. In relation to this assumption it is considered that the level of payments, which will be levied by operator of transmission system and operators of distribution systems for reimbursement of historical deficit will be continually distributed over the long time horizon and will cover actual needs, which would be updated every 6 years. Income from payment from operators of transmission system and distribution systems until the end of 2014 totaled to 258,155 mil €. Estimate of transfer from MH SR in form of delivery collected from the operator of transmission system and operators of distribution systems until 2020 is indicated in the Table No. 7.5.

Table No. 7.5: Estimation of contribution for the coverage of historical deficit levied

Collection for historical deficit						**[mil. €]**
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Collection for historical deficit of financial provisions in prices of 2014	66,296	68,428	68,272	68,319	68,348	68,377
Collection for historical deficit of financial provisions in nominal prices, adjusted for inflation	67,622	71,193	72,451	73,951	75,461	77,003
Collection for historical deficit of financial provisions in nominal prices, adjusted for inflation and way of collection	67,834	70,895	72,346	73,826	75,336	76,875

It is important to note, the Act on NJF shall implement in its provision § 3a, section 6 six year interval for update of the National Programme for handling of VJP and RAO in SR included economical estimates. In practice it implies eventual need to amend respective Implementing government regulation in respective intervals, as long as conditions for activities of the final stage of peaceful utilization of nuclear energy would change.

Another significant if not the most significant resource of Nuclear Fund is estimated appreciation of financial provisions accumulated in Fund account held with the State treasury. With regards to the mission of the Fund accumulation and management o financial provisions and their utilization in funding of future costs of the final stage of peaceful utilization of nuclear energy, it is vital to prevent financial provisions in account of Nuclear Fund to not appreciate, but in contrast to show the highest interest income while maintaining prudential rules and reasonable risk.

For the purpose of this document it is assumed, that basic appreciation of available financial provisions will achieve the level of 2,0 %, i. e. at the level of expected inflation after deduction of withholding tax. This assumption is from the long term quite conservative. In cases when conditions for ensuring of financial provisions can change (change in electricity price, voluntary contributions to NJF SR etc.) it is convenient to determine minimal level of

interest rate for appreciation of available financial provisions. Thus in this document also alternative scenario (more realistic) is introduced, assuming appreciation of available financial provisions at the level of 3,28 % i. e. in 1,28 % over the level of expected inflation. Such an increase in appreciation of available financial provisions will not manifest itself in short time horizon (5-10 years) but after the long time horizon (see Tables No. 7.9 and Figure No. 7.1). Management of NJF SR ensured fixed-term deposit of sum of 700 mil. € with interest rate 4,05 % p. a. until 2020, the sum of 120 mil. € with interest rate 4,95 % p. a. until 2021, the sum of 70 mil. € with interest rate 1,50 % p. a. until 2017 and the sum of another 70 mil. € with interest rate 2,95 % p. a. until the end of 2022, the sum of 140 mil. € with interest rate 2,59 % p. a. until the end of 2023, and the sum of 125 mil. € with interest rate 2,40 % p. a. until the end of 2034. These measures helped to achieve average interest rate of financial provisions in period from 2009 through 2014 at the level of 2,49 % p. a., while average inflation in respective period was recorded 1,63 % p. a. It results appreciation of NJF provisions after deduction of withholding tax in respective period was 0,39 % p. a. over the average inflation rate for respective period. This fact supports demand for searching manner for more effective appreciation of NJF provisions over the inflation from the long term.

Reallocation of interests for individual subaccounts is implemented in proportion of subaccount balance to the total amount of financial provisions in NJF in a given year. In the Table No. 7.6 an estimation of interest level according to current valid legislative documents is indicated.

Table No. 7.6: Estimation of interest level until 2020

Estimation of interest level (in nominal prices)				**[mil. €]**		
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Balance of NJF account at the beginning of the year	**1 225,129**	**1 319,458**	**1 411,885**	**1 516,192**	**1 636,157**	**1 793,152**
Interests (in nominal prices)	35,690	36,000	37,000	38,500	40,040	42,500

In accordance with § 7 of the Act on NJF, other financial resources of Nuclear Fund are defined as follows:

- Subsidies from the state budget earmarked for reimbursement of costs spent for treatment with nuclear material or radioactive wastes, whose originator is unknown (ZRAM). Perspective of future costs, eventually expected contributions from the state budget for future costs until 2020 are indicated in the Table No. 7.7. As long as these payments for solution of trapped materials are implemented ad hoc, it is not possible to plan them ahead and indicated sums are estimate based on existing development in a given field. Their level is relatively insignificant.

Table No. 7.7: Estimated contributions from the state budget for reserve creation for ZRAM

Contribution from the state budget for ZRAM						**[mil. €]**
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Estimated contributions for reserve creation for ZRAM in prices of 2014	0,344	0,358	0,358	0,358	0,358	0,358
Estimated contributions for reserve creation for ZRAM in nominal prices	0,351	0,373	0,380	0,387	0,395	0,403

- Subsidies and contributions from funds of European Union and other international organizations, financial institutions and funds provided for reimbursement of costs for the final stage of nuclear power engineering. Subsidy of EÚ (BIDSF) in form of compensation after Decision of SR on final shut down of JE V1 is not financial source for NJF SR. Funding of respective projects is in progress directly from BIDSF to implementing organization for decommissioning of JE V1 – JAVYS, a. s. Ultimately financial provisions from BIDSF will decrease amount of financial provisions provided from NJF for decommissioning of JE V1.
- Subsidies from the state budget. Based on existing experience "The Strategy of final stage of peaceful utilization of nuclear power engineering in SR" does not rely on such sources, in case estimated mechanism of payments levied by the operator of transmission system and operators of distribution system for reimbursement of historical debt will work. If situation which prevents reimbursement of historical debt occurs from any reasons, it is assumed subsidies from the state budget will compensate the failure of expected incomes of historical debt for individual year.
- Voluntary contributions from natural and legal persons.
- Penalties imposed by ÚJD SR pursuant to special regulation.

Amendment of the Act on NJF (i. e. the Act No. 143/2010 Coll.) imposed to NJF SR to create from 01.01.2012 separate subaccount for handling of IRAO. High-activity used sealed sources and also used sealed sources with time of half-life higher than 60 days are included within IRAO. Applicants for permission for activities leading to exposure by mentioned sealed sources deposit financial cash – principal to the subaccount for IRAO handling. It represents estimated costs for handling of given type of used source (in case of high-activity sealed sources), or amount of principal is determined as acquisition cost of sealed source (in case of used not high-activity sources with half-life higher than 60 days) – while organization authorized for handling of them after use would not take other decision. Amount of mentioned principal is adequate for the coverage of all costs for handling of IRAO. Legislatively preferred way for handling of sealed sources after their use is their return to supplier under the contract. Coverage for handling of used sealed sources in case return will not occurred from any cause is the purpose of principal. In case source will be returned to supplier, the principal will be returned to holder of permission leading to activities in which given source was used, thus to the subject, who deposited the principal to NJF.

Estimate of incomes of financial provisions is based on definitions for mandatory contributions from operators of nuclear power plants provided for in the Act on NJF. As operator of nuclear power plants has decided on leading to prolongation of their operating lifetime to 60 years, the calculation assumes alternatively 40 and 60 years of nuclear power plants V2, EMO12 and EMO34 operation. Perspective of incomes for 40 years and 60 years of JE operation is indicated in the Table No. 7.8.

Table No. 7.8: Estimate of incomes to NJF in interest rate 0 % above inflation (in nominal prices)

[mil. €]		**40 years of JE operation**		**60 years of JE operation**	
	Years 2015-2020	**After 2020**	**TOTAL**	**After 2020**	**TOTAL**
Balance of 01.01.2015	**1 225,129**		**1 225,129**		**1 225,129**
nuclear power plant V2	215,561	201,064	416,625	1 355,293	1 570,854
nuclear power plant EMO 12	202,873	1 038,914	1 241,787	2 615,815	2 818,688
nuclear power plant EMO 34	137,850	2 199,467	2 337,317	4 333,657	4 471,507
transfer of MH SR	437,112	2 429,607	2 866,719	2 429,607	2 866,719
contribution of st. budget for ZRAM	2,290	194,428	196,718	194,428	196,718
sum of contributions and transfer	**995,686**	**6 063,480**	**7 059,166**	**10 928,800**	**11 924,486**
Interests at rate of 0 % above inflation	229,730	4 010,278	4 240,008	10 304,735	10 534,465
TOTAL	**2 450,545**	**10 073,757**	**12 524,303**	**21 233,535**	**23 684,080**

Balance of 01.01.2015 represents value of 9,78 % of total income estimate of NJF in 40 years of JE operation, which amounts to 12 524,303 mil. €. Of this amount real contributions of holder of permission for JE operation represent 31,90 %, transfer from MH SR 22,89 %, state budget 1,57 % and interests 33,85 %. This means that nearly half source of NJF SR income after 2015 represent interests. It seems that appreciation of available financial resources is the key assumption for meeting of income targets and of balanced management of NJF SR. The Table No. 7.9 indicates estimation of incomes for balanced scenario for appreciation of available financial provisions, i. e. at rate 1,28 % p. a. in 40 years of JE operation and 0,36 % p. a. in 60 years of JE operation above the inflation.

Table No. 7.9: Estimate of incomes to NJF in balanced scenario of management of NJF SR

[mil. €]		40 years of JE operation		60 years of JE operation	
	Years 2015 - 2020	After 2020	TOTAL	After 2020	TOTAL
Balance of 01.01.2015	1 225,129		1 225,129		1 225,129
sum of contributions and transfer	995,686	6 063,480	7 059,166	10 928,800	11 924,486
interests at rate above inflation	229,730	12 979,717	13 209,447	16 753,008	16 982,738
TOTAL	**2 450,545**	**19 043,197**	**21 493,742**	**27 681,808**	**30 132,353**

Balance of 01.01.2015 for this kind of scenario corresponds to value of 5,70 % of total estimation of NJF incomes in 40 years of JE operation, which equals to 21 493,742 mil. €, real contribution of holder of permission for JE operation equals to 18,59 %, transfer from MH SR 13,34 %, state budget 0,92 % and interests 61,46 %. In this scenario this means appreciation of available financial provisions plays more significant role than in initial economic option.

7.4. Balance of subaccounts of NJF SR

Balance of financial resources on individual subaccounts is dependent on various factors. The Board of Governors of NJF submits annually until the end of November to the Supervisory Board proposal for redistribution of sources allocation into individual subaccounts for the following year. The mechanism for redistribution of sources allocation is defined in § 8 section 5 of NJF Act. Overview of financial resources balance in individual subaccounts of NJF is indicated in the Table No. 7.10.

Table No. 7.10: Balance of subaccounts of NJF SR of 01.01.2015

Name of the account	Subaccount	Balance of 01.01.2015 [€]
Nuclear power plant A1	A/A1	11 004 742,09
Nuclear power plant V1	A/V1	306 521 909,31
Nuclear power plant V2	A/V2	532 341 374,40
Nuclear power plant EMO 12	B	365 211 832,77
New Nucl. Inst. after 07.01.2006	C	0,000
Handling of Nucl. Mat. and RAO of unknown origin	D	0,000
Repositories RAO and VJP	E	974 129,00
Institutional control of repositories	F	0,000
Storage of VJP in separate Nucl. Inst.	G	3 524 990,00
Management of NJF	H	5 189 575,82
Handling of IRAO	I	360 809,08
TOTAL		**1 225 129 362,47**

7.5. Plan of costs for decommissioning of nuclear installations and handling of VJP and RAO

Large experience of SR in the field of handling of VJP and RAO has been acquired since 1972, when nuclear power plant A1 was commissioned. Specific feature of Slovak experience is the fact that methods and technologies for handling of VJP and RAO had to address with products of gas cooled reactor (nuclear power plant A1), water pressurized reactors (nuclear power plant V1, V2, EMO 12 and EMO 34) and also with products of accident in nuclear power plant A1. Thus several unique installations were built for processing of RAO before their transport and final disposal. It is evident that all such experience was transformed also to cost optimization for all complex of handling of RAO and VJP.

In the next chapter procedures for planning of costs for handling of VJP and RAO are listed during operation of JE and decommissioning of nuclear installations themselves, where following policies are applied:

- in view of meeting Maastricht criteria it is assumed in financial calculations that inflation rate in long term considerations will not exceed the level of 2 % annually,
- handling of VJP and operating RAO during operation of nuclear installation is reimbursed from resources of holder of permission for operation of nuclear installation,
- handling of storage of fuel from individual power plants of SR (operated and decommissioned) resulting from costs of wet type of storage in Interim storage Jaslovské Bohunice,

- handling of last loading of VJP in termination of operation is in principle possible to be reimbursed from resources planned for decommissioning (ISDC) but current only operator JE in SR will cover the costs for termination of operation of JE,
- costs for handling of operating RAO in termination of operation of JE are reimbursed by the operator of JE,
- policy applies all operating RAO would be processed yet before beginning of decommissioning of JE,
- costs for decommissioning of nuclear power plants and for handling of RAO generated during decommissioning of JE are reimbursed from NJF SR. Determination of costs for handling of these RAO is governed by international standard ISDC (International Structure for Decommissioning Costing of Nuclear Installations). Costs are continually updated in accordance with international best practice in this field. Costs are determined by individual items of ISDC and also in annual terms in individual years of decommissioning project.

The Act on NJF in § 8 through 11 defines possibility of usage, conditions and mechanism for providing financial provisions of the National Nuclear Fund. Required amount of financial provisions for a given year results from respective plans and needs of operator of operating nuclear installations and respective stage plans and conception plans for decommissioning of individual decommissioned nuclear installations. In next chapters annual demand of provisions for handling of VJP and RAO during operation of existing nuclear installations and decommissioning of nuclear installations for executed activity until 2020 is summarized and also total amount after this year.

7.5.1. Plan of costs for handling of RAO generated during operation of JZ

COSTS FOR HANDLING OF LIQUID RAO FROM OPERATION OF JE

Liquid RAO generated during operation of JE consist of concentrates and sorbents (ionexes). Calculation of costs for handling of liquid RAO generated during operation of JE includes also wastes generated during termination of operation. Calculation of total costs for handling of liquid RAO is the sum of costs for processing (bitumenation, cementation), transport and disposal. Total costs for handling of liquid RAO for individual JE are indicated in the Table No. 7.11.

Table No. 7.11: Annual costs for handling of operation liquid RAO

Annual costs for handling of operating liquid RAO							
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
JE V2 – 40 years of operation							
Annual cost for handling – prices of 2014 [ths. €]	1 526	2 903	3 047	2 839	2 839	2 839	28 305
Annual cost for handling – in nominal prices [ths. €]	1 557	3 020	3 234	3 073	3 135	3 198	35 586
EMO12 – 40 years of operation							
Annual cost for handling – prices of 2014 [ths. €]	1 412	2 042	1 725	1 725	1 725	1 725	42 480
Annual cost for handling – in nominal prices [ths. €]	1 440	2 125	1 831	1 867	1 904	1 943	62 415
EMO34 – 40 years of operation							
Annual cost for handling – prices of 2014 [ths. €]	0	0	1771	3 401	2 942	1 758	46 231
Annual cost for handling – in nominal prices [ths. €]	0	0	1 886	3 681	3 248	1 979	86 741
TOTAL prices of 2014 [ths. €]	**2 938**	**4 945**	**6 550**	**7 965**	**7 506**	**6 322**	**119 016**
TOTAL in nominal prices [ths. €]	**2 997**	**5 145**	**6 950**	**8 622**	**8 287**	**7 120**	**184 741**

COSTS FOR HANDLING OF SOLID RAO FROM OPERATION OF JE

Solid RAO generated during operation and termination of operation of JE consists of various forms of solid state. Calculation of total costs for handling of solid RAO includes costs for processing of compressed and combustible, metal and slight solid RAO intended for cementation. Total costs thus represent costs for processing, transport and disposal. Total annual costs in years until 2020 at price level of 2014 and in nominal value are indicated in the Table No. 7.12.

Table No. 7.12: Annual costs for handling of operation solid RAO

Annual costs for handling of operating solid RAO							
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
JE V2 – 40 years of operation							
Annual cost for handling – prices of 2014 [ths. €]	460	395	411	411	411	371	3 644
Annual cost for handling – in nominal prices [ths. €]	469	410	437	445	454	418	4 573
EMO12 – 40 years of operation							
Annual cost for handling – prices of 2014 [ths. €]	420	333	324	284	284	284	7 020
Annual cost for handling – in nominal prices [ths. €]	428	347	344	307	314	320	10 334
EMO34 – 40 years of operation							
Annual costs for handling – prices of 2014 [ths. €]	0	0	279	283	299	267	11 177
Annual cost for handling – in nominal prices [ths. €]	0	0	296	307	331	300	19 807
TOTAL in prices of 2014 [ths. €]	**880**	**728**	**1 015**	**979**	**995**	**922**	**21 841**
TOTAL in nominal prices [ths. €]	**897**	**757**	**1 077**	**1 060**	**1 098**	**1 038**	**34 714**

7.5.2. Plan of costs for handling of VJP generated during operation of JZ

Process of handling of VJP generated during operation of nuclear power plants in SR at present consists of following steps:

- storage of VJP in storage basin – short term storage,
- transport to Interim storage of VJP in Jaslovské Bohunice,
- storage in Interim storage Jaslovské Bohunice – long term storage,
- preparation for implementation of deep repository for VJP disposal.

COSTS FOR STORAGE OF VJP IN STORAGE BASIN

Slovenské Elektrárne, a. s., sole holder of permission for operation of JE in SR does not record costs for storage of VJP in storage basin separately. These costs are included within operating costs and they are not especially quantified for accounting needs.

COSTS FOR TRANSPORT OF VJP IN INTERIM STORAGE OF JASLOVSKÉ BOHUNICE

Costs for transport of VJP in Interim storage in Jaslovské Bohunice consist of costs of carrier and costs for physical protection of transport (they concern only transport outside of the site). Costs for transport of one container C-30 in prices of 2014 amount to 131 467 € (cycle). Costs for physical protection in transport outside of the site (i. e. from EMO to EBO) and for services of carrier in 2014 amounted to circa 100 000 € for one transport. In transport of VJP from JE V2, fuel is transported gradually i. e. before removal of fuel from reactor, required amount is transported to Interim storage. Transport of fuel from EMO 12 takes place in more containers at once. Costs for transport of VJP from storage basin of reactor of both JE to Interim storage Jaslovské Bohunice until 2020 and in total after 2020 are indicated in the Table No. 7.13 (in prices of 2014 and in nominal prices at annual inflation rate of 2 %).

Table No. 7.13: Costs for transport of VJP to Interim storage of Jaslovské Bohunice

Costs for transport of VJP							
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
JE V2 – 40 years of operation							
Number of cycles	4	2	4	3	3	2	30
Number of transports	2	2	2	2	2	2	15
Cost for transport – prices of 2014 [ths. €]	525,87	262,93	525,87	394,40	394,40	262,93	3 944,01
Cost for transport – in nominal prices [ths. €]	536,39	273,56	558,06	426,91	435,45	296,11	4 885,38
EMO12 – 40 years of operation							
Number of cycles	2	3	3	3	2	1	79
Number of transports	1	1	1	1	1	1	37
Cost for transport – prices of 2014 [ths. €]	362,93	494,40	494,40	494,40	362,93	231,47	14 085,89
Cost for transport – in nominal prices [ths. €]	370,19	514,37	524,66	535,16	400,71	260,67	20 366,32
EMO34 – 40 years of operation							
Number of cycles							116
Number of transports							42
Cost for transport – prices of 2014 [ths. €]							19 450,17
Cost for transport – in nominal prices [ths. €]							32 899,18
TOTAL in prices of 2014 [ths. €]	**888,80**	**757,34**	**1 020,27**	**888,80**	**757,34**	**494,40**	**37 480,08**
TOTAL in nominal prices [ths. €]	**906,58**	**787,93**	**1 082,72**	**962,07**	**836,16**	**556,78**	**58 480,08**

Total costs in nominal prices for transport of VJP from storage basin of reactor to Interim storage of Jaslovské Bohunice for all JE from 2015 and for 40 and 60 years of operation are indicated in the Table No. 7.14.

Table No. 7.14: Total costs for transport of VJP to Interim storage of Jaslovské Bohunice

Total costs for transport of VJP to Interim storage Jaslovské Bohunice [ths. €]		
	40 years of operation	60 years of operation
JE V2	7 411,85	20 965,47
EMO12	22 972,09	44 498,21
EMO34	32 899,18	60 465,70
Total	63 283,12	125 929,38

COSTS FOR STORAGE OF VJP IN INTERIM STORAGE JASLOVSKÉ BOHUNICE

Detailed description of VJP storage method in Interim storage Jaslovské Bohunice is described in the chapter "Storage of spent nuclear fuel". Prognosis of storage quantity of VJP in this storage is shown in the Chapter 3.1. In this chapter costs for storage of VJP from individual power plants of SR (operated and decommissioned) stored by wet type in the Interim storage Jaslovské Bohunice will be shown. Programme for development of deep repository assumes start of its operation in about 2065. All existing economic considerations assumed beginning of operation of HÚ in about 2040. Such time delay of beginning of operation will cause longer storage of VJP and thus also increase of required financial provisions. This increase at price level of 2014 equals to 52 470 mil. €. Annual costs for storage of VJP from individual JE in SR in prices of 2014 and in nominal prices are indicated in the Table No. 7.15. Values in the column "after 2020" represent sum of operator costs (reimburses costs during operation of JE) and NJF SR (reimburses costs after obtaining permission for decommissioning of a given JE). Costs for VJP storage during decommissioning are presented in chapters on decommissioning.

Table No. 7.15: Costs for storage of VJP

Costs for storage of VJP							
	2015	2016	2017	2018	2019	2020	after 2020
JE V1 – decommissioned JE							
Number of caskets of VJP	5 143	5 143	5 143	5 143	5 143	5 143	5 143
Cost for storage – prices of 2014 [ths. €]	3 525	3 189	4 143	3 937	2 732	2 732	131 477
Cost for storage – in nominal prices [ths. €]	3 595	3 318	4 397	4 262	3 016	3 076	250 666
JE V2 – 40 years of operation							
Number of caskets of VJP	4 759	4 847	5 024	5 151	5 290	5 434	7 354
Cost for storage – prices of 2014 [ths. €]	5 478	5 579	5 783	5 929	6 089	6 255	271972
Cost for storage – in nominal prices [ths. €]	5 587	5 804	6 137	6 418	6 722	7 044	551 478
EMO12 – 40 years of operation							
Number of caskets of VJP	1 632	1 776	1 920	2 064	2 160	2 304	6 600
Cost for storage prices of 2014 [ths. €]	1 878	2 044	2 210	2 376	2 486	2 652	191 037

Cost for storage – in nominal prices [ths. €]	1 916	2 127	2 345	2 572	2 745	2 986	393 417
EMO34 – 40 years of operation							
Number of caskets of VJP							6 132
Cost for storage– prices of 2014 [ths. €]							180 849
Cost for storage– in nominal prices [ths. €]							474 905
TOTAL prices of 2014 [ths. €]	**10 881**	**10 812**	**12 136**	**12 242**	**11 307**	**11 638**	**775 335**
TOTAL in nominal prices [ths. €]	**11 098**	**11 249**	**12 879**	**13 251**	**12 484**	**13 107**	**1 670 466**

Total costs in nominal prices for storage of VJP for all JE from 2015 and for 40 and 60 years of operation are presented in the Table No. 7.16.

Table No. 7.16: Total costs for storage of VJP

Total costs for storage of VJP in Interim storage Jaslovské Bohunice [ths. €]		
	40 years of operation	**60 years of operation**
JE V1	272 331	272 331
JE V2	589 196	979 647
EMO12	408 108	826 810
EMO34	474 905	1 092 209
Total	1 744 540	3 170 997

PREPARATION OF IMPLEMENTATION OF DEEP REPOSITORY FOR DISPOSAL OF RAO

The last step of handling of VJP is disposal in deep geological repository. Programme for development of deep repository in SR environment assumes beginning of its operation in about 2065 (see Chapter 4.3). Amount of costs connected to development, construction, operation and closing of deep repository is strongly dependent on period of operation of nuclear power plants V2 and EMO. For their 40 years of operation they are estimated at price level of 2014 in amount of 3 738,019 mil € and for 60 years of operation in amount of 4 432,037 mil. €. Financial provisions for the coverage of above mentioned costs will be reimbursed from accounts of individual nuclear power plants held with NJF SR. Amount of contribution is proportional to quantity of disposed VJP and RAO from decommissioning not disposable in Surface Repository from a given power plant in 40 years of operation of JE V2 and EMO (JE A1 – 2,70 %, JE V1 – 19,81 %, JE V2 – 28,34 %, EMO 12 – 25,52 % and EMO 34 – 23,63 %). Assumed costs for preparation and eventual implementation of deep repository at the territory of SR are indicated in the Table No. 7.17, especially for 40 and 60 years of operation. Estimate is an expert adjustment of estimates made in time of implementation of Slovak Programme for Development of Deep Repository in 1996 – 2001.

Table No. 7.17: Costs for development and implementation of HÚ

Costs for development and implementation of HÚ [mil. €]							after 2020	
Year	2015	2016	2017	2018	2019	2020	40 yrs. operation	60 yrs. operation
in prices of 2014	0,023	0,048	0,434	1,616	4,037	6,389	3 725,336	4 419,353
in nominal prices	0,024	0,051	0,460	1,749	4,497	7,308	13 618,767	19 212,168

7.5.3 Plan of costs for handling of ZRAM

Specific category of radioactive materials is intercepted nuclear material or RAO, of which originator in not known. Costs fro handling of such materials are reimbursed pursuant to § 7 of the Act on NJF through subsidies from the state budget of SR. Plan of subsidies from the state budget for handling of ZRAM until 2020 is presented in the Table No. 7.18. After 2020 this amount is expected to be 0,347 mil € annually at the price level of 2014.

Table No. 7.18: Costs for handling of ZRAM

Costs for handling of ZRAM [mil. €]						
	2015	2016	2017	2018	2019	2020
Estimated costs for reserve creation for handling of ZRAM in prices of 2014	0,294	0,359	0,358	0,358	0,358	0,358
Estimated costs for reserve creation for handling of ZRAM in nominal prices	0,300	0,373	0,380	0,388	0,395	0,403

7.5.3. Plan of costs for handling of institutional radioactive wastes

Amendment of the Act on NJF (i. e. the Act No. 143/2010 Coll.) imposed to NJF SR to create from 01.01.2012 a separate subaccount for handling of IRAO. High-activity used sealed sources (definition see Regulation of the Government of The Slovak Republic No. 348/2006 Coll.), and also used sealed sources with time of half-life higher than 60 days are included within IRAO. Applicants for permission for activities leading to exposure by above mentioned sealed sources deposit financial cash – principal to the subaccount for IRAO handling. This represents estimated costs for handling of a given type of used source (in case of high-activity sealed sources), or amount of the principal is determined as acquisition price of sealed source (in case of used not high-activity sources with half-life higher than 60 days) – while organization authorized for handling of it after its usage would not take other decision. Legislative preferred way for handling of sealed sources after their usage is their return to supplier under the contract. Coverage of handling of used sealed sources in case such return will not occur from any cause is the purpose of the principal. In case the source will be returned to the supplier, the principal will be returned to the holder of permission for

activities, in which given source was used, thus to the subject, who deposited the principal to NJF.

7.5.4. Plan of costs for decommissioning of nuclear installations

NUCLEAR POWER PLANT A1

Decommissioning of JE A1 from operation

Quantification of costs for decommissioning of nuclear power plant A1 at present is included in Plans of individual stages of decommissioning. Within these costs there are also costs spent by JAVYS, a. s. for maintenance and reparations of construction units and technologies connected to JE A1 and own operating, overhead and investing costs and delivery duties generated as part of implementation of decommissioning of nuclear power plant. These costs include also necessary financial provisions for decommissioning of experimental installations for processing and conditioning of RAO, which are part of object system of this power plant. Perspective of justified costs connected to implementation and ensuring of conception for decommissioning of JE A1 from 2015 at price level of 2014 was set to amount of 578,428 mil. €. Costs for decommissioning of JE A1 until 2020 in years and after 2020 in total are presented in the Table No. 7.19.

Table No. 7.19: Costs for decommissioning of JE A1

Decommissioning of JE A1 from operation							**[mil. €]**
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
total costs prices of 2014	48,007	46,574	43,693	44,213	36,389	33,717	325,836
total costs in nominal prices	48,967	48,456	46,367	45,857	40,176	37,971	418,817
total costs in discounted prices	48,429	47,398	44,857	45,790	38,019	35,537	363,860

Disposal of RAO from decommissioning of JE A1

Costs for disposal of conditioned RAO from decommissioning of JE A1 from operation from 2015 at price level of 2014 were set in amount of 160,470 mil. € and result from activities implemented in decommissioning defined in Plan for the II. stage of decommissioning of this plant. Table No. 7.20 shows estimate of annual need of financial provisions for disposal of RAO from its decommissioning until 2020 and costs in total after this year.

Table No. 7.20: Costs for disposal of RAO from decommissioning in repository Mochovce

Costs for disposal of RAO from decommissioning of JE A1 in repository Mochovce							**[mil. €]**
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
prices of 2014	0,907	3,839	1,370	1,122	2,122	2,122	148,989
in nominal prices	0,925	3,994	1,454	1,215	2,343	2,390	199,035
in discounted prices	0,915	3,907	1,406	1,162	2,217	2,237	169,291

In decommissioning of JE A1 RAO will generate, which can not be disposed of in Surface Repository in Mochovce. Nature of these wastes requires their disposal in deep geological formations. Quantity of these wastes corresponds to the amount of financial provisions of 100,926 mil. € at the price level of 2014 (2,70 % of total costs for deep repository).

Table No. 7.21: Contribution of JE A1 to HÚ

Contribution of nuclear power plant A1 to implementation of HÚ in SR [mil. €]	
	40-years of operation
prices of 2014	100,926
in nominal prices	368,087
in discounted prices	175,590

BALANCE OF RESOURCES AND WITHDRAWAL OF NJF FUNDS FOR A1

Overall balance or resources and withdrawal of provisions for decommissioning of JE A1 is indicated in the Table No. 7.22. Transfer from MH SR will become financial provision for all activities of decommissioning of this power plant.

Table No. 7.22: Balance of resources and of withdrawal of financial provisions for decommissioning of JE A1

Item [mil. €]	**prices of 2014**	**in nominal prices**	**in discounted prices**
Costs for decommissioning of JE from 2015 (including costs for disposal of RAO in HÚ)	578,428	688,611	623,890
Costs for disposal of RAO in repository Mochovce	160,470	211,354	181,135
Contribution to costs for HÚ (2,70 % of total costs)	100,597	368,087	175,269
Total costs	**839,495**	**1 268,052**	**980,294**
Balance of analytical account of 01.01.2015			11,005
Financial resources of NJF SR (transfer MH + interests)	828,490	1 257,047	969,289
Resources in total	**839,495**	**1 268,052**	**980,294**

NUCLEAR POWER PLANT V1

Decommissioning and disposal of RAO from decommissioning

The amount in the analytical account of JE V1 of 01.01.2015 is equaled to 306,522 mil. €. Justified expenditures for decommissioning of JE V1 and for handling of RAO from decommissioning from 2015 are stated in amount of 403,450 mil. €. (in prices of 2014). After decision of Government of SR on final shut down of JE V1, Bohunice International

Decommissioning Support Fund for power plant V1 units was established as compensation from European Union. Withdrawal of financial provisions from this Fund has already begun and its full spending would save 264,121 mil. € in 2015. Amount of historical deficit would be reduced by this amount and thus also transfer of MH SR assuming factual content of activities funded from NJF and BIDSF is taking into account. Total costs for decommissioning of JE V1 from operation are indicated in the Table No. 7.23.

Table No. 7.23: Total costs for decommissioning of JE V1

Costs for decommissioning of JE V1				**[mil. €]**			
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
decommissioning of 2014	50,073	48,938	48,884	39,676	29,300	39,129	101,828
disposal of RAO from decommissioning in prices of 2014		0,340	0,319	1,247	7,247	7,247	29,222
total in prices of 2014	50,073	49,278	49,203	40,923	36,547	46,376	131,050
in nominal prices	51,075	51,268	52,215	44,489	40,351	52,226	155,136
in discounted prices	50,513	50,150	50,453	43,123	38,184	48,880	141,198

Funding of above mentioned activities is ensured from two sources (NJF SR and BIDSF) as it is indicated in the Table No. 7.24.

Table No. 7.24: Funding of decommissioning of JE V1

Funding of decommissioning of JE V1 from operation					**[mil. €]**		
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
- from NJF in prices of 2014	18,158	18,856	25,969	30,940	6,510	5,876	13,955
- from NJF in nominal prices	18,522	19,618	27,558	33,491	7,187	6,618	16,623
- from NJF in discounted prices	18,318	19,190	26,660	32,044	6,801	6,194	15,077
- from BIDSF in prices of 2014	31,914	30,082	22,916	8,737	22,791	33,252	87,873
- from BIDSF in nominal prices	32,553	31,297	24,319	9,457	25,163	37,447	103,886
- from BIDSF in discounted prices	32,195	30,614	23,526	9,048	23,812	35,048	94,622

Storage of spent nuclear fuel

Costs for storage of VJP from nuclear power plant V1 in separate installations were stated based on assumed activities described in the chapter on handling of VJP. Amount of costs for handling of VJP is stated based on experience gained from MSVP Jaslovské Bohunice and it amounts to 151,735 mil. € from 2015 in prices of 2014, considering delay in commissioning of HÚ operation. Estimate of costs withdrawal for storage of VJP in separate installations is indicated in the Table No. 7.25.

Table No. 7.25: Costs for storage of VJP from JE V1 in separate installations

Costs for storage of VJP in separate installations					[mil. €]		
Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**after 2020**
in prices of 2014	3,525	3,189	4,143	3,937	2,732	2,732	131,477
in nominal prices	3,595	3,318	4,397	4,262	3,016	3,076	250,666
in discounted prices	3,556	3,246	4,254	4,078	2,854	2,879	173,289

Disposal of VJP from JE V1

To see complex picture on demand for financial provisions for all activities for complete decommissioning of nuclear power plant V1, it is necessary to add costs for final disposal of VJP. Measured costs for final disposal of VJP are depend on quantity of fuel and it is evident that they will decrease as quantity of disposed fuel will increase. At present operation of nuclear power plants of JE V2 and JE EMO is expected to be 40 years, but SE, a. s. management has decided on direction with the aim to prolongate it to 60 years. Costs for disposal of VJP from JE V1 in 40 years of operation, JE V2 and JE EMO in prices of 2014 amount to 738,083 mil. € (19,81 % of total costs of HÚ).

Table No. 7.26: Contribution of JE V1 to HÚ

Contribution of nuclear power plant V1 to implementation of HÚ in SR	[mil. €]
	40 years of operation
in prices of 2014	738,083
in nominal prices	2 700,670
in discounted prices	1 285,954

Balance of resources and withdrawal of provisions for JE V1

Complex picture after 2015 on balance of resources and withdrawal of financial provisions for all activities of complete decommissioning of nuclear power plant V1 is indicated in the Table 7.27 in 40 years of operation of nuclear power plants V2 and in Mochovce. If indicated power plants will operate 60 years, they will produce more VJP, what is related to lower measured costs for handling of VJP. It follows thus overall costs for final decommissioning of JE V1 and final disposal of wastes and VJP will be lower.

Table No. 7.27: Balance of resources and costs for decommissioning of JE V1

Item [mil. €]	in prices of 2014	in nominal prices	in discounted prices
Costs for decommissioning of JE from 2015	357,828	393,737	373,148
Costs for disposal of RAO	45,620	52,830	48,672
Costs for storage of VJP	151,735	272,331	194,155
Contribution to costs for HÚ (19,81 % of total costs)	738,083	2 700,670	1 285,954
Total costs	**1 293,266**	**3 419,268**	**1 901,929**
Balance of analytical account of 01.01.2015			306,522
BIDSF	237,565	264,121	248,865
NJF SR (transfer from MH SR + interests)	749,181	2 838,625	1 346,542
Sources in total	**1 293,266**	**3 419,268**	**1 901,929**

NUCLEAR POWER PLANT V2

Decommissioning and disposal of RAO from decommissioning

Nuclear power plant V2 is different to JE V1 in other type of reactor and higher weights of construction and technological components. Such differences result in amount of justified expenditures related to implementation and ensuring of conception for decommissioning of JE V2.

Overall amount of costs in the period of termination of operation of nuclear power plant V2 is estimated at price level of 2014 in amount of 207,648 mil.€. This Programme considers NJF SR resources will be used for reimbursement of costs for preparation of decommissioning in amount of 6,675 mil. €. Overall costs for decommissioning and handling of RAO at price level of 2014 were stated to amount 758,677 mil. €. Decommissioning process itself in 40 years of operation will begin in 2031 and in 2048 the locality would be released for other use. In 60 years of operation decommissioning and also release of locality will be postponed in 20 years. Justified expenditure for preparation for decommissioning, decommissioning itself and disposal of RAO from decommissioning summarizes the Table No. 7.28.

Table No. 7.28: Costs for decommissioning and disposal of RAO from decommissioning of JE V2

Withdrawal of financial provisions for decommissioning of JE V2					**[mil. €]**
		40 years of operation of JE		**60 years of operation of JE**	
	in prices of 2014	**in nominal prices**	**in discounted prices**	**in nominal prices**	**in discounted prices**
decommissioning preparation	6,675	7,807	7,153	11,601	8,523
decommissioning	723,450	1 191,010	901,176	1 769,778	1 073,818
disposal of RAO from decommissioning	35,227	55,997	43,206	83,209	51,484
TOTAL	**765,352**	**1 254,814**	**951,535**	**1 864,588**	**1 133,825**

Storage of spent nuclear fuel

Costs for storage of VJP from nuclear power plant V2 in separate installations were stated based on recent experience gained from MSVP Jaslovské Bohunice. Lower costs for storage of VJP V2 in 60 years of power plant operation result from shorter period of storage, in spite of its higher production, what is related with time delay of beginning of HÚ operation. Estimate of cost withdrawal for storage of VJP in separate installations is indicated in the Table No. 7.29.

Table No. 7.29: Costs for storage of VJP from JE V2 in separate installations

Costs for storage of VJP in separate installations		**[mil. €]**
	40years of operation	**60years of operation**
in prices of 2014	190,576	170,535
in nominal prices	447,451	492,742
in discounted prices	275,292	271,454

Disposal of VJP from JE V2

Characterization of part of RAO from decommissioning and also VJP do not enable their deposition in the Surface Repository in Mochovce. Final step for such wastes is their final deposition in deep geological formations. Contribution of JE V2 to development, construction, operation and closure of deep geological repository in SR is indicated in the Table No. 7.30 (28,34 % of total costs for HÚ in 40 years of operation and 29,69 % in 60 years of operation).

Table No. 7.30: Contribution of JE V2 to HÚ

Contribution of nuclear power plant V2 to implementation of HÚ in SR		**[mil. €]**
	40years of operation	**60years of operation**
in prices of 2014	1 055,894	1 311,573
in nominal prices	3 863,552	5 708,577
in discounted prices	1 839,674	2 444,410

Balance of resources and withdrawals of provisions for JE V2

Complex picture on demand for financial provisions for all activities of complete decommissioning of nuclear power plant V2 in 40 years of operation is indicated in the Table No. 7.31 and in 60 years of operation in the Table No. 7.32.

Table No. 7.31: Balance of resources and withdrawal of funds for decommissioning of JE V2 in 40 years of operation

Item [mil. €]	in prices of 2014	in nominal prices	in discounted prices
Decommissioning costs of JE	730,125	1 198,817	908,329
Disposal costs of RAO	35,227	55,997	43,206
Storage costs of VJP	190,576	447,451	275,292
Contribution to costs for HÚ (28,34 % of total costs)	1 055,552	3 863,552	1 839,674
Total costs	**2 011,480**	**5 565,817**	**3 066,501**
Balance on analytical account of 01.01.2015			532,341
Contribution of operator from 01.01.2015	376,131	425,373	396,996
Interests	574,546	877,543	687,432
Resources in total	**1 483,108**	**1 835,347**	**1 616,859**
Surplus (+) / Shortage (-)	**- 528,372**	**- 3 730,470**	**- 1 449,642**

Table No. 7.32: Balance of resources and withdrawal of funds for decommissioning of JE V2 in 60 years of operation

Item [mil. €]	in prices of 2014	in nominal prices	in discounted prices
Decommissioning costs of JE	730,125	1 781,379	1 082,341
Disposal costs of RAO	35,227	84,209	51,484
Storage costs of VJP	170,535	492,742	271,454
Contribution to costs for HÚ (29,69 % of total costs)	1 311,573	5 708,577	2 444,410
Total costs	**2 247,460**	**8 066,907**	**3 849,689**
Balance on analytical account of 01.01.2015			532,341
Contribution of operator from 01.01.2015	1 129,071	1 579,815	1 305,228
Interests	1 340,468	2 707,731	1 801,254
Resources in total	**3 001,970**	**4 819,977**	**3 638,973**
Surplus (+) / Shortage (-)	**754,510**	**- 3 246,930**	**- 210,716**

NUCLEAR POWER PLANT EMO 12

Subaccount B of NJF SR pursuant to section 1 of § 8 on NJF Act is defined as subaccount for decommissioning of nuclear power plant including handling of RAO from decommissioning in locality Mochovce. Nuclear power plant EMO 12 meets this definition at present. In estimated operation of 40 years shut down of the first unit is expected at the end of 2039 and of the second unit at the end of 2040.

Decommissioning and disposal of RAO from decommissioning

Considerations on demand for financial provisions for termination of operation and preparation of decommissioning result from Update of conceptual plan for decommissioning from operation elaborated in 2009 and specified by work group for comparison of costs for decommissioning of nuclear power plants in Slovakia in June 2011. Decommissioning conception is similar to JE V2 decommissioning. The difference lies in termination of operation as VJP from EMO 12 reactors should be cooled in storage basin for five years. Decommissioning itself will begin in 2046 and will be terminated in 2063. Total costs for decommissioning and handling of RAO at the price level of 2014 were stated in amount of 720,185 mil. €. Costs for termination of operation would be reduced if both reactors were shut down simultaneously, what would shorten and simplify structure of stage for termination of operation. Perspective of justified expenditures during period of preparation for decommissioning, decommissioning and disposal of RAO from decommissioning of this nuclear power plant is presented in the Table No. 7.33.

Relation of Mochovce locality to technologies for processing and conditioning of RAO and storage of VJP located in Jaslovské Bohunice site affects the amount of justified expenditures connected to implementation and ensuring of conception for decommissioning of JE EMO 12.

Table No. 7.33: Costs for decommissioning and disposal of RAO from decommissioning of JE EMO 12

Withdrawal of financial provisions for decommissioning of JE EMO 12				**[mil. €]**	
		40 years of operation of JE		**60 years of operation of JE**	
	in prices of 2014	**in nominal prices**	**in discounted prices**	**in nominal prices**	**in discounted prices**
decommissioning preparation	6,675	10,507	8,158	15,613	9,720
decommissioning	720,185	1 597,633	1 023,704	2 373,998	1 219,820
RAO disposal from decommissioning	35,227	73,887	48,846	109,792	58,204
TOTAL	**762,087**	**1 682,027**	**1 080,708**	**2 499,403**	**1 287,744**

Storage of spent nuclear fuel

Costs for storage of VJP from nuclear power plant EMO 12 in separate installations were stated based on assumption of storage of this fuel in dry storage in spite of the fact that currently it is stored in MSVP Jaslovské Bohunice. Estimate of withdrawal of costs for storage of VJP in separate installations is presented in the Table No. 7.34. Lower costs for storage of VJP of JE EMO 12 in 60 years of operation of power plant result from shorter period of storage in spite of its higher generation, what is related to time delay of beginning of HÚ operation.

Table No. 7.34: Costs for storage of VJP from JE EMO 12 in separate installations

Costs for storage of VJP in separate installations	**[mil. €]**	
	40 years of operation	**60 years of operation**
in prices of 2014	54,494	44,878
in nominal prices	179,248	197,962
in discounted prices	91,350	85,945

Disposal of VJP and VAO from JE EMO 12

Last step of handling of VAO and VJP is their final deposition in deep geological formations. Contribution of JE EMO12 to development, construction, operation and closure of deep geological repository in SR is presented in the Table No. 7.35 (25,52 % of total costs for HÚ in 40 years of operation and 27,57 % in 60 years of operation).

Table No. 7.35: Contribution of JE EMO12 for HÚ

Contribution of nuclear power plant EMO12 to implementation of HÚ in SR	**[mil. €]**	
	40years of operation	**60years of operation**
in prices of 2014	950,826	1 217,826
in nominal prices	3 479,106	5 300,680
in discounted prices	1 656,615	2 269,868

Balance of resources and withdrawals of provisions for JE EMO 12

Total picture on demand for financial provisions for all activities of complete decommissioning of nuclear power plant EMO12 in 40 years of operation is presented in the Table No. 7.36 and in 60 years of operation in the Table No. 7.37.

Table No. 7.36: Balance of costs and resources for decommissioning of JE EMO12 in 40 years of operation

Item [mil. €]	**in prices of 2014**	**in nominal prices**	**in discounted prices**
Costs for decommissioning of JE	726,860	1 608,140	1 031,862
Costs for disposal of RAO	35,227	73,887	48,846
Costs for storage of VJP	54,494	179,248	91,350
Contribution to costs for HÚ (25,52 % of total costs for HÚ)	950,826	3 479,106	1 656,615
Total costs	**1 767,365**	**5 340,381**	**2 828,673**
Balance on subaccount B (EMO12) of 01.01.2015			365,212

Contribution of operator from 01.01.2015	939,834	1 249,360	1 063,329
Interests	650,784	1 085,703	810,218
Resources in total	**1 955,830**	**2 700,275**	**2 238,759**
Surplus (+) / shortage (-)	**188,465**	**- 2 640,106**	**- 589,914**

Table No. 7.37: Balance of resources and costs for decommissioning of JE EMO12 in 60 years of operation

Item [mil. €]	**in prices of 2014**	**in nominal prices**	**in discounted prices**
Costs for decommissioning of JE	726,860	2 389,611	1 229,440
Costs for disposal of RAO	35,227	109,792	58,204
Costs for storage of VJP	44,878	197,962	85,945
Contribution to costs for HÚ (27,57 % of total costs)	1 217,826	5 300,680	2 269,868
Total costs	**2 024,791**	**7 998,045**	**3 642,457**
Balance on subaccount B (EMO12) of 01.01.2015			365,212
Contribution of operator from 01.01.2015	1 704,060	2 826,261	2 114,652
Interests	1 265,777	2 905,300	1 796,843
Resources in total	**3 335,049**	**6 096,773**	**4 276,707**
Surplus (+) / Shortage (-)	**1 310,258**	**- 1 901,272**	**634,250**

NUCLEAR POWER PLANT EMO 34

Generation and spending of financial provisions for decommissioning of nuclear installations including handling of RAO from this decommissioning commissioned after the Act No. 238/2006 Coll. entered into force, will be implemented on subaccount C of NJF SR. Based on preparation for completion of EMO 34 construction, it is possible to include this nuclear power plant within this subaccount.

Decommissioning and disposal of RAO from decommissioning

Considerations on costs for decommissioning of future nuclear power plant EMO34 are based on the study Update of costs for decommissioning of EMO34, elaborated at the beginning of 2009 and specified by work group for comparison of costs for decommissioning of nuclear power plants in Slovakia in June 2011. Costs for preparation for decommissioning, termination of operation and decommissioning of this power plant based on current knowledge are similar to costs for nuclear power plant EMO 12. In 40 years of operation of JE withdrawal of financial provisions for activities will begin in 2048 for first preliminary studies of decommissioning. Termination of operation will begin in 2056, decommissioning process will begin in 2062 and estimate of release of locality is in 2080. Perspective of costs

for the process of decommissioning for this nuclear power plant is presented in the Table No. 7.38.

Relation of locality Mochovce to technologies for processing and conditioning of RAO and storage of VJP located in locality Jaslovské Bohunice affects the amount of justified expenditures connected to implementation and ensuring of conception for decommissioning of EMO 34.

Table No. 7.38: Costs for decommissioning and disposal of RAO from decommissioning of JE EMO34

Withdrawal of financial provisions for decommissioning of EMO34				**[mil. €]**	
		40 years of operation of JE		**60 years of operation of JE**	
	in prices of 2014	**in nominal prices**	**in discounted prices**	**in nominal prices**	**in discounted prices**
preparation for decommissioning	6,675	14,424	9,385	21,434	11,183
decommissioning	728,978	2 217,350	1 191,536	3 294,865	1 419,804
disposal of RAO from decommissioning	35,227	99,442	55,709	147,766	66,381
TOTAL	**770,880**	**2 331,216**	**1 256,630**	**3 464,065**	**1 497,368**

Storage of spent nuclear fuel

Costs for storage of VJP from power plant EMO 34 in separate installations were stated based on current assumptions for operation of dry storage of VJP in Mochovce. Estimation of withdrawal of costs for storage of VJP in separate installations is presented in the Table No. 7.39.

Table No. 7.39: Costs for storage of VJP from JE EMO34 in separate installations

Costs for storage of VJP in separate installations	**[mil. €]**	
	40 years of operation	**60 years of operation**
in prices of 2014	49,152	43,809
in nominal prices	205,473	257,179
in discounted prices	91,791	95,242

Disposal of VJP and VAO from JE EMO34

Last step for handling of VAO and VJP is their final disposal in deep geological formations. Contribution of EMO 34 to development, construction, operation and closure of deep geological repository in SR is presented in the Table No. 7.40 (23,63 % of total costs for HÚ in 40 years of operation and 25,82 % in 60 years of operation).

Table No. 7.40: Contribution to EMO34 for HÚ

Contribution of nuclear power plant EMO34 to implementation of HÚ in SR [mil. €]		
	40 years of operation	60 years of operation
in prices of 2014	880,490	1 140,613
in nominal prices	3 221,445	4 964,221
in discounted prices	1 533,927	2 125,789

Balance of resources and withdrawals for EMO 34

Balance of demanded financial provisions and resources for all activities of complete decommissioning of nuclear power plant EMO 34 in 40 years of operation is presented in the Table No. 7.41 and in 60 years of operation in the Table No. 7.42.

Table No. 7.41: Balance of financial provisions and costs for decommissioning of EMO34 in 40 years of operation

Item [mil. €]	in prices of 2014	in nominal prices	in discounted prices
Decommissioning costs of JE	735,653	2 231,774	1 200,921
Disposal costs of RAO	35,227	99,442	55,709
Storage costs of VJP	49,152	205,473	91,791
Contribution to costs for HÚ (23,63 % of total costs)	880,490	3 221,445	1 533,927
Total costs	**1 700,522**	**5 758,134**	**2 882,348**
Contribution of operator from 01.01.2015	1 458,164	2 337,317	1 785,895
Interests	623,079	1 330,045	865,095
Resources in total	**2 081,243**	**3 667,362**	**2 650,990**
Surplus (+) / Shortage (-)	**380,721**	**- 2 090,772**	**- 231,358**

Table No. 7.42: Balance of financial provisions and costs for decommissioning of EMO34 in 60 years of operation

Item [mil. €]	in prices of 2014	in nominal prices	in discounted prices
Decommissioning costs of JE	735,653	3 316,299	1 430,987
Disposal costs of RAO	35,227	147,766	66,381
Storage costs of VJP	43,809	257,179	95,242
Contribution to costs for HÚ (25,82 % of total costs)	1 140,613	4 964,221	2 125,789
Total costs	**1 955,302**	**8 685,465**	**3 718,399**
Contribution of operator from 01.01.2015	2 216,018	4 471,507	2 982,189
Interests	1 172,035	3 458,401	1 859,625
Sources in total	**3 388,053**	**7 929,908**	**4 841,814**
Surplus (+) / Shortfall (-)	**1 432,751**	**- 755,557**	**1 123,415**

NON-REACTOR NUCLEAR INSTALLATIONS

Non-reactor nuclear installations are:

- Processing installations (TSÚ RAO and FS KRAO),
- Integral storage of RAO,
- Interim storage of VJP Jaslovské Bohunice.

The Act on NJF SR in force does not regulate way of accumulation of financial provisions for decommissioning of nuclear installations without nuclear reactor, it enables however to withdraw financial provisions. This difference will be addressed in forthcoming new Act on NJF SR. Costs for handling of RAO from decommissioning and decommissioning of non-reactor nuclear installations itself in 40 and 60-years of operation of JE V2 and JE EMO are presented in the Table No. 7.43.

Table No. 7.43: Costs for decommissioning of non-reactor JZ

Costs for decommissioning of non-reactor JZ [ths. €]						
	40 years of JE operation			**60 years of JE operation**		
	in prices of 2014	in nominal prices	in discounted prices	in prices of 2014	in nominal prices	in discounted prices
Bitumenation lines						
- handling of RAO	5 633	17 842	9 382	5 633	17 842	9 382
- decommissioning itself	16 096	50 983	26 808	16 096	50983	26 808
TOTAL	21 729	68 825	36 190	21 729	68 825	36 190
TSÚ RAO - supporting objects of JE A1						
- handling of RAO	6 065	16 564	9 460	6 065	16 564	9 460
- decommissioning itself	13 244	36 171	20 659	13 244	36 171	20 659
TOTAL	19 309	52735	30 119	19 309	52 735	30 119
HVB JE A1						
- handling of RAO	26 692	69 431	40 733	26 692	69 431	40 733
- decommissioning itself	80 312	208 906	122 561	80 312	208 906	122 561
TOTAL	107 004	278 337	163 294	107004	278 337	163 294
BSC RAO						
- handling of RAO	8 709	27 969	14 593	8 709	27 969	14 593
- decommissioning itself	18 820	60 440	31 534	18 820	60 440	31 534
TOTAL	27 529	88 409	46 127	27 529	88 409	46 127
Integral storage						
- handling of RAO	1 414	6 198	2 719	1 414	6 198	2 719
- decommissioning itself	5 589	24 496	10 748	5 589	24 496	10 748
TOTAL	7 003	30 694	13 467	7 003	30 694	13 467
MSVP Jaslovské Bohunice						
- handling of RAO	14 678	56 887	26 730	14 678	84 531	31 850

- decommissioning itself	22 081	85 579	40 211	22 081	127166	47 915
TOTAL	36 759	142 466	66 941	36 759	211 697	79 765
Completion of storage capacity of VJP						
- handling of RAO	3 416	23 869	8 075	3 416	35 469	9 622
- decommissioning itself	8 126	56 781	19 209	8 126	84373	22 889
TOTAL	11 542	80 650	27 284	11 542	119 842	32 511
FS KRAO Mochovce						
- handling of RAO	2 578	9 903	4 676	2 578	14 715	5 572
- decommissioning itself	10 968	42 131	19 896	10 968	62 605	23 707
TOTAL	13 546	52 034	24 572	13 546	77 320	29 279
non-reactor installations in TOTAL	**244 420**	**794 151**	**407994**	**244 420**	**927 859**	**430 752**

**Costs for decommissioning of completed part of storage capacity of VJP do not include costs for decommissioning of storage containers of VJP.*

7.6. Institutional control of repositories

Activities of institutional control of repository in Mochovce will begin only after 2080 and they will be executed in decades eventually hundreds of years. As funding of institutional control of repositories will be required only after 2080, financial provisions will not be distributed before this date for subaccount pursuant to § 8 section 1 letter f) of the Act on NJF, which will be used for funding of this activity in future.

Costs for active institutional control, which would be executed decades after closure of repository would not exceed amount of 0,250 mil. € on average annually at the price level of 2014. Costs for passive institutional control, which should be executed in about 200 – 300 years later, would be lower.

7.7. Management of the Fund

Provision of § 9 section 1 letter g) of the Act on NJF provides for amount of costs for management of NJF up to 1 % of annual income of NJF. Experience to date indicates that actual amount of costs for NJF management is always less that above mentioned 1 %. Nonetheless submitted document considers this provided amount in calculations presented in the Table No. 7.44. Conservative assumption will facilitate tackling financial problems.

7.8. Total balance of resources and withdrawals of NJF provisions

Based on assumptions presented in preceding chapters it is possible to developed perspective of financial provisions status in NJF until 2020. Total balance of financial provisions in NJF until 2020 is developed in nominal prices of relevant year and presented in the Table No. 7.44.

Amounts of expenditures of NJF for individual years in the Table No. 7.44 reflect the way of invoicing, thus they are not in accordance with demand for financial provisions in a given year. This results from manner of payments for performing the work. Financial provisions are paid by NJF only after performing the work, in case of monthly invoicing in next month. Thus payments for executed activities for month November, eventually December are made in January, eventually in February of following year, and thus they constitute also costs for NJF in the year, when they are paid. Dates for 2015 – 2020 result from NJF budget proposal.

Table No. 7.44: Balance of financial provisions of NJF until 2020

[mil. €]	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
initial balance	1 225,129	1 319,458	1 411,885	1 516,192	1 636,157	1 793,152
electricity generation income	61,621	61,455	75,739	97,058	112,031	123,239
transfer MH SR from PS, DS payment	67,834	70,895	72,346	73,826	75,336	76,875
state budget subsidy (ZRAM)	0,351	0,373	0,380	0,388	0,395	0,403
interests	35,690	36,000	37,000	38,500	40,040	42,500
NJF income in total	1 390,625	1 488,181	1 597,350	1 725,964	1 863,959	2 036,169
decommissioning of JE A1	-47,067	-48,541	-46,715	-47,609	-41,457	-38,338
decommissioning of JE V1	-18,501	-19,435	-26,235	-32,502	-11,571	-6,713
decommissioning of JE V2	0,000	0,000	-0,221	-0,269	-0,275	-0,955
handling of ZRAM (State Budget)	-0,300	-0,373	-0,380	-0,388	-0,395	-0,403
disposal of RAO from decommissioning	-0,950	-3,777	-2,218	-2,435	-9,047	-10,516
development of deep disposal	-0,024	-0,046	-0,392	-1,534	-4,039	-6,839
VJP storage	-3,525	-3,364	-4,217	-4,284	-3,224	-3,066
NJF management	-0,800	-0,760	-0,780	-0,785	-0,800	-0,850
NJF expenditures in total	-71,167	-76,296	-81,158	-89,806	-70,808	-67,680
balance at the end of period	1 319,458	1 411,885	1 516,192	1 636,157	1 793,152	1 968,488

Summary of income is indicated in the Table No. 7.8 and of total costs in the Table No. 7.45. Total balance of financial provisions in NJF, i. e. until completion of all activities of peaceful utilization of nuclear power engineering is indicated in the Figure No. 7.1.

Financial mechanism presented in previous tables results from following basic assumptions:

- contributions of operators of nuclear installations to NJF are calculated based on the Act on NJF,

- transfer from MH SR in form of delivery of operator of transmission system and operators of distribution systems from 2015 as indicated in the Table No. 7.5,
- costs for the final stage of peaceful utilization of nuclear power engineering provided for based on existing knowledge on expected process of decommissioning of nuclear facilities and handling of RAO from decommissioning and VJP,
- financial provisions for subaccounts of NJF SR without own funding (subaccounts: of repository of RAO and VJP, storage of VJP in separate nuclear installations and institutional control of repositories) are ensured annually based on calculation for a given resource subaccount (demand for financial provisions in a given year) and by decision on distribution by the Board of Governors of NJF.

Table No. 7.45: Summary of costs for the Final stage of peaceful utilization of nuclear energy from 2015

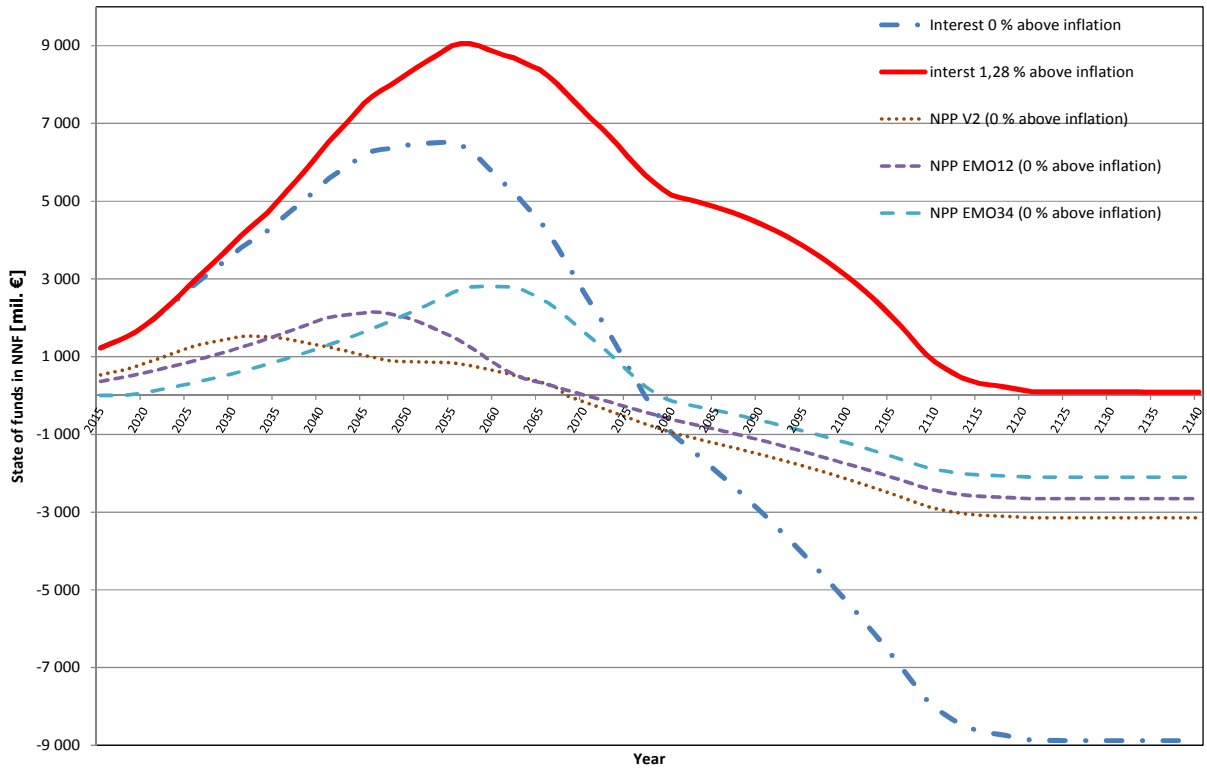
Item [mil. €]	in prices of 2014	in nominal prices	in discounted prices
Decommissioning costs of JE A1 (including costs for RAO disposal in HÚ)	578,428	688,611	623,981
Disposal costs of RAO from decommissioning of JE A1 in Mochovce repository	160,470	211,354	181,135
Contribution of JE A1 to costs for HÚ (2,70 % of total costs)	100,597	368,087	175,269
Decommissioning costs of JE V1	357,828	393,737	373,148
Disposal costs of RAO from decommissioning of JE V1	45,620	52,830	48,672
Storage costs of VJP from JE V1	151,735	272,331	194,155
Contribution of JE V1 to costs for HÚ (19,81 % of total costs)	738,083	2 700,670	1 285,954
Decommissioning costs of JE V2	730,125	1 198,817	908,329
Disposal costs of RAO from decommissioning of JE V2	35,227	55,997	43,206
Storage costs of VJP from JE V2	190,576	447,451	275,292
Contribution of JE V2 to costs for HÚ (28,34 % of total costs)	1 055,552	3 863,552	1 839,674
Decommissioning costs of EMO12	726,860	1 608,140	1 031,862
Disposal costs of RAO from decommissioning of EMO12	35,227	73,887	48,846
Storage costs of VJP from EMO12	54,494	179,248	91,350
Contribution of JE EMO12 to costs for HÚ (25,52 % of total costs)	950,826	3 479,106	1 656,615
Decommissioning costs EMO 34	735,653	2 231,774	1 200,921
Disposal costs of RAO from decommissioning of EMO34	35,227	99,442	55,709
Storage costs of VJP from EMO34	49,152	205,473	91,791

Contribution of EMO34 to costs for HÚ (23,63 % of total costs)	880,490	3 221,445	1 533,927
Costs for ZRAM	43,688	196,667	80,142
Institutional control of repositories	10,106	78,638	24,760
Decommissioning of non-reactor nuclear installations	244,420	794,151	407,994
NJF Management	65,414	105,827	80,139
COSTS IN TOTAL	**7 976,148**	**22 527,235**	**12 244,406**

Summary of costs for the final stage of peaceful utilization of nuclear power engineering after 2015 is compiled for expected costs reimbursed from financial provisions of NJF and BIDSF. In case of assumptions change, on which summary is compiled, will be costs for above mentioned final stage different. Of total nominal costs in amount of 22 527,235 mil. €, total costs for implementation of deep geological repository for RAO not disposable in Mochovce and VJP repository represent amount of 13 632,855 mil. €, what corresponds 61,25 % of total costs for the final stage of peaceful utilization of nuclear power energy in The Slovak Republic.

Above balance of financial provisions represents summary (cumulative) of all individual subaccounts of NJF SR. Principle of current management of NJF SR is based on saving system for every individual subaccount, whereby provisions of one subaccount cannot be used for financial demands of other subaccount.

Figure No. 7.1: Balance of financial provisions in NJF in years under the current legislative conditions



Principle task of above mentioned financial analysis was to establish, whether defined amount of contributions and deliveries to NJF will generate adequate financial provisions for all Final stage of peaceful utilization of nuclear power engineering in SR. Submitted analysis of balance of resources and withdrawal of financial provisions from NJF results from current conditions and assumptions on scale of activities in implementation and assurance of decommissioning of nuclear installations, assumptions on quantities and kinds of processed RAO and used technologies, existing legislative requirements for implementation of such activities, current estimates of prices of goods and services and personal costs.

Based on such information model was created assuming that complete and final solution of all results of present peaceful utilization of nuclear power engineering in SR will be approached in 130 years (not considering long term institutional control of repositories and construction of new nuclear source in locality of Jaslovské Bohunice). In such long period any change of input requirement, whether political, legislative or technical may cause change of level of assumed amount of withdrawal of financial provisions. For example it is quite difficult to estimate development of electricity price for period longer than 5 years. From this reason its development is estimate alternatively: at the level of expected inflation i. e. 2 %. In the Figure 7.1 development of balance of financial provisions in NJF SR under current legislative conditions is depicted (dotted and broken line). Estimate of incomes and costs is based on assumptions affected by statistical error of about +/-10 % in optimistic estimate. From the Figure and also from comparison of Tables No. 7.8 and 7.45 results that current legislative framework in current decrease in electricity price will not assure adequate financial provisions in NJF SR for balancing costs for the final stage of peaceful utilization of nuclear power engineering in SR. Balanced management in NJF SR under current conditions may be achieved in remuneration of available financial provisions of 1,28 % above inflation. For better illustration development of balance of financial provisions for individual operated JE in SR on remuneration of available funding at the level of inflation is depicted in the Figure 7.1.

8. TRANSPARENCY – INFORMATION TO THE PUBLIC

As it has already been mentioned in introductory chapter of this National Programme pursuant to relevant provisions of Directive of EU 2011/70/EURATOM (Article 10) transparency in the field of handling of spent nuclear fuel and radioactive wastes consists of two aspects:

- providing of necessary information for workers and for the public also by supervisory body,
- participation of public on decision making process on handling of spent nuclear fuel and radioactive wastes.

We could say that the first aspect predominantly by side of implementator of individual activities is fulfilling satisfactorily. There is legislative framework created for providing of information including international conventions in question. Information is released through all possible channels, in form of regular meeting with stakeholders or through implementation of individual activities. In providing information for public it is necessary to take into account documentation containing sensitive information. Pursuant to § 3 section 14 of the Act No. 350/2011 Coll., amending the Act No. 541/2004 Coll. on peaceful utilization of nuclear power engineering (the Atomic Act) and on alteration and amendment of other acts as amended, sensitive documentation is defined as follows: “For documentation containing sensitive information is considered documentation, of which disclosure would be used for planning and executing of activities with aim to cause damage or destruction of nuclear facility and thus adversely affect safety of public [15] and cause ecological or economical damage.” This documentation shall not be disclosed pursuant to special regulation [16]. Means of providing complex information on implemented activity is especially EIA process.

Aarhus Convention represents very significant element ensuring approach to information on environment and public participation in decision making process from international viewpoint. This Convention as international agreement is directly applied and enforceable in every state representing contracting party. It provides way, form, conditions, time frame and additional formalities associated with making information on environment available, identifies liable persons and approach to access to justice on issues of environment including possibility of making appeals to courts. In accordance to Aarhus Convention contracting parties are obliged to take measures for public participation in development of plans, programmes and policies concerning environment and also public participation in preparation of legal norms themselves. Executive body of Convention is so-called secretariat, which convenes and prepares meetings of contracting parties and also shall circulate reports and relevant communication. Activities and facilities concerned in Aarhus Convention are specified directly in its annex. From viewpoint of this National Programme the most significant is the first part of the annex entitled Power engineering industry, which states explicitly items like nuclear power plant and operation sites for handling of VJP and RAO.

Process of EIA in The Slovak Republic is the process with sole and existing legislative framework, which would ensure the second transparency policy mentioned above. Process of EIA as tool for decision making process is governed by law and for implementation of EIA processes is responsible state body – the Ministry of Environment of The Slovak Republic.

In addition to EIA process, eventually public hearings within it, there is a range of instruments for public participation in decision making process under leadership of implementator of activities. Very good overview released in one of their documents OECD NEA [13], which covers probably the most significant initiative concerning public participation – Forum of Stakeholder Confidence. The document is inter alia guidance how to select appropriate way of public participation in decision making process and offers its comparatively extensive list (see Annex No. 3).

For provisions of the Directive 2011/70/EURATOM concerning transparency to be applied it is necessary:

- to continue in informing the public in a manner and scope at least as implementator of activities for handling of RAO and VJP nowadays,
- to assure relevant EIA processes were launched in such a due time before intended activity, so they will become real tool for decision making process – this assures the Ministry of Environment of SR in cooperation with the Ministry of Economy of SR, the National Nuclear Authority and the implementator,
- to proceed to reasonable selection of public participation techniques [13] and to start their systematic utilization – this assures in case of need the Ministry of Economy of SR in cooperation with the National Nuclear Fund and the implementator.

9. INTERNATIONAL AGREEMENTS ON HANDLING OF SPENT NUCLEAR FUEL AND RADIOACTIVE WASTES

Slovak Republic in present has no effective treaty – international treaty on handling of spent nuclear fuel and/or radioactive wastes.

10. PROJECTED IMPACTS OF CONTRIBUTIONS AND DELIVERIES ON PRICES OF ELECTRICITY PRICE, PRICES OF OTHER GOODS AND SERVICES ON ECONOMIC AND SOCIAL DEVELOPMENT OF STATE

Sale of electricity generated in nuclear power plants is exclusively in competence of SE, a. s. in present and it concerns electricity generated in nuclear power plants V2 and EMO 12. Sale of power electricity is managed by distribution company, own direct customers, eventually electricity traders acting in defined territory of SR.

Amount of stated contributions to NJF (from 2012 amount of 13 428, 36 € for installed MW_e per year, which will be adjusted by inflation rate annually and 5,95 % of revenues of sold electricity generated in nuclear power plant) means that nuclear electricity production in Slovakia is the most cost effective way of its production in comparison with coal and gas thermal power plants, eventually in comparison with combined cycles.

Contributions of operator of transmission system and operator of distribution system for balancing historical deficit were imposed in 2011 in amount about 70 mil. € annually, means at illustrative price of power electricity in SR in amount of 55,- €/MWh price increase in 3 %. Considering average price for end user in amount of 120,- €/MWh, it would correspond to price increase in 1,5 %, what represents economical reasonable way of resource accumulation for balancing of historical deficit.

11. PROJECTED IMPACTS OF CONTRIBUTIONS AND DELIVERIES ON COMPETITION OF ELECTRICITY PRODUCERS IN NUCLEAR INSTALLATIONS IN ELECTRICITY MARKET OF SR, INTERNAL ELECTRICITY MARKET OF EU

Impact of contribution on competition of electricity producers will not be significant especially if we consider that similar problems exist practically in all states with similar structure of peaceful utilization of nuclear power engineering. Difference in individual states and one of essential difference in approaches (which however has potential to affect competition of domestic producers) is the scale of state budget participation.

12. IMPACT OF NATIONAL PROGRAMME ON BALANCE AND OPERATING RELIABILITY OF POWER SYSTEM OF SR IN EU

The National Programme is based on existing aims of power engineering of Slovakia analyzed in “Power engineering policy in SR” currently in the process of acceptance. Therefore, there is not assumed that it would anyhow affect balance, safety and operating reliability of power system.

13. OPINIONS OF AUTHORITIES OF STATE ADMINISTRATION IN FIELD OF PUBLIC HEALTH AND IN FIELD OF RADIATION PROTECTION AND HEALTH PROTECTION AND OPINION OF MŽP SR IN FIELD OF IMPACTS OF IMPLEMENTATION OF PROGRAMMES ON ENVIRONMENT

Announcement on update of strategic document of national scope was pursuant to § 17, section 3 of the Act No. 24/2006 Coll. on environmental impact assessment and on alteration and amendment of other regulations (hereinafter referred to as „the Act No. 24/2006 Coll. on environmental impact assessment“) delivered to the Ministry of Environment of The Slovak Republic (hereinafter referred to as „MŽP SR“) of December 1, 2014 and of December 2, 2014 was pursuant to § 6, section 1 of the Act No. 24/2006 Coll. on environmental impact assessment posted on the web site of the Ministry of Economy of The Slovak Republic (www.mhsr.sk) in section Energy, MŽP SR (www.enviroportal.sk), NJF (www.njf.sk) and of December 4, 2014 in mass media means of national scope (daily PRAVDA). At the listed web sites was released all documentation of „Proposal of National Policy and National Programme for handling of spent nuclear fuel and radioactive wastes in SR in form of update of strategic document The Strategy of the final stage of peaceful utilization of the nuclear power engineering in The Slovak Republic“ (hereinafter referred to as „Proposal of National Policy and National Programme for handling of VJP and RAO in SR“) including Announcement on update of strategic document of national scope and also Comparison of „Proposal of National Policy and National Programme for handling of VJP and RAO in SR“ and „The Strategy of the final stage of peaceful utilization of the nuclear power engineering in The Slovak Republic“.

In the process of examination procedure to the Announcement on strategic document of national scope „Proposal of National Policy and National Programme for handling of VJP and RAO in SR“ were delivered opinion of Public Health Authority of SR, Slovak Agency for Environment and 3 opinions of MŽP SR:

- Public Health Authority of SR in the letter No. OOZPŽ/9520/2014 of 12.17.2014 states – Public Health Authority has no comments to submitted documentation on the grounds – there are expected no negative effects on health of population in connection to activities in „Proposal of National Programme for handling of VJP and RAO in SR“.
- Slovak Agency for Environment, section of environmentalism and project management in the letter No. CZA4040/2014 of 12.19.2014 in conclusion states – adaptations and amendments of assessed strategic document in comparison with updated Strategy for the final stage of peaceful utilization of the nuclear power

engineering in SR lie only in specifying quantities of radioactive wastes and detailed specification of their characteristics and flows and in updating and specifying of economic part and we do not suppose that implementation of activities within „Proposal of National Policy and National Programme for handling of VJP and RAO in SR“ will cause other effects on environment and health than in already assessed strategic documents and implementation of new partial facilities, objects and activities including their changes for support for planned activities of assessed strategic document will be the subject of separate processes of EIA pursuant to legislation, it is not necessary to further assess strategic document. We recommend preferred variants.

- MŽP SR, section of environmental assessment and management, department of environmental risks and biological safety in the letter No. 59069/2014 of 12.16.2014 states – in regard to scope of our department we have no comments to Announcement on strategic document.
- MŽP SR, section of environmental assessment and management, department of air protection in the letter No. 57942/2014 of 12.10.2014 states – in viewpoint of scope of department of air protection we have only one specific statement, which was accepted into text of assessed document.
- MŽP SR, section of geology and natural resources in the letter No. 59075/2014 of 12.16.2014 – section geology and natural resources has no comments.

Result of examination procedure is The Decision No. MH SR 09498/2015-4100-28524 and No. MŽP SR 2909/2015-3.4/hp of June 15, 2015 stating Update of strategic document of national scope „Proposal of National Policy and National Programme for handling of spent nuclear fuel and radioactive wastes in SR in form of update of strategic document The Strategy of the final stage of peaceful utilization of the nuclear power engineering in The Slovak Republic“ will not be further assessed pursuant to the Act No. 24/2006 Coll. on environmental impact assessment and on alteration and amendment of other regulations as amended.

14. END NOTES

[1] The Strategy of the final stage of peaceful utilization of the nuclear power engineering in SR. Approved by the Government of The Slovak Republic Decision No. 26/2014 of January 15, 2014. Board of Governors of NJF, Bratislava, 2013

[2] Kostolanský M., Plško J., Kučerka M.: BIDSF Project C9.1 Feasibility study for enlargement of RÚ RAO Mochovce, Agreement No. BIDSF 009 4 001. Input data, part 1.: Questionnaires LQ, SQ. PMU BIDSF, Jaslovské Bohunice, March 2008

[3] Fiedler F., Plško J.: BIDSF Project 9.1 Feasibility study for enlargement of RÚ RAO Mochovce, Agreement No. BIDSF 009 4 001. Input data part 2.: Questionnaires OQ, DQ, RQ, TCQ. PMU BIDSF, Jaslovské Bohunice, March 2008

[4] Biurrun E., Sanches-Sudon J.: Agreement BIDSF 009 4 001. Assessment of conceptual proposal of alternatives. PMU BIDSF, Jaslovské Bohunice, April 2009

[5] Decommissioning costs of WWER - 440 nuclear power plants. Interim report: Data collection and preliminary evaluations. IAEA-TECDOC-1322. IAEA, Vienna, November 2002

[6] Improvements of radioactive waste management at WWER nuclear power plants. IAEA-TECDOC-1492, IAEA, Vienna, April 2006

[7] Burclová J., Pražská M.: Strategic procedure for handling of IRAO and ZRAM in SR. AllDeco s.r.o., Jaslovské Bohunice, October 2008

[8] Facility for handling of IRAO and ZRAM Mochovce. Assessment report pursuant to the Act No. 24/2006 Coll. on environmental impact assessment as amended. EKOS Plus, s.r.o., Bratislava, March 2011

[9] Konopásková S., Burclová J.: Safety report on assessment of scope of IRAO disposal with emphasis on unused sealed sources in RÚ RAO Mochovce. Project: EUAID/200401676407 Elaboration of Proposal for improvement of system for management for handling of institutional radioactive waste in SR. Task 3.2. AllDeco, Jaslovské Bohunice, September 2007

[10] Classification of Radioactive Waste. IAEA Safety Standards. General Safety Guide No. GSG-1. IAEA, Vienna, 2009

[11] Categorization of Radioactive Sources. IAEA Safety Standards. Safety Guide No. RS-G-1.9. IAEA, Vienna, 2005

[12] Information provided by JAVYS, a. s.

[13] Stakeholder Involvement Techniques. Short Guide and Annotated Bibliography. NEA Publication No.: 5418. OECD, Paris, 2004

[14] Ondra F. Zachar M. Salzer P.: Handling of contaminated soils, balance of RAO for demand for enlargement of RÚ RAO. Revision No. 1. of document: TED/RAO/VUJE/SK/008/10. DECOM, a. s., Trnava, 2010

[15] Article 4 section 4 of Convention on access to information, public participation in decision making process and access to justice in issues of environment (Announcement No. 43/2006 Coll.).

[16] § 11 section 1 letter h) of the Act No. 211/2000 Coll. on free access to information and on alteration and amendments of other regulations (the Act on freedom of information) amended in the Act No. 145/2010.

15. ANNEXES

ANNEX NO. 1: Legislative framework in the field of handling of radioactive wastes and spent nuclear fuel

- Joint Convention on safety of handling of spent nuclear fuel and on safety of handling of radioactive waste. Announcement of the Ministry of Foreign Affairs of The Slovak Republic No. 125/2002 Coll.
- Consolidated version of the Treaty establishing the European Atomic Energy Community. Official Journal of EU 2010/C 84/01-112. 03.30.2010
- Directive of the Council 2011/70/EURATOM of July 19, 2011, which established framework of the Community for responsible and safe handling of spent nuclear fuel and radioactive waste. Official Journal of EU 2010/L 199/48-56, 08.02.2011.
- EC Directive 2001/42/EC of European Parliament and Council of June 27, 2001 on assessment of effects of particular plans and programmes on environment. Official Journal of EU 2001/L 197/30-37, 07.21.2001
- Directive of European Parliament and Council 2011/92/EU of December 13, 2011 on assessment of effects of particular public and private projects on environment (codified version). Official Journal of EU 2012/L 26/1-21, 01.28.2012
- Convention on access to information, public participation in decision making process and access to justice on issues of environment (Aarhus Convention). Announcement of the Ministry of Foreign Affairs of The Slovak Republic No. 43/2006 Coll.
- Protocol on registries of releases and transmissions of pollutants to the Convention on access to information, public participation in decision making process and access to justice on issues of environment (Kiev protocol). Announcement of the Ministry of Foreign Affairs of The Slovak Republic No. 353/2010 Coll.
- Convention on assessment of cross boarder effects on environment (Convention Espoo). Announcement of the Ministry of Foreign affairs of The Slovak Republic No. 162/2000 Coll.
- Protocol on strategic environmental assessment to the Convention on assessment of cross boarder effects on environment (Kiev protocol). Announcement of the Ministry of Foreign Affairs of The Slovak Republic No. 439/2010 Coll.
- Recommendation of Commission of December 4, 2008 on criteria for export of radioactive waste and spent nuclear fuel to third countries [notified under number K (2008) 7570] (2008/956/EURATOM) Official Journal of EU 2008/L338/69-71. 12.17.2008
- Directive of Council 2006/117/EURATOM of November 20, 2006 on supervision and control in transport of radioactive waste and spent nuclear fuel. Official Journal of EU 2006/L 337/21-30 12.05.2006
- Decision of Commission of March 5, 2008 establishing standard document on supervision and control in transport of radioactive waste and spent nuclear fuel as

states Directive of Council 2016/117/EURATOM [notified under number K (2008) 793] (2008/312/EURATOM). Official Journal of EU 2008/L 107/32-59. 04.17.2008.

- Recommendation of Commission of October 24, 2006 on management of financial provisions for decommissioning of nuclear installations from operation and handling of spent nuclear fuel and radioactive waste (2006/851/EURATOM). Official Journal of EU 2006/L330/31-35. 11.28.2006.
- Directive of Council 2013/59/EURATOM of December 5, 2013, establishing basic safety norms of protection against dangers arising from ionized radiation and repealing Directives 89/618/EURATOM, 90/641/EURATOM, 96/29/EURATOM, 97/43/EURATOM and 2003/122/EURATOM.
- Resolution of Council on establishing national systems for supervision and control of presence of radioactive substances in recycling of metal substances in member states (2002 C /119/05). Official Journal of EU 2003/C/119/7-9. 05.22.2002.
- Directive of Council 2013/59/EURATOM of December 5, 2013, establishing basic safety norms of protection against dangers arising from ionized radiation and repealing Directives 89/618/EURATOM, 90/641/EURATOM, 96/29/EURATOM, 97/43/EURATOM and 2003/122/EURATOM.
- Recommendation of Commission of September 15, 1999 on classification system for solid radioactive waste (SEC (1999) 1302 final) (1999 /669 / ES, EURATOM). Official Journal EÚ 1999/L 265/37-45. 10.13. 1999.
- Recommendation of Commission of December 6, 1999 on application of Article 37 of the Treaty EURATOM (1999/829/EURATOM). Official Journal of EU 1999/L 324/23-43. 12.16.1999.
- Regulation of Council (EURATOM) No. 300/2007 of February 19, 2007 establishing cooperation tool in the field of nuclear safety. Official Journal of EU 2007/L81/1-10, 03.22.2007.
- Regulation of Council (EURATOM) No. 2587/1999 of December 2, 1999 defining investment projects necessary for notification duty to Commission in accordance to Article 41 of the Treaty establishing European Community for Atomic Energy. Official Journal of EU 1999/L315/1-3. 12.09. 1999.
- Regulation of Commission (EURATOM) No. 1352/2003 of July 23, 2003 amending Regulation (ES) No.1209/2000, laying down procedures for notifications pursuant to Article 41 of the Treaty establishing European Community for Atomic Energy. Official Journal of EU 2003/L 192/15-17. 07.31.2003.

In the field of nuclear safety following regulations apply:

- The Act No. 541/2004 Coll. on peaceful utilization of nuclear energy, 10 times amended and/or supplemented (provisions of Acts No. 238/2006 Coll., No. 21/2007, No.335/2007 Coll., No. 94/2007 Coll., No. 408/2008 Coll., No. 120/2010 Coll., No. 145/2010 Coll., No. 137/2010 Coll., No. 350/2011 Coll., and No. 143/2013 Coll.).
- Decree of ÚJD SR No. 30/2012 Coll. relating to the rules governing details of requirements in handling of nuclear materials, radioactive wastes and spent nuclear fuel.
- Decree of ÚJD SR No. 33/2012 Coll. on regular, complex and systematic assessment of nuclear safety of nuclear installations.
- Decree of ÚJD SR No. 430/2011 Coll. relating to the rules governing details of requirements for nuclear safety.
- Decree of ÚJD SR No. 52/2006 Coll. on professional competency as amended by Regulation of ÚJD SR No. 34/2012 Coll.
- Decree of ÚJD SR No. 431/2001 Coll. on system for managing quality.
- Decree of ÚJD SR No. 57/2006 Coll. relating to the rules governing details of requirements in transport of radioactive materials.
- Decree of ÚJD SR No. 58/2006 Coll. relating to the rules governing details of scope, content and way of developing of documentation of nuclear installations necessary for individual decisions, in accordance to the text of Regulation of ÚJD SR No. 31/2012 Coll.

In the field of radiation protection following regulations apply:

- Regulation of the Government of The Slovak Republic No. 345/2006 Coll. on basic safety requirements for protection of health of workers and population against ionized radiation.
- The Act No. 355/2007 Coll. on protection, support and development of public health with later subsequent amendments.
- Regulation of the Government of The Slovak Republic No. 348/2006 Coll. on requirements for control assurance of high activity sources and orphan sources.
- Regulation of the Ministry of Health of The Slovak Republic No. 545/2007 Coll. relating to the rules governing details of requirements for radiation protection assurance in activities leading to exposure and activities important from viewpoint of radiation protection.

Some provisions of Slovak legislative proposals formulating framework for the topic of National Programme

Provisions in question are often referred to in various parts of this National Programme. Here we highlight newly established classification of radioactive waste in Regulation of ÚJD SR No. 30/2012 Coll. based on approach in safety standard of IAEA [10] in question. § 5 of the Regulation divides radioactive wastes into five classes as follows:

a) temporary radioactive wastes, activity of which during storage with regard to very short half-life will decrease under limit value for their release to environment,

b) very low level radioactive wastes, activity of which is slightly higher than limit value for their release to environment, contain primarily radionuclides with short half-life, eventually also radionuclides with long half-life in low concentration, which require in deposition lower grade of isolation from environment by system of engineering barriers or they do not require using of engineering barriers and period of institutional control of repository is shorter than in case of surface type of repository of radioactive wastes,

c) low-level radioactive waste, which average mass activity of radionuclides with long half-life, especially of radionuclides emitting alpha radiation is less than 400 Bq/g, maximal mass activity of radionuclides with long half-life, especially of radionuclides emitting alpha radiation is locally less than 4 000 Bq/g, do not produced residual heat and after conditioning fulfill the limits and conditions for safe operation for surface type of repository of radioactive wastes,

d) intermediate-level radioactive wastes, which average mass activity of radionuclides with long half-life, especially of radionuclides emitting alpha radiation is equal to 400 Bq/g or is higher, can produce residual heat and measures for its removal are less than in case of high level active radioactive wastes and after conditioning do not fulfill limits and conditions for safe operation for surface type of repository of radioactive wastes,

e) high-level radioactive wastes, which average mass activity of radionuclides with short and long half-life, especially of radionuclides emitting alpha radiation exceeding values stated for low and intermediate-level radioactive wastes, are disposable only in deep type of repository of radioactive wastes, whereby measures for removal of residual heat form a significant factor in designing of such repositories.

§ 10 of the Regulation concerns depositing of radioactive wastes and contains nine paragraphs related to:

- requirements related exclusively to disposal of packed form of radioactive wastes in accordance with approved limits and conditions (criteria of acceptance) of safe operation of repository,
- requirements for safety analysis of repository,
- provisions related to safety analysis: reasonable framework for safety analysis proposed applicant/holder of relevant permission, analysis of uncertainties and sensitivity should be their part, decisions on changes or remedy measures should be based on them,

- provisions related to institutional control,
- requirements that preliminary proposal of closure of repository should be part of pre-operational safety report.

Separate provisions of the Regulation are related to disposal of spent nuclear fuel (§ 18) stating:

- spent nuclear fuel is deposited in repository,
- above mentioned provisions on disposal of radioactive wastes apply appropriately for repository and provisions on storage of spent nuclear fuel (ensuring of subcritical state, removal of residual heat, need for decontamination, safe manipulation etc.) also apply appropriately for repository
- requirements of provision in question of Act (subcriticality, heat removal, minimization of radiation effects) shall be fulfilled without operator intervention

It is important to note practical classification for sealed sources in Slovakia as recommended by other safety standard of IAEA [11] has not been implemented. All the fourth part of Regulation of the Ministry of Health No. 545/2007 Coll. concerns handling of institutional radioactive wastes, i. e. their collection and classification, processing, storage. Provisions on long term storage, conditioning and depositing of institutional wastes referred to, based on infrastructure for handling of them, provisions of the Atomic Act. Further quite extensive part of the Regulation – the fifth – concerns releases of radioactive substances to environment, i. e. their releases to waters and air and release of radioactively contaminated material from under scope of institutional control.

Further significant legislative proposals

The third pillar of set of legislative proposals for handling of radioactive wastes and spent nuclear fuel takes form of proposals concerning National Nuclear Fund as follows:

- The Act No. 238/2006 Coll. on National Nuclear Fund for decommissioning of nuclear installations and for handling of spent nuclear fuel and radioactive wastes (the Act on Nuclear Fund) as amended and supplemented by (the Act No. 528/2006 Coll., Act No. 94/2007 Coll., Act No. 408/2008 Coll., Act No. 143/2010 Coll., Act No. 550/2011 Coll., Act No. 391/2012 Coll. and the Act Nol.143/2013 Coll.
- Decree of the Government of The Slovak Republic No. 312/2012 Coll. establishing details on way of selection and payment of due delivery for the National Nuclear Fund for decommissioning of nuclear installations and for handling of spent nuclear fuel and radioactive wastes as amended by the Decree of the Government of The Slovak Republic No. 145/2012 Coll.
- Decree of the Government of The Slovak Republic No. 426/2010 Coll. establishing details on amount of delivery from electricity delivered to end users and on the manner of its collection for the National Nuclear Fund for decommissioning of nuclear installations and for handling of spent nuclear fuel and radioactive wastes as amended

by the Decree of The Slovak Republic No. 19/2013 Coll. and of the Decree of the Government of The Slovak Republic No. 297/2013 Coll.

In conclusion of this number of proposals forming legislative framework in the field of handling of radioactive wastes and spent nuclear fuel, it is important to note the Act No. 24/2006 Coll. on environmental impact assessment (the Act EIA) as amended. This Act has been 11 times modified and /or amended from 2006 by provisions of acts, specifically:
No. 275/2007 Coll., No. 454/2007 Coll., No. 287 /2009 Coll., No. 117/2010 Coll., No. 145/2010 Coll., 258/2011 Coll., No. 408/2011 Coll., No. 345/2012 Coll., No. 448/2012 Coll., No. 39/2013 Coll. and last No. 180/2013 Coll.

For the sake of completeness we mention the Act No. 569/2007 Coll. on geological works (geological act) amended and its implementing Regulation of the Ministry of Environment of The Slovak Republic No. 51/2008 Coll.

ANNEX NO. 2: Methods of public participation on decision making process

- public hearing,
- deliberative polling – similar to opinion poll with the difference laying in the fact that opinions are collected after the issue was explained to people and time was provided to think over it; including feedback meetings, sometimes with interest of media,
- concentrated groups – small groups of invited persons discussing the issue or proposal facilitating view of their reactions, values, interests and perspectives and shows how the dynamics inside the group affects opinion,
- civil consultative groups – small groups of persons representing various interests and experience, meeting regularly or ad hoc for discussions on issues in question and ensuring informed input,
- consultation groups – fora when important representatives of society meet, including representatives non-governmental and social organizations, people from economic and political sphere to make relevant recommendations for policy and improve upcoming dialogue among interested parities,
- nominal group process – structured interactive technique for generating ideas of high quality during short time (less than two hours); it is useful in objects setting, obstacle defining, finding creative answers to individual questions,
- „multi-actor policy workshop“ – small groups formed of important stakeholders and technical experts in order to collect opinions on important questions in dialogue; may facilitate innovative view of the problem,
- „charette“ (originally from French) – 20-60 people working together looking for solutions of a given problem during predetermined time (usually one day) under leadership of experienced facilitator; practical ideas and opinions are generated at the beginning of decision making process and problem issues with number of different interests are labeled,
- „Delphi process“ – people with different experience and interests relevant to issue take part in series of planned controlled discussions (face to face or also by correspondence); used for decisions based on facts and for strategies reflecting expert opinion for well defined problem,
- round table – representatives of various opinions and interests meet themselves to make decision on the basis of equality; the most useful is at the beginning of decision making process in defining direction of policy in a given field,
- civil working group – people with special knowledge or representing interests of community may be authorized to form ad hoc working group dealing with problem in detail with need to make decision
- study circles – 5-20 people meet as agreed (e. g. 3-5 times) to discuss specific issue (or they meet themselves regularly in case of more complex list of topics); supply necessary information documents; cooperation in integrated learning and mutual respect is expected; it is useful in monitoring or documentation of development in

thinking of group and generates recommendations based on shared knowledge on the issue,

- workshop in line with scenario – scenario is set for stimulation of dialogue among policy makers, experts, people from business and civils; visions and proposals for need of technologies and possibilities are created,
- referendum,
- conferences for consensus looking – organized at the national level, usually by „neutral“ subject; small group of volunteers is selected – civils representing public but also spectrum of opinions; they meet themselves in weekends, learn on dialogue subject and ask questions to relevant experts; at last selected civils compile a report with conclusions and recommendations for representatives of public in decision making process,
- civil jury – participants are selected by chance to serve their community in meetings on problems concerning community e. g. geographically; the jury selects from the set of proposed solutions,
- civil panel – generally similar to previous form with difference civil participants may contribute by proposals for solutions themselves,
- selection of locality with participation of all – committee of participants from public and technical experts to work together (in case of need also more months or years) in order to development of such a solution, which will be acceptable from technical as well as from society viewpoint; it may be combined with other techniques of information or consulting with big community, e. g. with information campaign or referendum,
- committees for local monitoring, information and regulation – have worked already within construction and operation and are place for regular improvement of participation and dialogue between stakeholders and public; they may include representatives participated from really all interested parties also e. g. representatives of business and industry chambers, environmental organizations, regulatory authorities etc.
- selection of appropriate way of public participation will be conducted depending on particular situation and particular project based on consensus of interested parties.