Jadrová a vyraďovacia spoločnosť, a.s.





Nuclear Decommissioning in Slovakia

Launch of ELINDER Programme
December 2nd, 2016

Martin Macášek

General overview



- JAVYS stablished in April 2006 JAVYS to safely operate and decommission A1 and V1 NPPs, as well as to provide safe RAW management and disposal.
- 100 % Shareholder Ministry of Economy of the Slovak Republic
- JAVYS performs activities in accordance with the governmental document "National Policy and National Programme on Spent Nuclear Fuel and Radioactive Waste Management"











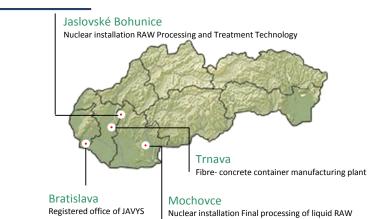


General overview



Core activities and services provided by JAVYS, a.s.

- 1. Decommissioning of A1 NPP
- 2. Decommissioning of V1 NPP
- 3. Radioactive waste management
- characterization
 - Design and implementation of RAW characterization system
 - · Destructive analysis of RAW samples
 - Non-destructive inspection of RAW
- processing and treatment
 - Processing of liquid RAW
 - Treatment of liquid RAW by cementation
 - · Processing of solid RAW
 - · Treatment of solid RAW by cementation
- transport
 - Transport of solid or solidified RAW
 - Transport of new and filled fibre- concrete containers
 - Transport of institutional RAW and captured radioactive materials
- 4. Production of fibre-concrete containers
- 5. Spent Nuclear Fuel management
- 6. Management of Institutional RAW and CRAM



The mission of JAVYS, a.s. is to safely, reliably and effectively operate and decommission nuclear facilities (decommissioning of A1 NPP and V1 NPP), manage radioactive waste and spent nuclear fuel, with a minimum impact on the environment.





Essential conditions for successful decommissioning process of nuclear facilities includes following infrastructures:

- Regulatory Framework
- > Financing Sources
- Management of Materials from Decommissioning
- Site Operation Services
- Personnel Infrastructure



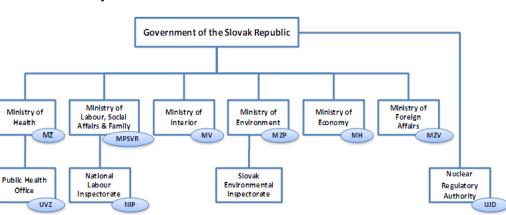
Regulatory Framework

International Agreements

(Main) Slovak legislation:

- Act No. 541/2004 Coll., as amended (Atomic Act)
- Act No. 24/2006 Coll., as amended (Act on EIA)
- Act No. 355/2007 Coll., as amended (Public Health Act)
- Act No. 50/1976 Coll. as amended (Construction Act)







The premature shurdown and consequent decommissioning of four WWER 440 V 230 type units of the

Korloduy nuclear power plant with an overall capacity of 1 760 MW has imposed a heavy long-term burden on Bulgarian citizens in terms of energy, economic, environmental and social implications.

The Union has commissed so assist Bulgaria and Slovakia

in addressing the exceptional financial burden imposed by the decommissioning process. Since the pre-accession

period, Bulgaria and Slovakia have received substantial financial support from the Union, notably through the

Kozloduy and Bohunice programmes established for the

period 2007 - 2013. The Union financial support under those programmes will end in 2013.

Financing Infrastructure

- ➤ Slovak Nuclear Fund (since 1995)
- ➤ The Bohunice International Decommissioning Support Fund
- ➤ Council Regulation No. 1368/2013 on Union support for the nuclear decommissioning assistance programmes in Bulgaria and Slovakia
- ➤ Nuclear Decommissioning Tax
- >JAVYS' own resources

2012 2011 Official Journal of the European Union (Non-legislative acts) REGULATIONS COUNCIL REGULATION (EURATOM) No 1368/2013 of 13 December 2013 on Union support for the nuclear decommissioning assistance programmes in Bulgaria and Slovakia, and repealing Regulations (Euratom) No 549/2007 and (Euratom) No 647/2010 THE COUNCIL OF THE EUROPEAN UNION, obligations. Slovakia shut down all units concerned within the respective deadlines. Having regard to the Treaty establishing the European Atomic In line with their obligations under the Accession Treasy Energy Community, and in particular Article 203 thereof, and with Union assistance, Bulgaria and Slovakia have closed the Kozloduy and Bohunice VI nuclear power planes and have made significane progress sowards sheir decommissioning. Further work is necessary in order to Having regard to the proposal from the European Commission, consinue the progress with the actual decontamination, dismaneling, management of spent fuel and radioactive wasse operations and to implement the steady process towards the decommissioning end state in accordance with the respective decommissioning plans, whilst Having regard to the opinion of the European Parliament (1), ensuring that the highest safety standards are applied. Based on the available estimates, completion of the decommissioning work will require substantial additional financial resources. The premature shutdown and consequent decommiszioning of the Bohunice VI nuclear power plans with (1) According so the Protocol concerning the conditions and ewo WWER 440 V 230 type units with an overall arrangements for admission of the Republic of Bulgaria capaciey of 880 MW has resulted, besides social and and Romania to the European Union (*), Bulgaria committed itself to the closure of units 1 and 2 and energy implications, in a significant financial burden of direct and indirect coses for Slovakia. unies 3 and 4 of the Kozloduy nuclear power plant by 31 December 2002 and 31 December 2006 respectively. and so she subsequent decommissioning of shore units.

In line with its obligations, Bulgaria shut down all units

nuclear power plant by 31 December 2006 and 31 December 2008 respectively, and to the subsequent

decommissioning of those units. In line with its

concerned wishin the respective deadlines.

(2) According to Protocol No 9 on unit 1 and unit 2 of the Bohunice V1 nuclear power plant in 5lovakia (3 areached to the 2003 Act of Accession, Slovakia committed itself to the closure of unit 1 and unit 2 of the Bohunice V1.

(1) Opinion of 19 November 2013 (not vet published in the Official

Josznal). (7) OJ L 157, 21.6.2005, p. 29. (7) OJ L 236, 23.9.2003, p. 934.



Site Operation Services (SOS)

Established Site Operation Services **(SOS)** remained in most part needed for decommissioning processes. Main SOS are:

- Heating and cooling systems, water supply, electricity generation and supply
- Road&rail access with offloading facilities
- Sewage (non-/radioactive), potable water systems, other piping networks, office space
- Support services (catering, public transport, etc.)
- Non-radioactive machine shops, workshops and general production facilities, especially with large machinery, stocks of spare parts, consumables
- Maps, diagrams, drawings (land drains, active and inactive drains, roadways ...)
- Area protection system
- Spent Fuel transport and storage
- > Others



Personnel Infrastructure and Project Organisation

Each decommissioner's organisation structure is specific to:

- **Country** (overal set up of nuclear industry system, state system, politics,...)
- Factory (size, type of facility, private/public, shareholders' expectations)
- History (after accident/incident, stakeholder requirements, general conditions prior shut down)
- Company's scope of activities (operator of one/multiple facilities, single or multiple type of facilities, profit or non profit)
- Future strategy and system of work (company's business plan)
- International obligations (special international liabilities and regimes, e.g. EU funding)
- Human resources available in space and time (knowledge of decommissioning aspects)



Employees' education levels:				
University	316			
High school	501			
Grammar school	1			
PhD.	6			
MBA	1			
Postgradual study in decommissioning of nuclear facilities (Slovak Technical University, Bratislava)	40			
Postgradual study in public procurement (Univerzity Roma Tor Vergata)	1			

Nuclear facilities





A1 NPP



V1 NPP



FP LRW



RAW Processing and Treatment Tech.



ISFS

Nuclear Power Plant A1



Start of construction	Start of ope	eration End of operatio	Start of decommissioning	Decommissioning confirmed by Slovak Government	SE-VYZ	End of 1. stage
1958	1972	1977	1979	1994 1	996	2009



Reactor type : KS 150 (3 x 50 MW)

Fuel : based on natural uranium

Moderator : heavy water

Coolant : CO₂

Working pressure: 6,5 MPa

Steam generators: 6 Turbines: 3

Nuclear Power Plant A1



Start of

2. Stage of

Decommissioning

Continuous Decommissioning Process

End of Decommissioning

2009 2033

1st stage Radiation Safety Status

2nd stage Decommissioning of external active objects and

low contaminated parts of the Main Production

Unit

3rd stage Continuation of decommissioning of Low

contaminated parts of the Main Production Unit

4th stage Decommissioning of intermediate

contaminated parts of the Main Production Unit

5th stage Decommissioning of High

contaminated parts of the Main Production Unit



Nuclear Power Plant A1 – 2. Stage of Decommissioning JavyS





Nuclear Power Plant V1





2 x VVER 440-V230

Fuel: UO₂ (2,5% U-235)

Moderator: H₂O Coolant: H₂O Nr. Of Units: 2

steam

generators: 6 x 2 turbines: 2 x 2

Current stage (11/2016)

1st Uni Start of construction	t Start-up 2nd Unit Start-up	Small REKO	Gradual REKO	v1 completion Shut-down	1st Unit Shut-down	2nd Unit Shut- down	1st stage	2nd sta	ge End
1972 1	978 1980	1992	1996	1999 2000	2006	2008	2011	2015	2025

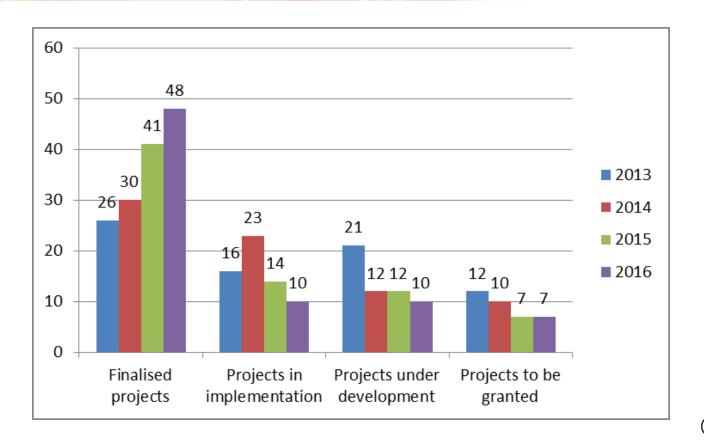
Nuclear Power Plant V1 – Progress in Decommissioning JavyS



Finalized projects	50 projects
Projects under implementation	12 projects
Projects before or under procurement	6 projects
Projects before granting	7 projects

Nuclear Power Plant V1 – Progress in Decommissioning JavyS



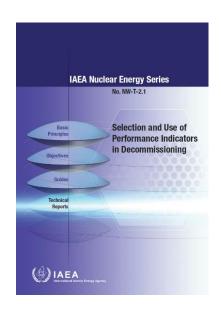


(as of 31st August 2016)

Key Performance Indicators



Key Performance Indicator	1 st half of year 2016
Key Performance Indicator 1 / Overall Schedule Performance Index	0.954
Cumulative Overall Schedule Performance Index (COSPI 06/2016)	0.901
Key Performance Indicator 2 / Overall Waste Conditioning Performance Index	0.888
Key Performance Indicator 3 / Overall Cost performance index for contracted projects	1
Cumulative Overall Cost Performance Index (COCPI 06/2016)	1
Key Performance Indicator 4 / Excess of the 'Maximum Individual Dose'	fulfilled



Actual values converge closely to target value "1"

= fulfillment of targets in timely and cost effective manner

Dismantling of insulation in Turbine Hall





Dismantling of Insulation in the Turbine Hall









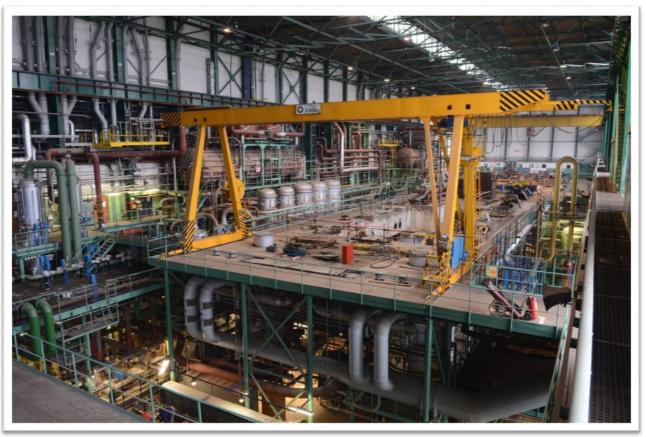
Dismantling of insulation in Turbine Hall





Dismantling of the Tech. Equipment in Turbine Hall





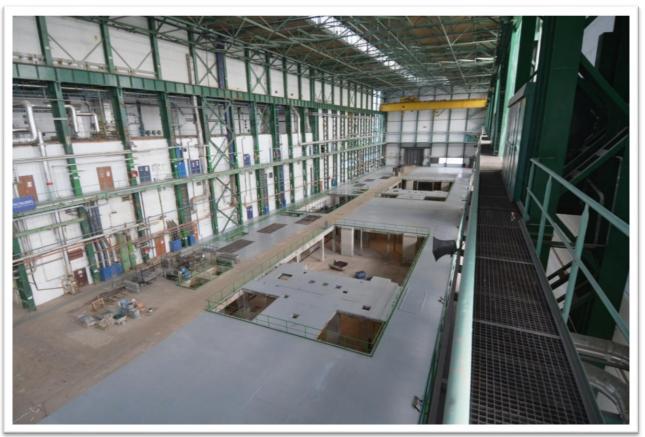
Dismantling of the Tech. Equipment in Turbine Hall





Dismantling of the Tech. Equipment in Turbine Hall

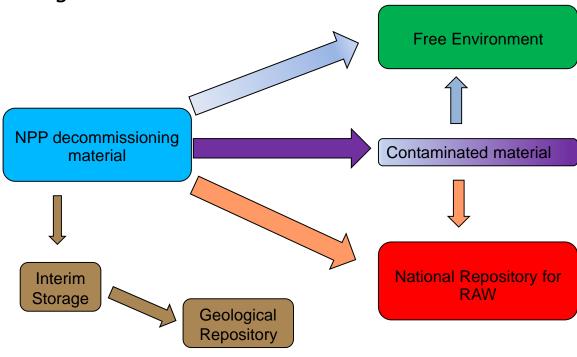




Waste management

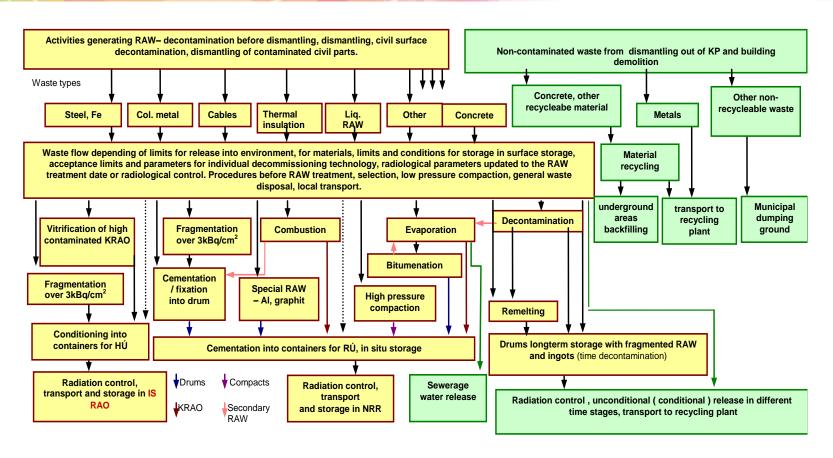


Decommissioning Material Flow



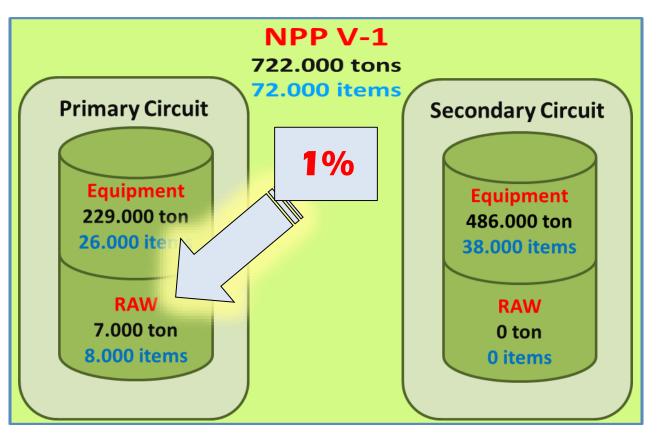
Waste management - Decommissioning material flow





Waste management - V1 NPP Waste reduction





Dismantling and demolition of V1 NPP external buildings – Phase 1







Dismantling and demolition of V1 NPP external buildings – Phase 1





Dismantling and demolition of V1 NPP external buildings – Phase 1





Dismantling of Insulation in the V1 NPP Contr. Area



Dismantling, sorting, decontamination, compacting, packing, transport and final disposal of thermal insulation materials from the controlled area of the V1 NPP at both Units 1 and 2.



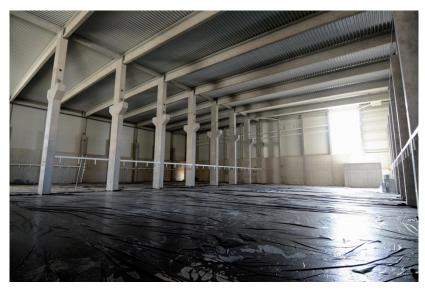


Interim storage of RAW at Bohunice Site



- Storage of RAW (ILW) not disposable at the National Repository of RAW
- Decay storage
- Package forms: specialy designed casks, ISO containers, 200 I drums, Fibre-Concrete Containers





RAW Treatment and Conditioning Facilities



- separation
- incineration
- super compacting
- concentration
- cementation
- bituminization
- vitrification
- Low level RA-water purification facility
- Metal RAW fragmentation and decontamination facility
- Sludges fixation equipment
- Equipment for sludges from longtime storage pool fixation



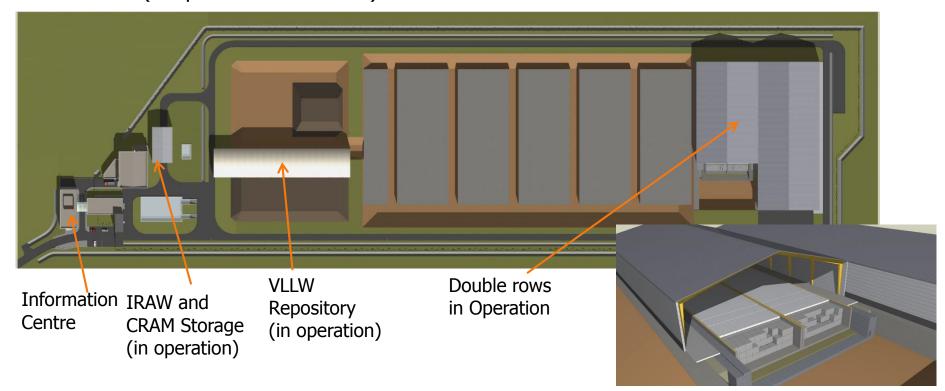


Final product: Filled fibre-concrete container (FCC)

National Radioactive Waste Repository in Mochovce

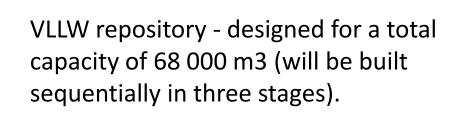


Final repository of very low and low level RAW for RAW from operation and decommissioning of Nuclear facilities in Slovakia, from research institutes, medical and other institutions (in operation since 2001)



National Radioactive Waste Repository in Mochovce







I. stage - 20 000 m3 (in operation since 03/2016)

II. stage - 9 000 m3 (operation since 2019)

III. stage – according to future needs

Interim spent fuel storage



JAVYS is reponsible for activities in the area of spent fuel management within the Slovak Republic.

Capacity:

Number of storage pools:

Storage magazine types:

Max. cooling medium temperature:

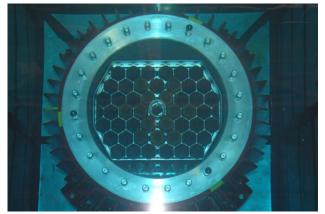
14 112 spent fuel assemblies

3 in operation + 1 reserve

KZ-48, T-12, T-13

50 °C







Controls and audits of performed works



Audits of V1 NPP Decommissioning Project since 2010:

- 1) Performance audit by European Court of Auditors (2010)
- 2) Financial Audit by Moore & Stephens (2011)
- 3) Delegation of Members of European Parliament (2013)
- 4) Costs and Risk assessment by ŐKŐ Institute (2013)
- 5) EBRD Environmental, Health&Safety and Social Policy audit (2014)
- 6) Performance audit by European Court of Auditors (2015-2016)
- 7) Financial audit by European Court of Auditors (2015)
- 8) EBRD Procurement audit (2015)
- 9) EBRD audit on personnel costs and benefits for 2014 (2015)
- 10)EC Ex-ante audit (2016)
- 11)EBRD audit on personnel costs and benefits for 2015 (2016)







