Ing. Peter Graňák
Jadrová a vyraďovacia spoločnost',a.s. - JAVYS
Nuclear and decommissioning company, plc
Activities:
• NPP V1 Decommissioning
• NPP A1 Decommissioning
• RAW Management
• Institutional RAW & Detected RAM Management
• Spent Fuel Management
• Tasks related to New NPP Build

1.4.2006 – start of activities performance

Ministry of Economy SR is the only JAVYS shareholder
Nuclear and Decommissioning Company, plc.

JAVYS
Jaslovské Bohunice
NPP A1, NPP V1, RAW treatment and conditioning facilities, Interim spent fuel storage

JAVYS
Mochovce
Facility for treatment and conditioning of liquid RAW

JAVYS
Bratislava Headquarters

JAVYS
Trnava
FCC production facility

JAVYS
NRWR at Mochovce
The Bohunice Nuclear Site consists of 3 nuclear power plants, the Bohunice A1 NPP and the Bohunice V1 NPP (Units 1 and 2) owned by JAVYS and the Bohunice V2 NPP (Units 3 and 4) owned and operated by Slovenské elektrárne, a.s. The history of the Bohunice Nuclear Site goes back to 60-ties of the 20th century when the Bohunice A1 NPP construction started.
Nuclear and Decommissioning Company, plc. Nuclear Facilities

NPP V1

NPP A1

RAW Treatment and Conditioning Facilities

Facility for Final Treatment and Conditioning of Liquid RAW

National RAW Repository

Interim Spent Fuel Storage
Nuclear Power Plant V1

<table>
<thead>
<tr>
<th>Construction Start-up</th>
<th>1st Unit Start-up</th>
<th>2nd Unit Start-up</th>
<th>Small REKO</th>
<th>Decision of NPP V1 Shut-down</th>
<th>1st Unit Shut-down</th>
<th>2nd Unit Shut-down</th>
</tr>
</thead>
</table>

**WWER 440-V230**

- **fuel:** \( \text{UO}_2 \) (2.5% \( \text{U}^{235} \))
- **moderator:** \( \text{H}_2\text{O} \)
- **coolant:** \( \text{H}_2\text{O} \)
- **Nr. of Units:** 2
- **steam generators:** 6 x 2
- **turbines:** 2 x 2
Nuclear Power Plant V1 Decommissioning

OPERATION LICENCE

- NPP V1 Operation termination
  - Spent fuel cooling and its transport into ISFS
  - Operative RAW treatment
  - Decommissioning projects preparation within BIDSF
  - Obtaining a decommissioning licence
  - Free release of non-radioactive waste
  - Monitoring

Decommissioning – 1st phase
- Inactive systems and facilities dismantling
- Decontamination after dismantling
- Inactive construction objects demolition
- RAW from decommissioning treatment
- Non-radioactive waste release into environment
- Monitoring

DECOMMISSIONING LICENCE

Decommissioning – 2nd phase
- Active systems and facilities dismantling
- Decommissioning after dismantling
- Construction objects demolition
- RAW waste from decommissioning treatment
- Non-radioactive waste release into environment
- Monitoring

1st Unit Operation

2nd Unit Operation

2007 2008 2009 2010 2011 2015 2025

End of decommissioning
Nuclear Power Plant A1

Structure of NPP A1 Decommissioning Project – 1st phase – Radiation Safety Status:

- Environment
- Main Production Unit
- Rad-waste treatment
- Technical support of decommissioning

<table>
<thead>
<tr>
<th>Start of construction</th>
<th>Start of operation</th>
<th>End of operation</th>
<th>Start of decommissioning</th>
<th>Decommissioning confirm by Slovak Government</th>
<th>Creation of SE-VYZ</th>
<th>End of Decommissioning - 1st phase</th>
</tr>
</thead>
</table>

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 – Schedule of Decommissioning

<table>
<thead>
<tr>
<th>Phase Description</th>
<th>Start of Decommissioning – 2\textsuperscript{nd} phase</th>
<th>Start of Decommissioning – 3\textsuperscript{rd} phase</th>
<th>Start of Decommissioning – 4\textsuperscript{th} phase</th>
<th>Start of Decommissioning – 5\textsuperscript{th} phase</th>
<th>Main Production Unit conversion into the technology of RW treating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1\textsuperscript{st} phase</td>
<td>2009</td>
<td></td>
<td></td>
<td></td>
<td>2033</td>
</tr>
<tr>
<td>2\textsuperscript{nd} phase</td>
<td>2017</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3\textsuperscript{rd} phase</td>
<td></td>
<td>2021</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4\textsuperscript{th} phase and 5\textsuperscript{th} phase</td>
<td></td>
<td></td>
<td>2025</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1\textsuperscript{st} phase: Radiation Safety Status
2\textsuperscript{nd} phase: Decommissioning of external active objects and low contaminated parts of the Main Production Unit
3\textsuperscript{rd} phase: Continuation of decommissioning of Low contaminated parts of the Main Production Unit
4\textsuperscript{th} phase and 5\textsuperscript{th} phase: Decommissioning of intermediate contaminated parts of the Main Production Unit

Main Production Unit conversion into the technology of RW treating is scheduled for 2025.
RAW Treatment and Conditioning Facilities

Bohunice RAW treatment Centre

Facility is in Jaslovské Bohunice and it is intended for low and intermediate level RAW treatment.

Technologies:
- separation
- incineration
- super compacting
- concentration
- cementation

Final product: Filled fibre-concrete container (FCC)

Further RAW treatment facilities
- Vitrification facility
- Bituminization facilities
- Discontinuous bituminization facility
- Low level RAW-water purification facility
- Metal RAW fragmentation and decontamination facility
- Sludges fixation equipment
- Equipment for sludges fixation from longtime storage pool
Facility is situated in Mochovce NPP’s area and in preference it was intended for treatment of RAW from Mochovce NPP’s operation.

The main technology of liquid RAW treatment is treatment of radioactive concentrates, sorbents a sludges into bitumin matrix and its next deposition into 200 l drums, which are sealed by cement filler in fibre-concrete container.

Technologies:
- concentration
- bituminization
- cementation

Final product: Filled fibre-concrete container (FCC)

22. 5. 2005 – start of construction
22. 2. 2007 – start of active tests
24. 4. 2007 – end of active tests

27.5.2009
Nuclear Regulatory Authority of SR Resolution – start of operation
RAW Management Fibre Concrete Containers Production

In Operation since 1996

Volume: 2,9 m³
Parameters: 1,7 x 1,7 x 1,7 m
Max. weight of FCC with RW: 15 t

Production:
- 360 pcs. of FCC in 2009
- 350 pcs. of FCC in 2010
- 352 pcs. of FCC in 2011
- 247 pcs of FCC in 2012
- 490 pcs of FCC in 2013
Radioactive materials Transport

Spent Fuel:
• inside Bohunice / V1, V2 to ISFS
• outside / Mochovce to Bohunice

Liquid RW

Solid RW

For Transport JAVYS:
• keeps required licences
• has trained personnel
• is equipped by special technical equipment
National Rad waste Repository in Mochovce

Repository of surface type

Final repository of very low and low level RAW

RAW from operation and decommissioning of Nuclear facilities in Slovakia, from research institutes, medical and other institutions

Capacity of 1 double row:

3 600 FCC

Stored FCC till 31th December 2013:

3 445 pcs.

Total volume of FCC with RAW
Interim Spent Fuel Storage

Basic data after reconstruction

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage capacity</td>
<td>14,112 FA</td>
</tr>
<tr>
<td>Number of storage pools</td>
<td>3 operational + 1 reserve</td>
</tr>
<tr>
<td>Ground-plan parameters</td>
<td>45 m x 75 m</td>
</tr>
<tr>
<td>Total built area</td>
<td>95,000 m³</td>
</tr>
<tr>
<td>Possibility of expanding</td>
<td>2 – 3 pools</td>
</tr>
<tr>
<td>The type of storage</td>
<td>In the basket type KZ-48, T-12, T-13</td>
</tr>
<tr>
<td>Maximal number of storage baskets</td>
<td>294 pcs of KZ-48</td>
</tr>
<tr>
<td>Maximal temperature of pool water</td>
<td>50 °C</td>
</tr>
<tr>
<td>Purification plant capacity</td>
<td>25 m³/h</td>
</tr>
<tr>
<td>Type of spent fuel transport</td>
<td>railway carriage, transport</td>
</tr>
<tr>
<td></td>
<td>cask type C-30</td>
</tr>
<tr>
<td>Proportions of pool (l w d)</td>
<td>23,4 x 8.4 x 7.2 m</td>
</tr>
<tr>
<td>Number of casettes in basket type KZ-18</td>
<td>48 (before 30 in T-12 and T-13)</td>
</tr>
<tr>
<td>Designed cooling power</td>
<td>2,533 kW</td>
</tr>
</tbody>
</table>

Operation from 1987

- Providing of spent fuel storage
- Providing of internal transport of SF from V2 NPP Units
- Providing of external transport of SF from SE-EMO Units
- Providing of SF transport from V1 NPP Units after the end of operation
- Increase of ISFS storage capacity by use of new storage baskets KZ-48 type
- Enlargement of ISFS by possible dry storage in medium-term plan
- Long-term monitoring of building constructions, technological systems and SF condition
31.12.2009 JESS, a.s. creation

51 %
Grounds, buildings
Staff into project team

49 %
Finance
Technological and project know-how
FOCUS

on

NPP V1

Operation termination and decommissioning
**BOHUNICE NPP V1 – Technical Parameters**

### 2 x WWER 440-V230

- **Fuel:** $\text{UO}_2$ (2.5% U-235)
- **Moderator:** $\text{H}_2\text{O}$
- **Coolant:** $\text{H}_2\text{O}$
- **Units/NPP:** 2
- **Steamgenerators:** $6 \times 2$
- **Turbines:** $2 \times 2$
- **Power output:** 880 MW

### Similar power plants

- **Kozlодuy, Bulgaria – post operational phase**
- **Greifswald, Germany – in decommissioning**
Bohunice NPP V1 Decommissioning

Governmental decision 801/1999 about pre-mature shut down of the NPP V1 2006 (1st unit) & 2008 (2nd unit)

1972 Construction erection
1978 1st unit start up
1980 2nd unit start up
1992 Small reconstruction
1996 Gradual reconstruction
1999 Reconstruction completion
2000 1st unit shut down
2006 Launch of 1st stage of decommissioning
2008 2nd unit shut down
2011 Launch of 2nd stage of decommissioning
2015 Brown-field status
2025
Decommissioning of NPP V1 – Preparedness of SR for decommissioning

Slovak Republic’s awareness of its responsibility for the back-end cycle of the nuclear energy resulted:

1. In the preparation and **construction of the following infrastructure**, purely **financed via national funding**:

   - **Bohunice RAW Treatment Centre**
   - **Final Processing of Liquid RAW**
   - **(Wet) Interim Spent Fuel Storage**
   - **National near-surface RAW Repository in Mochovce**

2. In the **establishment of the National Nuclear Fund** in **1995**
The V1 NPP Conceptual Decommissioning Plan (V1 CDP) was developed in 2006 under the governmental Decree No. 974/2000 as the first step in preparation of the V1 NPP decommissioning documentation.

It was elaborated in compliance with the Slovak regulations and provides general technical and financial information on possible and reasonable decommissioning options, in order to demonstrate that the decommissioning process will be technically executable and mainly suitable from the viewpoint of health protection, nuclear and radiation safety, physical and environmental protection.

The Conceptual Decommissioning Plan for the Bohunice V1 NPP was developed for following basic alternatives:

<table>
<thead>
<tr>
<th>Alternative 1</th>
<th>Immediate decommissioning option</th>
<th>IDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 2</td>
<td>Safe enclosure option under surveillance for 30 years</td>
<td>SES</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>Reactor safe enclosure for 30 years - RSE</td>
<td>RSE</td>
</tr>
<tr>
<td>Alternative 4</td>
<td>Zero = no action alternative</td>
<td>ZERO</td>
</tr>
</tbody>
</table>
BOHUNICE NPP V1 – Decommissioning Options

**Option 1 - Immediate Dismantling Option (IDO)**

- **NPP V1 Operation**
- **Operation Termination**:
  - 1978, 1980
  - 2006, 2008
- **I. Stage of Decommissioning**:
  - 2012
  - Dry State Reaching, Dismantling of Unnecessary Non-active Equipment and Demolition of Unnecessary Non-active CBs.
- **II. Stage of Decommissioning**:
  - 2015
  - Decontamination, Dismantling the active and successively demolition also remaining servicing systems and demolition of empty CBs.
- **Site Release**:
  - 2025

**Option 2 - Safe Enclosure under Surveillance (SES)**

- **NPP V1 Operation**
- **Operation Termination**:
  - 1978, 1980
  - 2006, 2008
- **I. Stage of Decommissioning**:
  - 2012
  - Dry State Reaching, Decommissioning to SES Reaching.
  - ~2019
  - Maintaining SES
- **II. Stage of Decommissioning**:
  - ~2049
  - Decommissioning SES
- **III. Stage of Decommissioning**:
  - 2063

**OPTION 3 - Reactor Safe Enclosure (RSE)**

- **NPP V1 Operation**
- **Operation Termination**:
  - 1978, 1980
  - 2006, 2008
- **I. Stage of Decommissioning**:
  - 2012
  - Dry State Reaching, Decommissioning to RSE Reaching.
  - ~2025
  - Maintaining RSE
- **II. Stage of Decommissioning**:
  - ~2055
  - Decommissioning RSE
- **III. Stage of Decommissioning**:
  - 2063
Difficulties Resulting from Premature Shutdown of the Bohunice V1 NPP

- The Bohunice V1 NPP formed technologically integral part of V1, V2 and A1 NPPs’ system located at Bohunice site, with many interconnections and mutual dependencies.

- Premature shutdown brought forward challenges related to: systems’ modifications and decommissioning preparation, including licensing preparation - overall value of modifications in 60 MEUR (Reconstruction of Area Protection System and Public Warning and Notification System, Temporary Power Reserve Supply, Modification of the JAVYS Power Supply after V1 NPP Final Shutdown, Modification of Heating and Steam Distribution System, Modification of Essential Fluids Systems).

- Public opposition against premature shut down of the Bohunice V1 NPP after extensive and expensive modernisation was done in 2000.

- Social impact to nearby urban areas in terms of unemployment and diminished local taxes.
Stages after operation termination

  - Defuelling of reactors
  - Conditioning of historical wastes
  - Preparation of the Licensing Documentation for Stage 1 (BIDSF Project B6.3)
  - Plant physical & radiological characterization (BIDSF Project B6.4)
  - Access control & physical security
  - Primary circuit decontamination
  - Preparation of Technical Studies and Specifications, Tender Documents for contracting Stage 1 projects

- **Decommissioning Stage 1**

- **Decommissioning Stage 2**
Decommissioning of the Nuclear Installations

- A new rapidly growing industrial sector
- Newly „identified“ BUT standard term of the lifecycle of the Nuclear installation
- If short description to be used then „LOGISTIC CHALLENGE“

**Efficient decommissioning requires:**

- **Financial resources** available at the time of need
- Good and Efficient decommissioning database
- Defined material **logistic channels**
- Efficient **radiological monitoring**
- Waste **treatment** and **processing facilities**
- **Transport**
- **Disposal site**
- Good and **efficient regulatory control**
Internal environment
• Technical aspects
• Organizational aspects
• Financial aspects
• Logistical aspects

External environment
• Regulatory aspects
• Social aspects
Transition from Operation to Decommissioning

Technical aspects

• Definition of physical and radiological inventory
• Definition of systems necessary for operation
  (maintenance costs, costs of its operation)
• Modification of the necessary systems

• Processing of historical waste

• Removal of spent fuel
  Cooling
  Storage or disposal
Organizational aspects
• Application of different type of management (Line management vs Project organization)

• Internal acceptance of operation termination

• Change of thinking (operation vs decommissioning)

• Change of key personnel (military vs inventive staff)

• How to involve operational staff – transfer of historical knowledge & experience
Transition from Operation to Decommissioning

Financial aspects

• Who pays the transition

• As early as possible shift from operation to decommissioning

• Development of strategy of decommissioning based on available resources
Logistic aspects

*Are the logistic routes available*

Spent fuel
- Temporary storage facility with enough capacity
- Transportation means available

Radioactive waste
- Are there facilities for management/treatment available
- Are there temporary storage-buffer storage facilities available
- Are there disposal facilities available

Conventional waste
- The strategy on waste re-use
Regulatory aspects
• Shift from re-active approach to interactive approach

• Involvement of the regulator in the process (regular meetings, on-site inspector)
Social aspects

• Transition from the productive age to retirement of the NPP

• Communication about consequences on regional community (loss of income, loss of employment opportunities, loss of „bright future vision“, ...)

• Give a community a positive vision
Thank you for attention

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