Organizational and Managerial Aspects of Decommissioning after an Accident

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Slovak Republic

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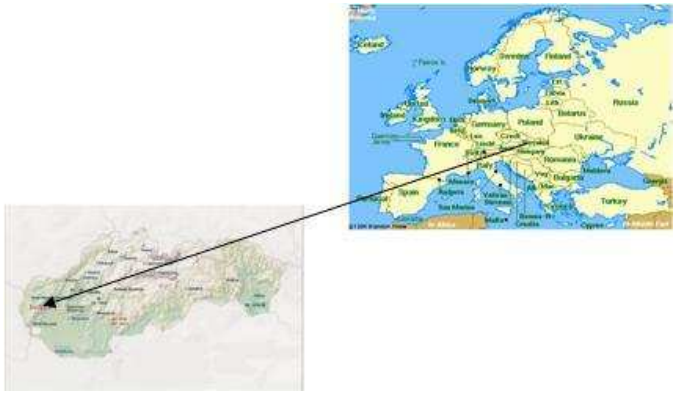
Jadrová a vyraďovacia spoločnosť, a.s.

Jadrová a vyraďovacia spoločnosť, a.s.
(Nuclear and decommissioning company, Plc.)



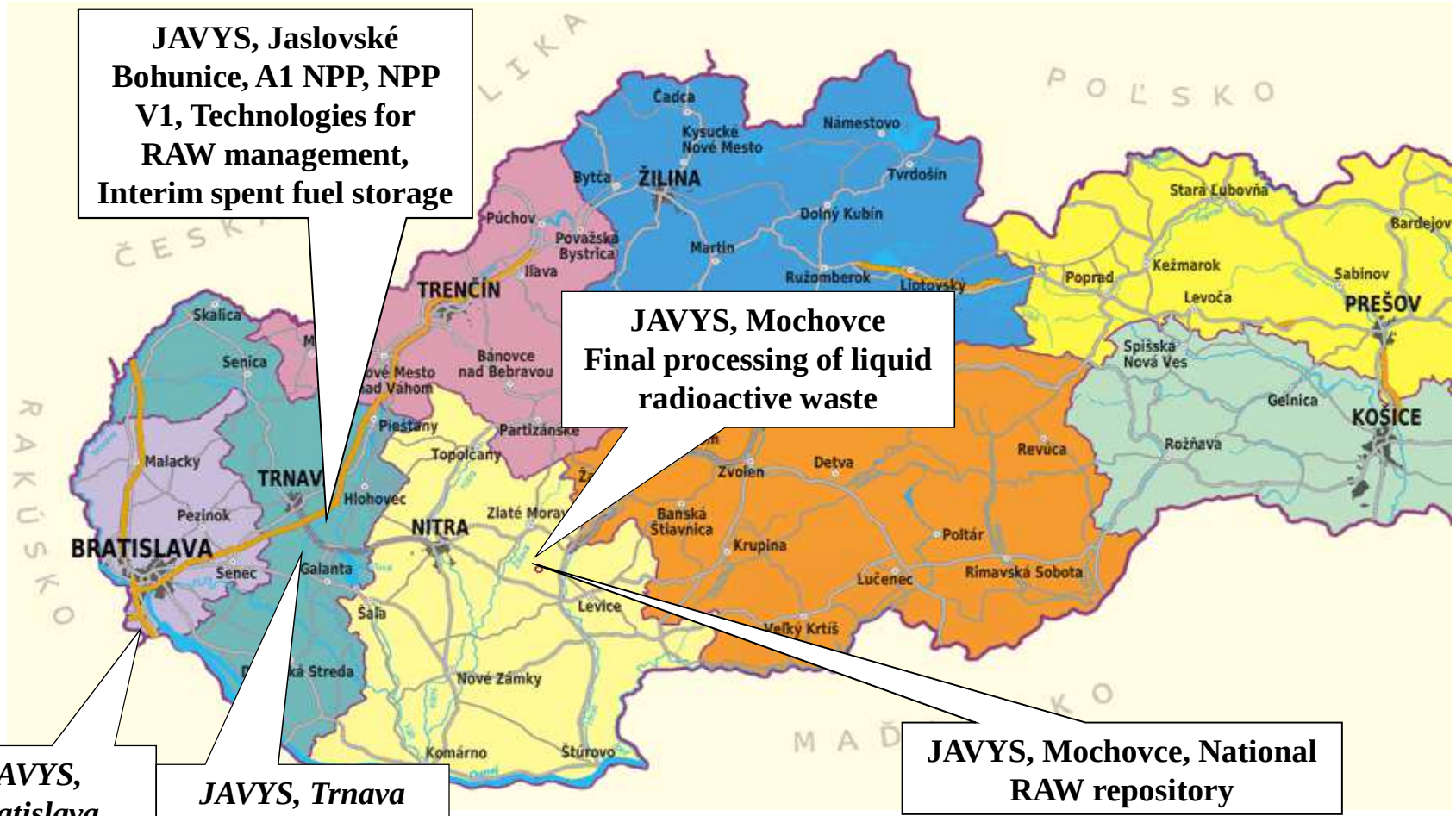
Is a state company (Plc.). The Ministry of Economy of the Slovak Republic is the only JAVYS, a.s. shareholder.

JAVYS, a.s. activities:

- ✓ **Decommissioning:** **A1 NPP decommissioning (HWGCR, 1 unit, KS-150)**
  V1 NPP decommissioning (VVER 440, 2 units, V-240)
- ✓ **RAW management:** **Technologies for RAW processing and treatment**
  Final processing of liquid radioactive waste
  RAW management
  National RAW repository
- ✓ **SF management:** **Interim spent fuel storage**
- ✓ **Institutional RAW and detected radioactive material (RAM) management**

Nuclear facilities in JAVYS, a.s.

Jadrová a vyraďovacia spoločnosť, a.s. (JAVYS, a.s.) manages following nuclear facilities:



Organizational and managerial issues

- ✓ **Relevant technical, safety, financial and socioeconomic aspects need to be re-assessed and more ones have to be taken into account for decommissioning of nuclear facility shut-down after an accident.**

- ✓ **It includes also organizational and managerial issues and aspects.**

- ✓ **There are several examples of nuclear facilities shut-down after an accident worldwide, for those it was necessary to establish specialized national decommissioning organizations or entities for management of the decommissioning project.**

Organizational and managerial issues

- ✓ **In many cases it is needed to manage and coordinate implementation of important particular activities delivered by several sub-contractors or to implement the decommissioning project in cooperation with the general contractor.**
- ✓ **Moreover, other nuclear facilities in operation in construction or in decommissioning phase can be located on the site with nuclear facility shut-down after an accident. This is an additional issue and challenge for effective organization and management of decommissioning activities.**

Organizational and managerial issues

- ✓ **The general contractor approach can be illustrated on example of A1 NPP in Slovakia, where is the decommissioning project implemented through the plant operator JAVYS and its general contractor.**

- ✓ **During the transition period from shutdown to beginning of the A1 NPP decommissioning has been in practice tested several supplier's chain schemes for the project activities implementation.**

- ✓ **It included e.g. particular contracts for certain type of works with external suppliers from Czechoslovakia / Slovakia and abroad vendors (e.g. from UK or RF), implementation of particular activities through program PHARE etc.**

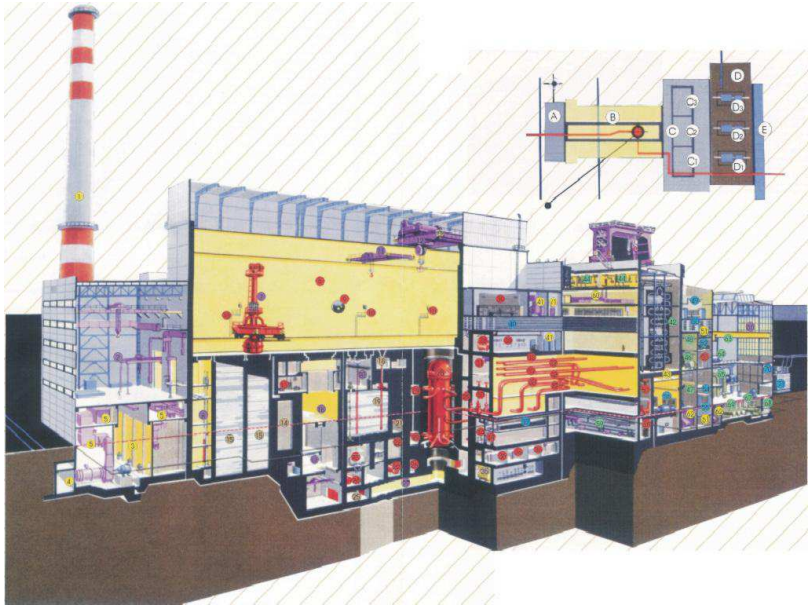
- ✓ **Model of General contractor was indicated as the most suitable in this case.**

- ✓ **General contractor for Stage I and II of the decommissioning project has been company VUJE, Inc. which contracted other particular sub-suppliers.**

A1 NPP

A1 NPP was designed as the first NPP in the former Czechoslovakia.

A1 NPP was an experimental nuclear power plant.



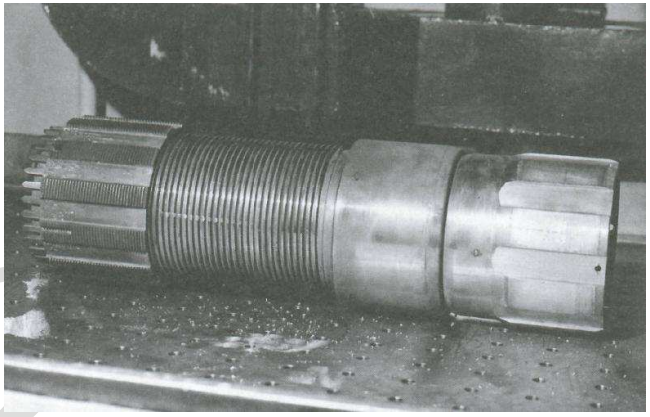
Start of construction:	**1958**
Start of operation:	**1972**
Operation period:	**12/1972 - 02/1977**
Brutto electric power:	**143 MW**
Netto electric power:	**110 MW**
Reactor type:	**KS-150**
NPP type:	**HWGCR**
Fuel:	**natural uranium (24 600 kg)**
Moderator:	**D_2O (57 200 kg)**
Coolant:	**CO_2 (max. press 6,5 MPa)**

Characteristic feature - refuelling during operation.

First nuclear accident in A1 NPP

Operation of A1 NPP was accompanied by two accidents.

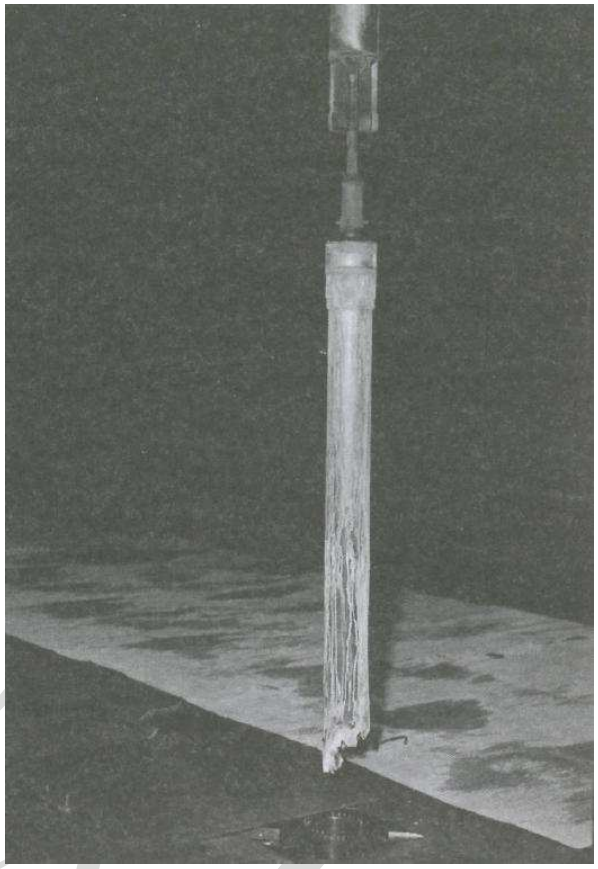
First nuclear accident:
- **on January 05th 1976**
- **lockable system of technological channel failed**
- **fuel assembly shot off from the reactor**
- **leakage of coolant (CO_2) occurred through open channel**
- **leakage was stopped by covered by loading equipment**
- **reactor core was cooled down with no damage**
- **level 3 according to the INES**
- **in September 1976, A1 NPP was commissioned again**

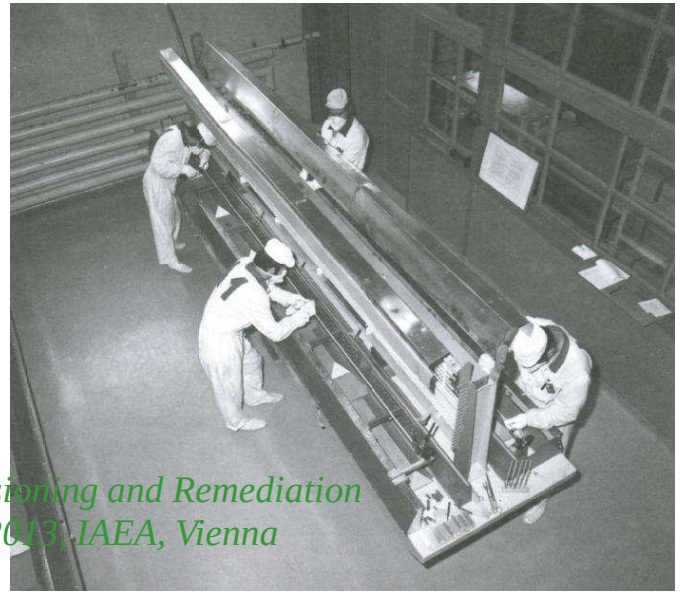


Second nuclear accident in A1 NPP

Second nuclear accident:

- **on 22nd February 1977**
- **in installing a fuel assembly**
- **causing by human factor**
- **loaded fuel assembly was defunctioning**
- **local overheating in reactor core**
- **damaging of reactor inner channel**
- **penetration of heavy water to cooling fluid CO_2**
- **through untightness in steam generator to secondary circuit**
- **damaging of most of fuel assemblies in reactor core**
- **level 4 according to the INES**





Shutdown of A1 NPP

The key aspect for the main direction of further activities after the A1 NPP accident on 22nd February 1977 was the decision made on the basis of the detailed technical and economical analysis by the Government of ČSSR on 17th May 1979 that operation of the A1 NPP would not be renewed and would be shutdown.

Specific technical aspects of A1 NPP status after shutdown:

- ✓ **damage of most of fuel assemblies coverage in reactor during accident,**
- ✓ **corrosion damage of spent fuel in chrompik coolant (potassium chromate solution),**
- ✓ **high level contamination of primary circuit by fission products,**
- ✓ **specific RAW contaminated by Pu (dowtherm, chrompik, ...).**

Initial A1 NPP status

- ✓ **Initial decommissioning conditions:**
  - **decommissioning legislation did not exist**
  - **decommissioning documentation was not prepared**
  - **experimental / prototype character of the A1 NPP**
  - **inadequate fuel management (exceeded burn-up of fuel)**
  - **absence of technologies for RAW management including RAW repository**
  - **RAW was only stored on-site**
  - **unprepared staff for decommissioning project**
  - **none experience with decommissioning process**
  - **none financial resources for A1 NPP decommissioning**

- ✓ **Development of the A1 NPP decommissioning strategy was long-term and partially spontaneous process, mainly because decommissioning was a new problem in former Czechoslovakia.**

Responsibility and financing

The following state companies were gradually responsible for A1 NPP decommissioning :

1. **1979 - 1994** **Slovenský energetický podnik, š.p. (Slovak energetic company)**
2. **1994 - 2006** **Slovenské elektrárne, a.s.**
3. **From 2006** **Jadrová a vyraďovacia spoločnosť, a.s.**

During A1 NPP operation, no financial resources were accumulated to cover the costs for its decommissioning.

Financing of A1 NPP decommissioning is currently secured by means of National Nuclear Fund, which:

- **develops and updates the Strategy of the final part of peaceful use of nuclear energy in the Slovak Republic, and**
- **reimburses the justified costs for decommissioning works.**

Shutdown of A1 NPP

1980-1987 **Initial state task "Termination of the A1 NPP operation"**
1988-1990 **Consequent state task "Reconstruction and decommissioning of NPP"**

- **solution proposals of the assessment state of the A1 NPP technology**
- **principles of NPP decommissioning**
- **radiation safety during NPP decommissioning**
- **evaluation of radioactive material at A1 NPP site,**
- **review of barriers against leakages in order to analyse liquidation options**
- **decontamination and treatment of RAW (vitrification and fluid incineration, dowtherm bituminsation, study of reactor vessel dismantling, etc.)**

- **technical solution for handling of slightly damaged nuclear fuel within its preparation for transport**
- **1983-1990 transport of 440 slightly damaged fuel assemblies to Soviet Union.**

A1 NPP decommissioning preparation

- ✓ **The first title of A1 NPP decommissioning Project was „Bringing the A1 NPP into a radiological safe status.“ The radiological safe state was defined as state of the A1 NPP where no uncontrolled release of activity into environment would occur. Fuel, which could not be handled, should be transported to Russian Federation.**

- ✓ **In 1996-1999, 132 pcs of highly damaged fuel assemblies were transported to Russian Federation.**

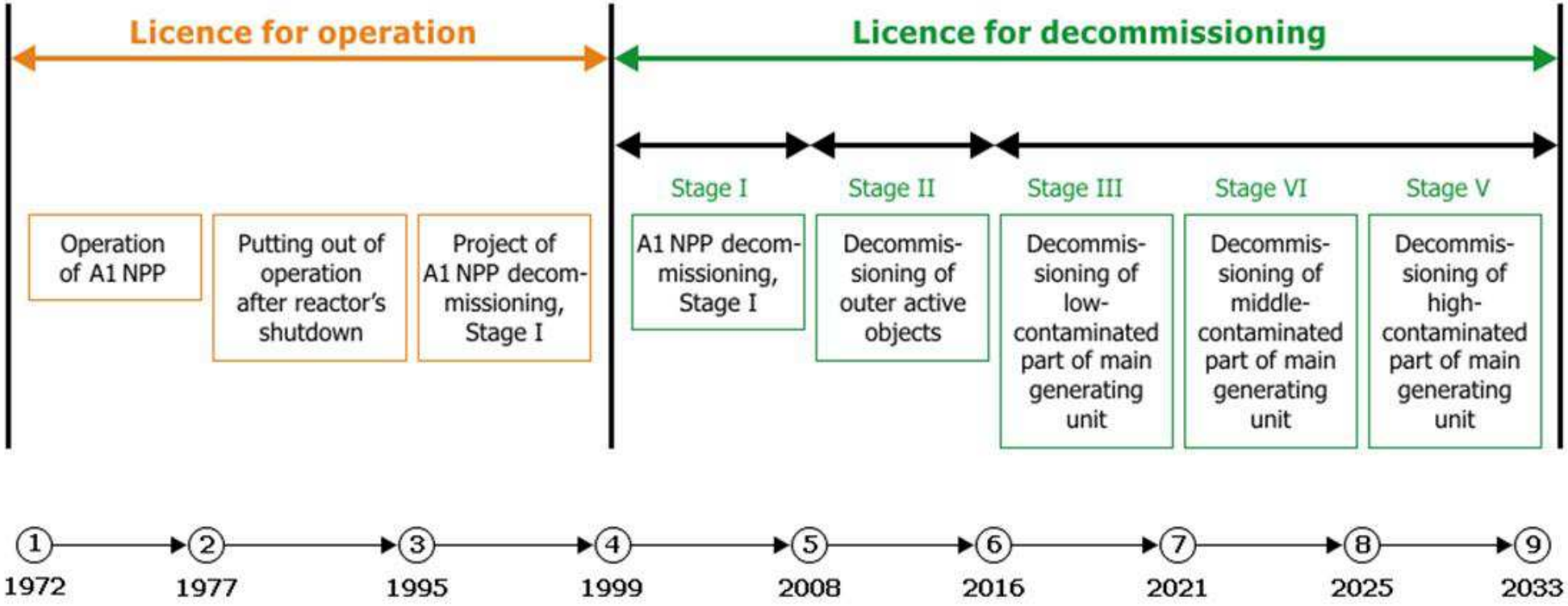
- ✓ **The Government of the SR decided to develop “Comprehensive project for setting of the A1 NPP into radiation safe condition” upon the condition of preparation by December 1994.**

- ✓ **The Slovak Government accepted the above mentioned project and adopted the Governmental Decree stating that the A1 NPP radiation safe condition shall be achieved by the end of 2007.**

Final status of the A1 NPP decommissioning – brownfield.

A1 NPP decommissioning

Stage I - Radiation Safety Status
Stage II - Decommissioning of external active objects and low contaminated parts of the Main Production Unit
Stage III - Continuation of decommissioning of low contaminated parts of the Main Production Unit
Stage IV and Stage V - Decommissioning of intermediate contaminated parts of the Main Production Unit

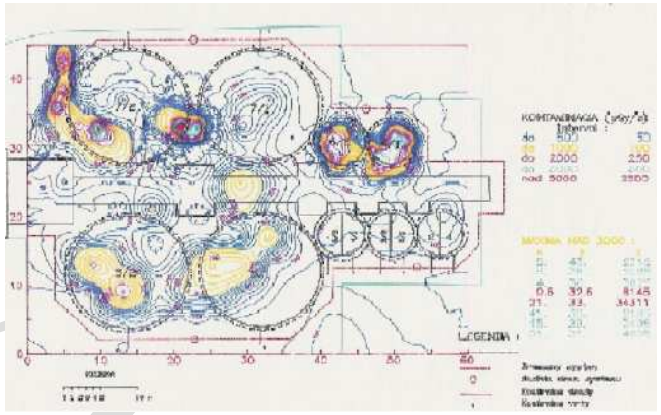


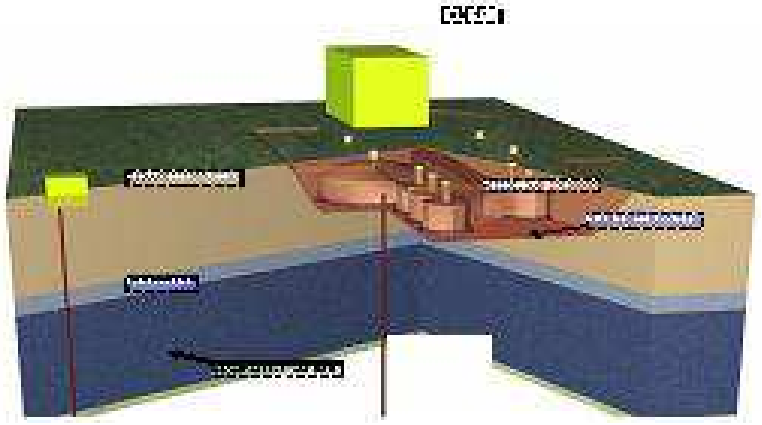
A1 NPP decommissioning – Stage I

A1 NPP decommissioning project has started in 1998. The Project was divided into the following four groups:

1. Environment

- **Preparation of active water purification plant, tanks for liquid RAW for decommissioning.**
- **Washing of radioactive contamination prevention from contaminated soil in the surrounding of tanks.**
- **Decommissioning of solid and liquid RAW storages.**

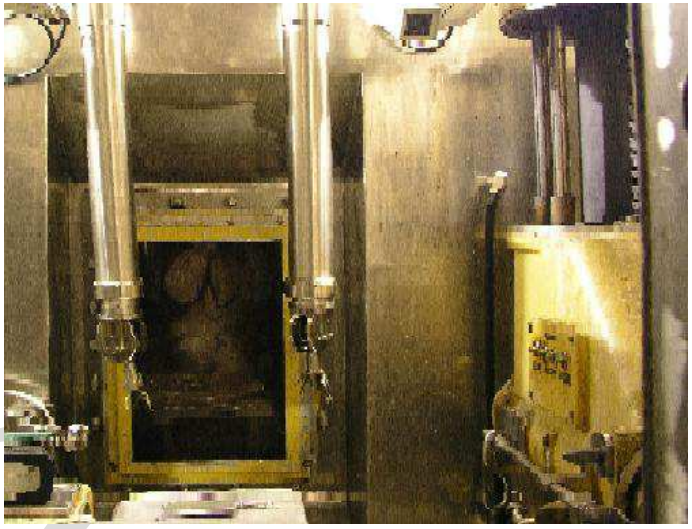


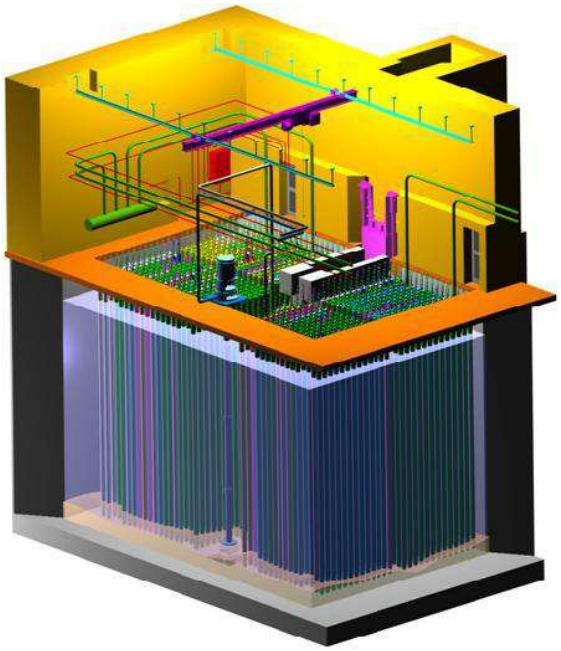


A1 NPP decommissioning – Stage I

2. Main production building

- **Decommissioning of long term spent fuel storage (from which was stored fuel earlier transported to Russian Federation).**
- **Proposal for a hot cell management.**
- **Decontamination of A1 NPP rooms and equipment, mainly long term spent fuel storage (LTSP) and reactor hall.**

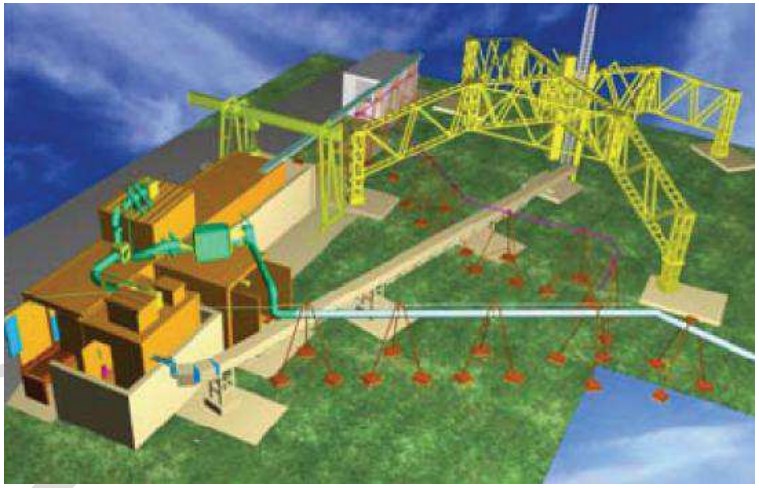




A1 NPP decommissioning – Stage I

3. RAW processing, treatment and storage

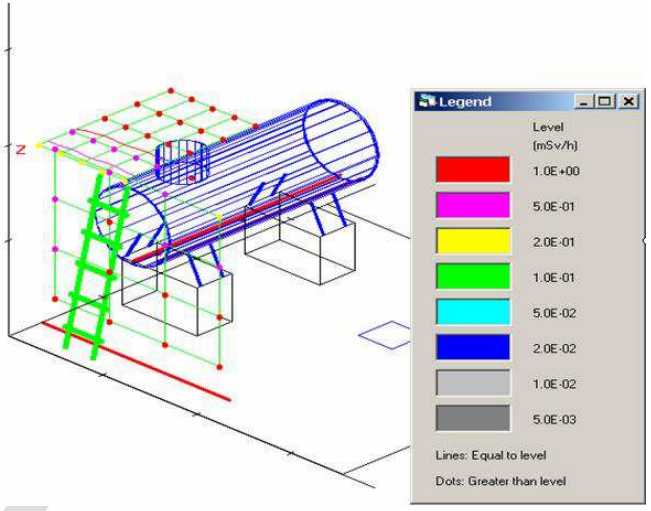
- Development of processes and equipment for treatment and conditioning of sludge, spent ion exchangers.
- Development of processes and equipment for treatment and conditioning of contaminated soils and concrete.
- Treatment of solid and metallic radwaste.
- Preparation of interim radwaste storage construction.
- Development of processes and equipment for treatment and conditioning of sludge from the pond and canisters LTSP.



A1 NPP decommissioning – Stage I

4. Technical support for decommissioning

- Development of a code for data calculation for decommissioning.
- Development of the A1 NPP inventory and decommissioning database.
- Design and manufacturing of decontamination equipment and tools.
- Radiation safety optimisation.
- Cover model of national radioactive waste repository at Mochovce site.
- Safety assessment of disposal facility.



A1 NPP decommissioning – Stage II

Organization and management of the A1 NPP decommissioning project (Stage II) are as follows:

- **Decommissioning project (Stage II) is organized into the four main groups of tasks. In total there are 60 tasks and 234 particular technical tasks to be implemented.**

- **The top level management of the decommissioning project includes project leaders and technical project leaders (deputy project leaders) on the side of the plant operator as well as on the side of the general contractor (mirror parallel structure).**

- **The intermediate level management includes heads of groups of tasks which are again appointed on the side of the plant operator and the general contractor.**

A1 NPP decommissioning – Stage II

- **The low level management is represented by technical heads responsible for the implementation of the particular tasks on the side of the plant operator and on the side of the general contractor.**

- **Regular joint meetings on assessment of implementation of tasks, groups of tasks and project itself are organized on low, intermediate and top managerial levels.**

- **Project implementation is supported by other technical and non-technical units, e.g. for radiation protection, quality assurance, communication with regulator, financial matters etc.**

A1 NPP decommissioning – Stage II

The first stage of the A1 NPP Decommissioning project was successfully finished in 2008 and the second one has started in 2009. The Project was divided into the following four groups:

1. Decommissioning of non-operated facilities and civil buildings

- **decommissioning of non-operated facilities,**
- **reconstruction of buildings after dismantling and making rooms available for further use.**

2. RAW management

- **Operation of lines designated for management of contaminated soils, contaminated concrete, sludges, spent resins, etc.,**
- **Monitoring of environment during decommissioning (mobile monitoring stations I and II).**

A1 NPP decommissioning – Stage II

3. Management of contaminated soils

Delivery of equipment:

- **to remove contaminated soil from the buildings,**
- **to sort and monitor contaminated soil,**
- **preparation of design documentation for VLLW repository.**

4. Technical support of decommissioning and environmental protection

The task focused on providing the conditions for continuity and safety of A1 NPP decommissioning project. It is mainly:

- **reinstating pumping,**
- **model of National Radwaste Repository (NRR) coverage,**
- **radiation safety and occupational safety,**
- **safety assessment of RAW disposal from the second phase of decommissioning at NRR,**
- **removal, sorting, decontamination, monitoring of contaminated concrete, soil.**

RAW management

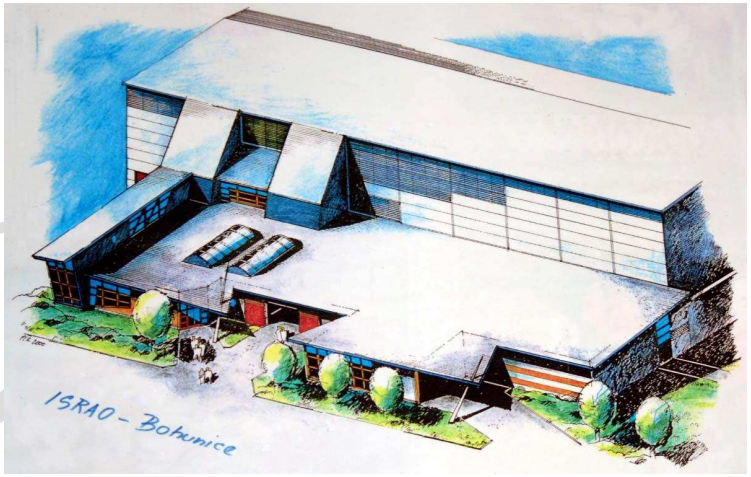
During the NPP A1 decommissioning were gradually provided, for the needs of management of RAW generated from NPP A1, the various technologies for processing and conditioning of RAW, which are part of nuclear facility – Technologies for RAW processing and conditioning:

- ✓ **Bohunice radwaste treatment center with waste sorting, incineration, supercompaction, concentration and cementation.**
- ✓ **Bitumenization units (two for liquid concentrate processing, one unit for spent resins processing).**
- ✓ **Others facilities: metallic RAW fragmentation and decontamination, vitrification, open air cementation facility (mobile), equipments for sludges fixation from A1 NPP long term storage pool and workstation for spent aerosol filters treatment, workstations for contaminate soils and concrete management, etc.**

Planned activities of JAVYS

Company JAVYS, a.s. is planning to increase the efficiency of RAW management in the process of A1 NPP and V1 NPP decommissioning and to construct:

- ✓ **Interim storage of RAW**
- ✓ **Metallic RAW melting facility**
- ✓ **VLLW repository**
- ✓ **Structures for disposal of RAW (the third double row)**
- ✓ **Enlarge the capacity of processing lines (e.g. decontamination, fragmentation)**
- ✓ **Extend the capacity of monitoring workplaces for free release (into environment)**



Conclusions

- ✓ **Example of NPP A1 decommissioning demonstrates complexity of the decommissioning process implemented on nuclear facility shut-down after a nuclear accident.**
- ✓ **Decommissioning of the NPP A1 is thoroughly planned and optimized, if necessary.**
- ✓ **The second stage of NPP A1 decommissioning started in 2009. The preparation of tender proposal for the third phase of decommissioning will start this year. Whole process of the NPP A1 decommissioning will continue until 2033.**
- ✓ **Decommissioning of NPP A1 enables to use experience and lessons learned for others NPPs in the Slovak Republic and abroad.**

Thank you for your attention!