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Decommissioning of SU "PRRAW Novi Khan"

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Abstract
The SU "PRRAW Novi Khan" is surface type repository and it was constructed according to a modified Russian design in the early sixties. According to the National Strategy for RAW&SNF management, the SU "PRRAW-Novi Han" will be decommissioned on stages after the 2022. The decommissioning will be done by retrieval of RAW and sealed sources from the disposals; treatment; conditioning and packing in new containers, in accordance with the acceptance criteria of the National Disposal Facility; dismantling of the underground facilities and remediation of the site. During the preparatory stage it should be clearly defined the final status of the facility and the final destination of all generated waste, and should be selected technologies and provided all necessary tools and equipment for removal of RAW; dismantling of the facilities and treatment conditioning and packing of produced RAW.

Keywords
repository, radioactive waste, decommissioning, remediation

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1.0 History [1]

The "Permanent Repository for Radioactive Waste (PRRAW)-Novi Khan" (Fig.1) is surface type repository and it was constructed according to a modified Russian design (type TP-4891) in the early sixties.

The original purpose of the repository is to store radioactive waste from the Research Reactor IRT-2000, operating in the Institute for Nuclear Research and Nuclear Energy of Bulgarian Academy of Sciences (INRNE - BAS). Later the "PRRAW Novi Han" begins to accept radioactive waste from nuclear applications. They have varied radioisotope composition, activity and diverse chemical composition.

In 1994, the operation of PRRAW - Novi Han was stopped temporarily for carrying out reconstruction of the storage units, buildings and infrastructure. In the meantime, the newly radioactive waste was stored in a Central Isotope Repository of the INRNE - BAS.

Until 1999 on the territory of the repository temporary sites for storage of radioactive waste in railway containers and in concrete storage units were built. The waste collected so far is transported from INRNE-BAS in Novi Han.

In 2004, by decree of the Bulgarian Government, the State Enterprise "Radioactive Waste" was established. Initially in the Enterprise structure a specialized unit (SU) was created at the NPP "Kozloduy" with the aim of processing and conditioning radioactive waste generated by

the operation of NPP "Kozloduy". In 2005 the Repository in Novi Han, that by then had been managed by the INRNE BAS, joined State Enterprise for Radioactive Waste (SE RAW).

Presently the SU ”PRRAW - Novi Han” accepts low and intermediate level short and long-lived radioactive waste [9], generated from nuclear applications in industry, agriculture, medicine, research, and education.

Fig.1.

2.0 Site description

The site of the SU ”PRRAW - Novi Han” is located 35 km southeast of Sofia (about 15 km from the Sofia ring road) and not less than 4.5 km north of the village of Novi Han - the nearest village. PRRAW site has an area of 42.5 acres.

A view of the site is shown in Fig.2.

The main radioactive waste management activities in SU “PRRAW Novi Han” are:

- Acceptance Control of the incoming radioactive waste;
- Processing, conditioning and storage of radioactive waste.

3.0 Facilities at the site [2]

Acceptance preparation and laboratory complex

The activities in the processing and conditioning of radioactive waste, as well as their preparation for storage are carried out in Acceptance preparation and laboratory complex (APLC). APLC (Fig.3) is equipped with a special drainage system; a special ventilation system; system for preparation of reagent solutions for decontamination and radiation system for internal control. There are a physical and radiochemical laboratory, a system of technological rooms and storage facilities with the appropriate equipment.

Fig. 2. View of the site

Fig.3. Acceptance preparation and laboratory complex (APLC)

A system of specialized workplaces equipped with glove boxes (Fig.4) for processing of low level radioactive waste and smoke detectors is situated in the APLC.

Fig.4. Glove boxes in APLC

Fig.5. Drums with Pu-239 and Am-241

The smoke detectors containing Pu-239 or Am-241 are dismantled from the plastic holders in the glove boxes and the sources are put in metal bins and bins are put in drums. Then full drums with Pu-239 and Am-241are returned back to a storage units- ISO containers (Fig.5).

A facility for the processing of liquid radioactive waste is also situated in the APLC. The purification of liquid radioactive waste is implemented by zeolite adsorption (Fig.6), and vacuum evaporation (Fig.7). The processes for purification of liquid radioactive waste are controlled by a control panel (Fig. 8).

Fig.6 Columns for purification of LRAW

Fig.7 Evaporator

Fig.8 Control panel

The Cementation unit (Fig.9) for liquid waste as well as the cementation unit for solid waste have been designed as a working facility. The processes are controlled by a control panel.

Fig.9 Cementation unit for conditioning of low level radioactive waste

In the APLC is situated a System for abrasive decontamination (Fig.10) and Press System for conditioning of solid radioactive waste (Fig.11).

Fig.10 Working chamber of the system for abrasive decontamination

Fig.11 Press System

Hot cell

The Hot cell (Fig.12) is a unique facility for the country, allowing safe operation with sealed radioactive sources used in industry and medicine. The acceptance control of RAW and dismantling containers with sources is performing in the Hot Cell.

Fig.12 Hot cell

4.0 Permanent Repository units [2]

Disposal for unconditioned solid low and intermediate level waste category 2a [5] is shown in Fig.13. It is an underground multi barrier facility that consists of three cells, each one with the dimensions of 5.0m x 4.5m x 3.5m, the total volume is 236 m^3. The overall buried activity is of 7.28 TBq, and the total volume of solid radioactive buried waste is of 120m^3.

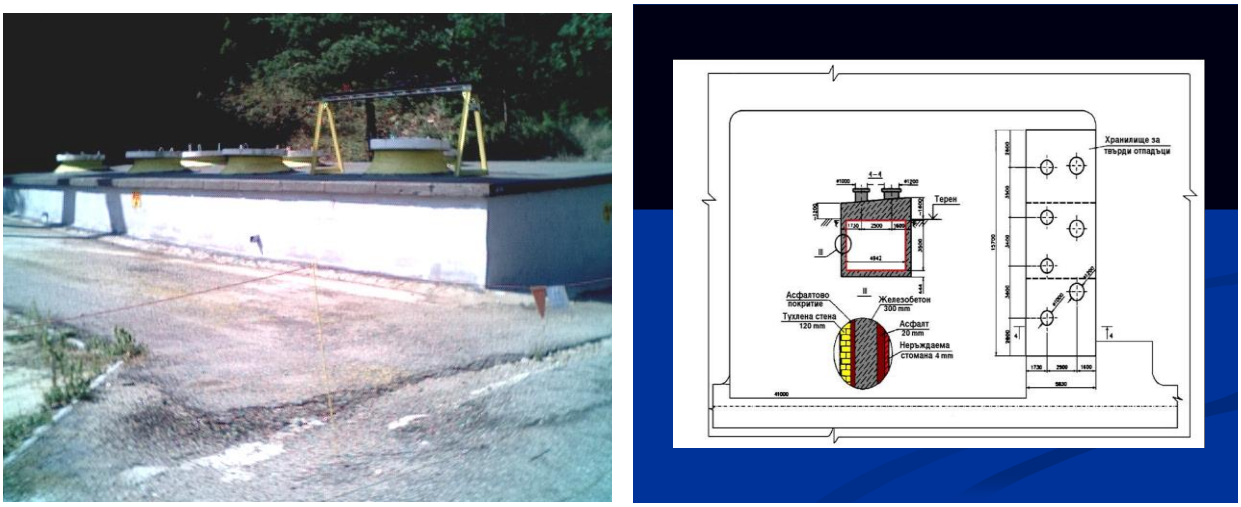


Fig.13 Disposal for solid radioactive waste

Disposal for conditioned low and intermediate level short-lived biological waste from medicine and science is shown in Fig.14. This is an underground reinforced concrete multi barrier facility with the dimensions of 8.4m x 4.0m x 2.5m and height of the overhead part of 0.5m. The total volume of the facility is of 80m^3 and there are buried about 30m^3 of RAW.

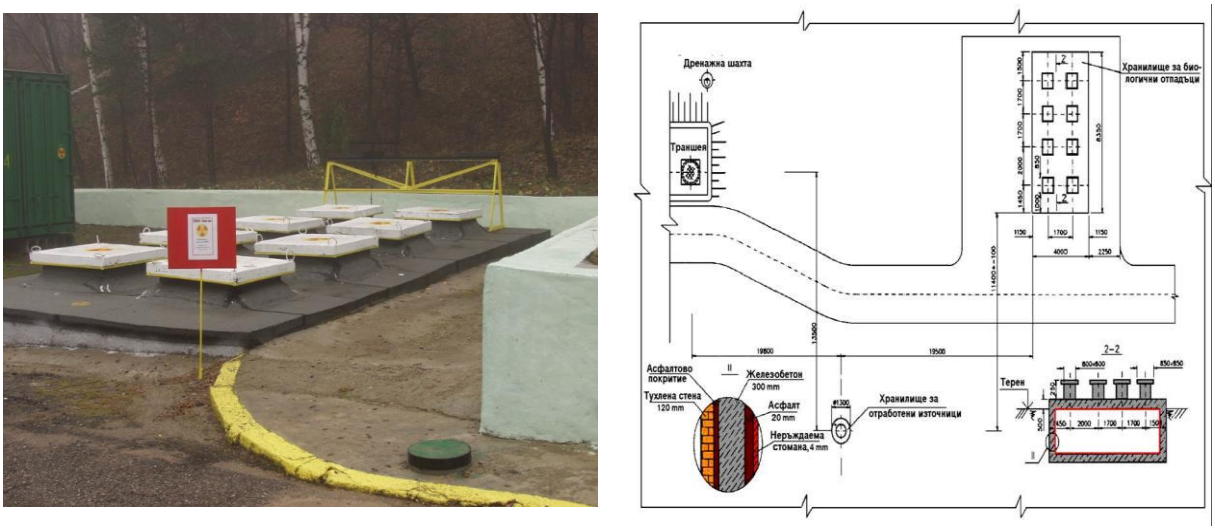


Fig.14 Disposal for biological radioactive waste

Concrete trench for unconditioned low and intermediate level short-lived solid radioactive waste category 2a [5] is shown in Fig.15. It is an underground reinforced concrete facility with the dimensions of 29.0m x 4.1m, built from fabricated concrete elements with a thickness of 300mm, covered with brick wall. The trench is covered with bituminous hydro insulation and equipped with drainage system. It consists of eight cells with a total volume of 200 m^3, each cell is equipped with a hole with an outer diameter 1.30m. Three of the cells are completely filled with RAW stabilized with cement grout.

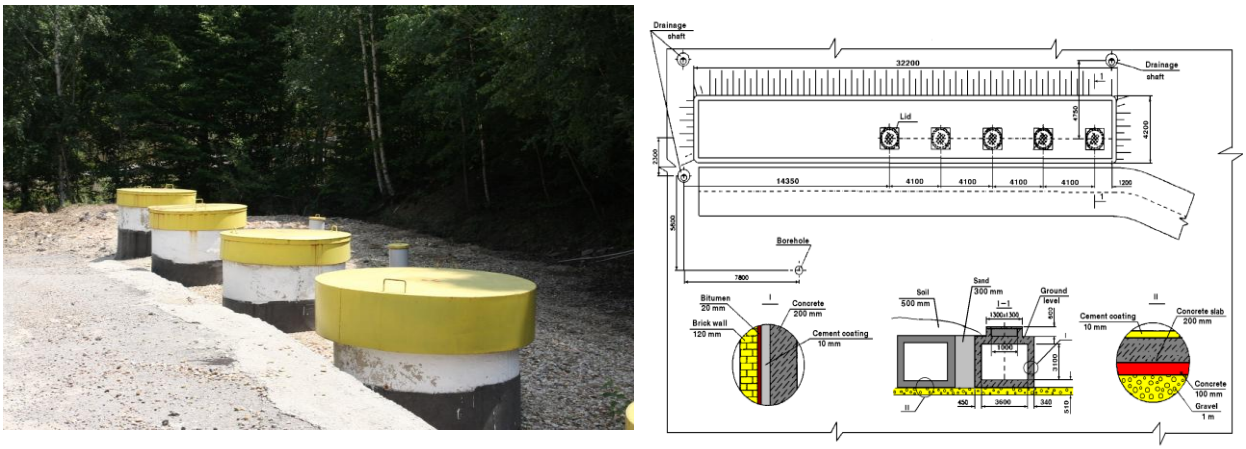


Fig.15.Concrete trench for solid radioactive waste category 2a

A bore hole for disposal of unconditioned low and intermediate level spent radioactive sources (SIR) is shown in Fig.16. It is a reinforced concrete facility, situated underground to a depth of 5.5m, with a capacity of 1m^3. Protection from ionizing radiation is provided by reinforced concrete and 5 lead plates with a thickness of 10mm, located between the store and the surface. The facility is additionally protected with heavy movable roof structure. The volume of the buried SIR is about 0.75m^3.

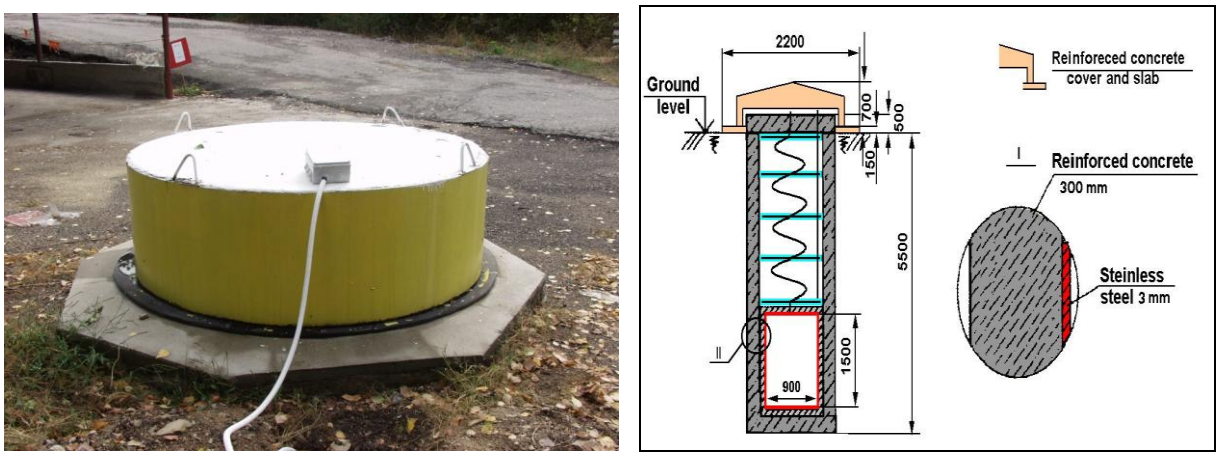


Fig.16 A bore hole for spent radioactive sources (SIR)

An IAEA expert mission to survey the state of the repository for spent radioactive sources SIR was organized from 21 to 27 October 2001 (Fig.17, 18).

Fig.17

Fig.18

The results of the mission show that the total activity of waste sources located in the Bore hall is 67.9 TBq. The main contribution has Cs 137 (84.11%) and CO 60 (14.49%). There are no structural defects in the underground vessel through video surveillance. No presence of water in the underground vessel.

The facility unit for temporary storage of short-lived low level liquid radioactive waste, as well as for secondary liquid RAW is shown at Fig. 19 and Fig. 20. It consists of four stainless steel tanks, each one with a capacity of $12m^3$, set in concrete cell with dimensions 5.7m x7.4m x4.3m.

Fig. 19

Fig. 20

5.0 Temporary storage units [2]

Site №1 was build for temporary storage of solid RAW categories 2a and 2b [5] (Fig.21). The site has a capacity of 14 standard ISO containers for storage of RAW with sizes of 6.00m x 2.45m x 2.30m, and useful volume 34m^3.

Fig.21

At present there are 13 metal ISO containers with a total volume of 442 m3. They are used for temporary storage of spent sealed radioactive sources, fire alarm devices and neutralizers of static electricity.

Site №2 was build for temporary storage of low- and intermediate-level solid RAW categories 2a and 2b [5] in concrete receivers "PEC" type (Fig.22) and type "CUBE" (Fig.23), as in concrete containers type StBGOU (Fig. 24). The site has a capacity of 6 concrete receivers type PEC, 171 concrete containers type StBKUB and 18 concrete containers type StBGOU.

Fig.22 Temporary structures for storage of spent sealed radioactive sources, consisting of five reinforced concrete container type "PEC".

Fig.23 A set of containers type CUBE for temporary storage of radioactive waste, equipped with movable roof

Fig.24 A set of concrete containers type "GOU." Used for storage of spent gamma irradiation devices

Site №4 was build for temporary storage of radioactive waste categories 1, 2a and 2b [5]. The RAW is stored in metal drums of 200l capacity, ordered by 4 drums in one Euro pallet. The capacity of the site is 400 drums (100 Euro pallets).

In the recent years, in line with the strategy for the decommissioning of SU ”PR for RAW - Novi Han” a new type of concrete containers (Fig.25) were put into operation. They are designed for storage and transportation of conditioned radioactive waste to the National Disposal Facilities for RAW.

Fig.25

At present in SU "RAW Novi Han" there are stored: 83472 SIR containing Am^{241}, with a total activity 2.14 TBq; 126567 SIR containing isotopes of Pu with a total activity 2.92 TBq; 5305 pieces, containing isotopes of Cs with a total activity 483 TBq; 3626 pieces, containing Co^{60} with a total activity of 1265 TBq; over 160 neutron sources with activity 1.92 TBq; 3038 pieces SIR containing Ra with a total activity 59.92 GBq; 5062 pieces SIR 14C with a total activity 142.70 GBq; 6100 pieces SIR containing Sr^{90} with a total activity of 350 GBq; 21 823

pieces SIR containing Kr with a total activity 1.344 TBq, and another 4500 SIR with varied radioisotope composition with a total activity around 4.50 TBq [4].

6.0 Strategy for decommissioning of the Special Division "Novi Khan Repository"

According to the National Strategy for RAW&SNF management [4], the SU "PRRAW-Novi Han" will be decommissioned in stages after the 2022. The decommissioning will be done by retrieval of RAW and sealed sources from the disposals; treatment; conditioning and packing in new containers, in accordance with the acceptance criteria of the National Disposal Facility; dismantling of the underground facilities and remediation of the site [3].

Assumptions of the decommissioning strategy:

- The selected strategy is deferred dismantling combined with the application of active and passive post operational institutional control of the facility.
- The Decommissioning of "Novi Khan repository for RAW" will be done by removing of RAW from the disposals, treatment, conditioning and packing in a new containers; dismantling of the underground units and remediation of the site.
- The produced RAW will be temporary stored in interim storages, and then transported to disposal facilities.
- The facilities of „Novi Khan repository" are relatively independent concerning their location, physical and radiation protection; monitoring, etc. This condition allows decommissioning of the facilities to be implement separately in stages.

The preliminary time schedule of the "Novi Khan Repository" decommissioning program is shown in Fig.26.

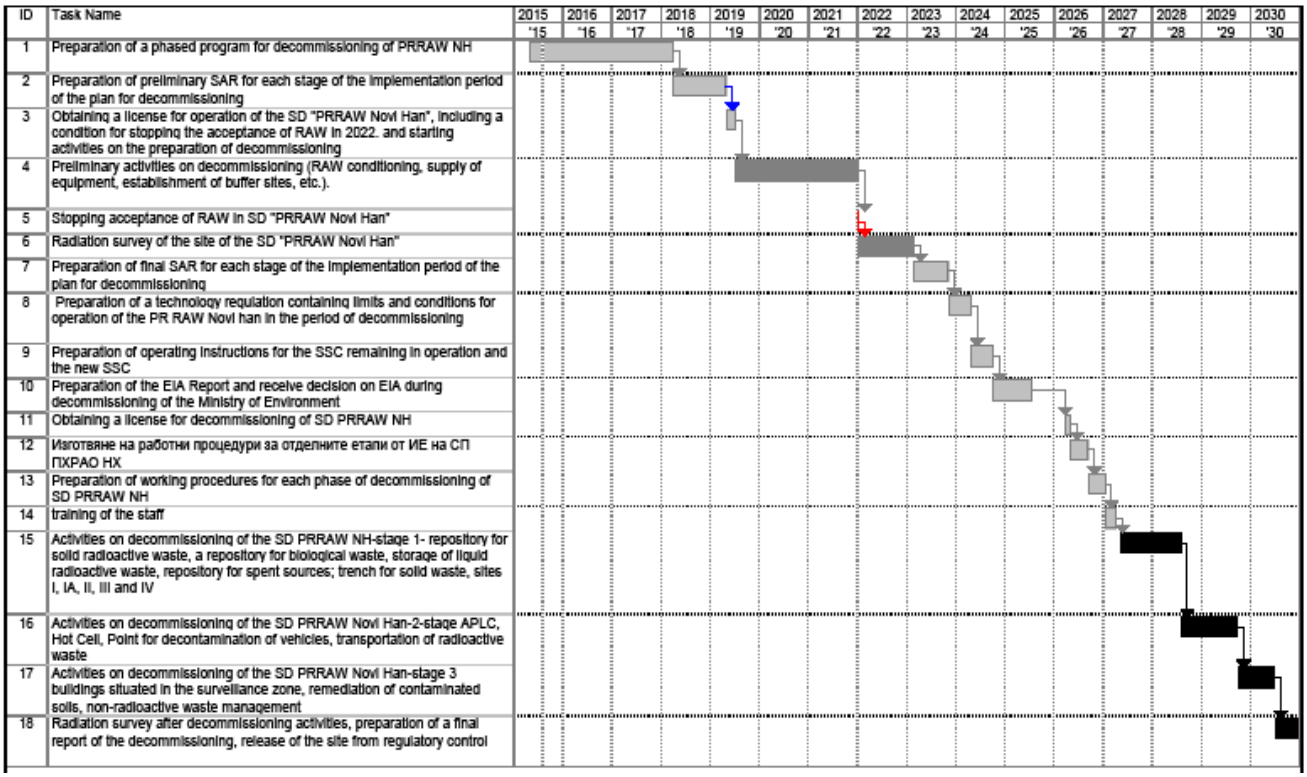


Fig.26

During the preparatory stage, according to the national legislation [6] and the IAEA recommendations [7, 8] the following activities should be performed:

- Clear definition of the final status of the facility and the final destination of all generated waste;
- Detailed radiological survey of all the facilities and waste characterization at the site to determine the quantities and categories [5] of waste;
- Selection of the technologies and provision of all the necessary tools and equipment for the removal of RAW (Fig.27); dismantling of the facilities and treatment conditioning and packing of produced RAW.

Fig.27

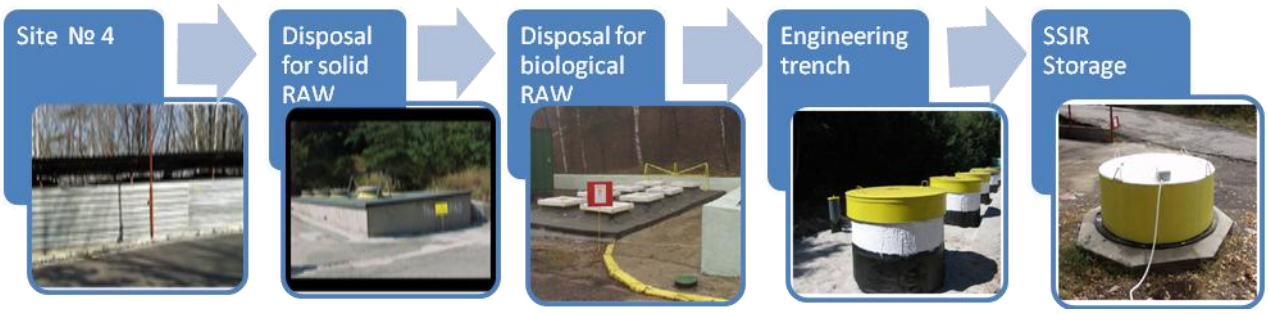
- Precise time schedule and cost estimation of decommissioning
- Selection of methods and tools for radiation protection of workers and the population (Fig.28)

Fig.28

- Determination of the remaining lifetime of SSCs (systems, structures and components) important to safety;
- Determination of the quantities of radioactive waste to be received in the process;
- Assessment of the waste quantities that will be transferred in the national repository for radioactive waste;
- Management of radioactive waste, which do not meet the criteria for acceptance into the National Disposal Facility (NDF);
- Planning activities for remediation and restoration of the site of the SP "RAW Novi Han" after decommissioning.

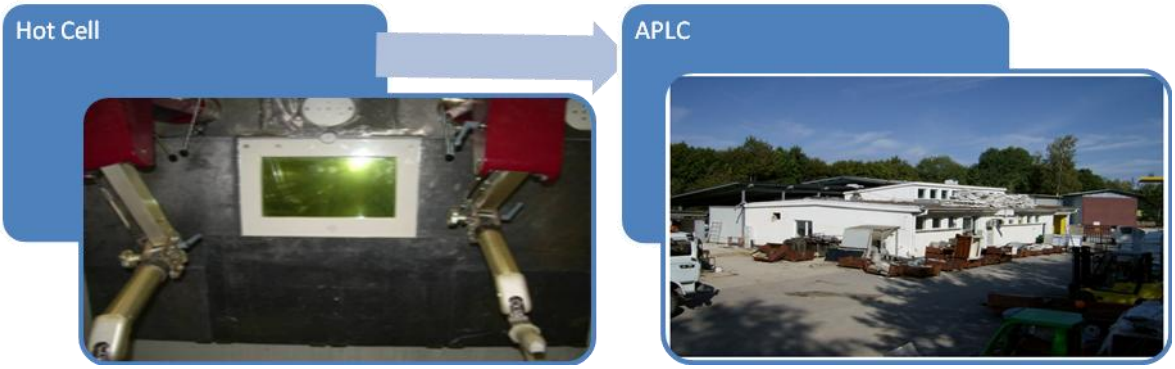
7.0 Stages of the SU "PRRAW Novi Han» decommissioning

Stage 1



Stage 2

Stage 3



Stage 4 Decommissioning of buildings and facilities in the surveillance zone

8.0 Conclusions

Prior to the start of the decommissioning activities of SU “PRRAW Novi Han”, a necessary condition is to determine and specify the final packing of the waste before transporting it from the site and the final destination of the conditioned waste.

It is also necessary to build and put into operation the National Disposal Facility for 2a category RAW and other facilities for 2b category RAW, where the radioactive waste resulted from the decommissioning process will be transported and buried.

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