



## DECOMMISSIONING OF THE IFIN-HH VVR-S NUCLEAR RESEARCH REACTOR

*Dr. Mitica Dragusin, IFIN-HH, Romania*

### I. Introduction

IFIN-HH institute administrates with the diligence of a good owner the principal public property goods involved in decommissioning:

- VVR-S Nuclear Research Reactor;
- Treatment Plant for Radioactive Waste;
- National Repository of Radioactive Waste at Baita-Bihor.

In May 2002 the Romanian Government decided the final shutdown for the decommissioning of the Nuclear Reactor VVR-S.



**Fig. 1 VVR-S Nuclear Research Reactor**

Characteristics of VVR-S research reactor:

- Type of nuclear reactor: soviet design thermal neutrons research reactor, moderately cooled and reflected with distilled water, fuelled with enriched uranium 10% in the beginning and 36% subsequently;
- Period of operation: 1957-1997 (40 years)
- Thermal power of the reactor: 2 MW
- Number of horizontal experimental channels: 9
- Number of vertical experimental channels: 16
- Number of mobile thermal columns: 1
- Number of biological channels: 3
- Number of tanks for active wastes disposal: 1
- Flow rate of the thermal neutrons ( $n/cm^2s$ ): maximum  $2 \times 10^{13}$ , middle-range  $1 \times 10^{13}$ , at exit from the horizontal channels  $(0.2 \div 5) \times 10^9$ 
  - Number of circulating pumps: 5
  - Number of heat exchangers: 2
  - Number of distillation tanks for addition in the reactor block: 4

**Project objectives:**

- 1. Decommissioning of VVR-S nuclear research reactor: 2010 – 2020;**
- 2. Repatriation of EK-10 spent nuclear fuel: 2010 – 2013;**
- 3. Modernisation of radioactive waste treatment plant 2010-2012.**

**Emplacement:** Magurele Town, at 8 Km from downtown Bucharest city

**Beneficiary:** Horia Hulubei National Institute of Physics and Nuclear Engineering – IFIN-HH

**Institute website:** [www.nipne.ro](http://www.nipne.ro)

**Financing:** Ministry of Education, Research, Youth and Sport (MECTS), National Agency for Scientific Research (ANCS), State Budget according to Government Decision H.G. 898/2009.

**More information on website:** <http://cdrwm.nipne.ro>



**Fig. 2 VVR-S Reactor Block and internal view of SNF pond**

## **II. Current Status of the Decommissioning Project**

**Decommissioning authorisations acquired by IFIN-HH:**

- **Environmental License No. 1 / 2007;**
- **Decommissioning Plan of VVR-S reactor approved by CNCAN by Certificate No. CNCAN\_PD\_VVR-S/01\_2008;**
- **License for Decommissioning the VVR-S Research Reactor No. 1/2010**
- **License for Quality Management of decommissioning VVR-S Research Reactor no 011-07/2011**



**Decommissioning Project Start:**  
**1 of January 2010;**

**Decommissioning strategy implemented:**

Immediate decommissioning (DECON), by successive implementing of activity phases, until free release from under the authorization regime.

**Final state of decommissioning:**

Reusing of the building in the field of material sciences (irradiation of polymers) with radiation processing by a electron liniar acceleration installation.

### **III. Spent Nuclear Fuel Management**

- HEU Spent Nuclear Fuel: The spent S-36 fuel (36% enrichment) has been repatriated into Russian Federation in July 2009 during the RRRFR-Romania Project with USA funding, accomplishing a world premiere by using aerial transport for this category of radioactive materials in TUK-19 containers. The radioactive wastes from reprocessing this fuel will be disposed in Russian Federation.
- LEU Spent Nuclear Fuel: The spent EK-10 fuel (10% enrichment) will be repatriated in Russian Federation in 2012, in parallel with the deploying of decommissioning activities form Phase1.
- In conformity with the decommissioning norms and the selected strategy the nuclear fuel will be totally evacuated from the IFIN-HH site.



**Fig. 3 Repatriation of S-36 HEU fuel in Russian Federation by airplane**

## IV. Decommissioning Project Phases

There are 3 decommissioning phases in the Decommissioning Plan.

### Phase 1:

- Nuclear objective is definitively shut down and systematically monitored. It maintains the functionality of all buildings and systems of the nuclear reactor, with the discharge of materials, equipment and non-nuclear structures that do not affect the conduct of the next phases of decommissioning;
- Some systems are rehabilitated and are prepared for the actual decommissioning activities, (utilities, control and surveillance systems, etc.);
- Reactor building site is prepared as a work precinct to meet the work activities from the next decommissioning phases.



Fig. 4 Illustration of decommissioning phase 1 activities

### Phase 2:

- The following activities will be performed: decontamination, initiating of dismantling and demolition activities, radioactive waste treatment and conditioning and their transport and storage in order to attain a progressive restrain of nuclear contaminated areas.
- The nuclear objective will not reach the levels of release from licensing requirements, but the premises for decommissioning the reactor block, hot cells and spent fuel cooling pond are created.



Fig. 5 Illustration of decommissioning phase 2 activities



### Phase 3:

- All the nuclear reactor materials, equipments and components are removed, including all adjacent support utility systems (which are not necessary for the installation that will be hosted into the reactor building in the afterword) in order to utilise the building without any restrictions.
- Following, the finalisation of Phase 3, it is considered that are no longer necessary the surveillance and inspection, and the site is released from the Romanian National Commission for Control of Nuclear Activities (CNCAN) surveillance.



**Fig. 6 Illustration of decommissioning phase 3 activities**

### References:

1. Decommissioning Plan for VVR-S Research Reactor rev 9, IFIN-HH, 2009;
2. Feasibility Study for decommissioning VVR-S, repatriation of LEU Spent Nuclear Fuel EK-10 and modernisation of the installations of Radioactive Waste Treatment Plant, IFIN-HH, 2009.