

RESEARCH REACTOR DECOMMISSIONING ACTIVITIES IN ROMANIA

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Responsible for Decommissioning of Nuclear Facilities

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ROMANIA



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Outline

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Legal and Regulatory Framework

- **Romanian legislation and regulatory framework** took into consideration at a higher level the decommissioning activities of nuclear facilities after ratifying, by the Law nr. 105/June 16, 1999, the "Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management", adopted in 5 September, 1997 in Vienna.
- **National Commission for Nuclear Activities Control – CNCAN** – which by law is an independent regulatory body in the field of nuclear activities that has the empowerment to offer regulation, authorization and control for nuclear activities. CNCAN was established on January 8, 1990 through reorganization of a former regulatory body. CNCAN is coordinated by Prime Minister's Cabinet. CNCAN must to approve decommissioning plan (DP) and to issue the license for decommissioning of the nuclear facility.
- **National Agency for Radioactive Waste – ANDRAD** – is the competent authority for disposal administration of spent nuclear fuel and radioactive wastes and coordination of the **decommissioning** of nuclear facilities and of the management of spent nuclear fuel and radioactive wastes. Government Ordinance (GO) No. 11/January 30, 2003 and Government Decision (GD) no. 1601/ December 23, 2003 established the ANDRAD's foundation and organization. ANDRAD is subordinate to MEF from April 2007. ANDRAD must to give an expert opinion for the decommissioning plan.

Legal and Regulatory Framework (cont.)

- **License holder** has the liability:
 - **To elaborate DP** and supporting documents . **DP** is revised after 5 years. **DP** is an imperative component of the documents requested by CNCAN to issue the authorization for operation for a new nuclear facility.
 - **To obtain** from CNCAN the **license for decommissioning** (valid 5 years) based on a proper documentation that contains **DP** and other documents.
 - **Performs decommissioning activities** itself or with authorized organizations.
 - **Requires** from CNCAN **the certificate** for free release of the site.
 - The **waste producers are responsible** for predisposal activities related to their waste and for the decommissioning of their facilities. They shall bear the expenses related the collection, handling, transport, treatment, conditioning, storage and disposal of the waste they had produced, and shall pay the legal contribution to the funds earmarked for management of radioactive waste and decommissioning.
 - By conditions set in the **license for decommissioning**, and by regulatory standards and norms, the licensee is requested to send the radioactive waste for treatment and disposal or long term storage at dedicated facilities.

Legal and Regulatory Framework (cont.)

The legal framework for decommissioning of nuclear facilities is assured by next laws:

- **The Romanian law No. 111/1996** on safe deployment of nuclear activities with subsequent modifications and completions (laws No. 193/2003 and 63/2006) applies to research, designing, holding, sitting, construction, installation, commissioning, operation, modification, preservation, **decommissioning**, import-export of nuclear facilities.
- **The GO 11/2003** with subsequent modifications and completions (GO No. 31/2006, law No. 26/2007) on the safety management of the radioactive waste. The law establishes duties and responsibilities of ANDRAD in the management of the radioactive waste area and duties and responsibilities of the nuclear license holders.
- The holders of nuclear license have the obligation to register themselves to ANDRAD if they produce radioactive waste by operation or **decommissioning** as it is provided in GO No. 1080/September 5, 2007.
- For the future it is in plan a tight collaboration of the ANDRAD with CNCAN to have a data base with all holders of license that produce radioactive waste.
- The **decommissioning of research reactors** is approved by GD, as it is provided in the Romanian laws No. 57/2006 on peaceful utilization of nuclear energy.

Legal and Regulatory Framework (cont.)

In the practice of the decommissioning of nuclear facilities there are applied:

- **Norms** emitted by CNCAN:

- **NSN-15**, "Norms on Decommissioning of Nuclear Installations" approved by Order No. 1815.09.2002 of the CNCAN President, published in the Official Bulletin No. 867/2.12.2002, in force from January 1st, 2003, are applicable for decommissioning of the following nuclear installations: **research reactors**; subcritical assemblies, radioactive waste treatment plant, intermediary storage of spent nuclear fuels; intermediary storage of radioactive waste. These norms establish the conditions and steps necessary for decommissioning of nuclear installations with the purpose of release from licensing regime. **The norm specifies the obligation to have DP for new RR at the first licensing. This norm will be revised next year.**
- **NDR-01**, "Fundamentals norms for safety management of the radioactive wastes" elaborated by CNCAN with the Order no. 56/March 25, 2004. The norms represent the adaptation of the IAEA SS No. 111-F: "The principles of radioactive waste management"
- **NDR-02**, "Norms for Free Release of Materials Resulting from Authorized Practices" that establish the clearance levels for materials. For the future decommissioning activities of nuclear facilities there are requested specifically norms for materials, buildings and soil. CNCAN plans to issue specific norms.

- IAEA documents:

- **SRS-26**, "Safe Enclosure of Nuclear Facilities Durind Deferred Dismantling"
- **SRS-36**, "Safety Considerations in the Transition from Operation to Decommissioning of Nuclear Facilities"
- **SRS-45**, "Standard Format and Content for Safety Related Decommissioning Documents"
- **IAEA-TECDOC-1476**, "Financial aspects of decommissioning"
- **Safety Requirements No. WS-R-5**, "Decommissioning of Facilities Using Radioactive Material"

Legal and Regulatory Framework (cont.)

ANDRAD has the next responsibilities for decommissioning of nuclear facilities:

- **Prepares the National Strategy** for safe management of radioactive waste and **decommissioning** and monitor its implementation.
- **ANDRAD is responsible** by law for disposal of radioactive waste.
- **Gives an expert opinion** for the plan for the decommissioning of the nuclear and radiological facilities.
- **Coordinates** the waste management predisposal activities and the activities for **decommissioning** of the nuclear facilities.
- **Administrates the decommissioning activities** if the financial resources are deficient after a financial liquidation of a nuclear license holder.
- **Proposes specific objectives** for the National Plan for research and development regarding the **decommissioning** of nuclear and radiological facilities.
- **Administrates** the financial resources earmarked for the safe management of SNF and RW, disposal and decommissioning of nuclear facilities.
- **Promote** through the MEF the necessary GO, GD or laws related to decommissioning activities.

Decommissioning Strategies

In Romania there is in operation the nuclear research reactor TRIGA (dual core) from Pitesti-Mioveni and in transition phase for decommissioning the Russian origin nuclear research reactor VVR-S from Bucharest-Magurele.

- As regarding the **decommissioning strategy for the TRIGA reactors**, the safe enclosure with deferred dismantling is preferred. The main argument for this option is the presence of more facilities on the site, whence may have different live time. The final objective of the decommissioning is the green field status of the site, but also the possibilities to use the building for nuclear or non-nuclear activities are not excluded. **Till 2025 all aspects for decommissioning will be well reflected in DP and stage 3 of decommissioning is scheduled for 2055.**
- **As regarding the VVR-S reactor, after decision of** Board of Administration of IFIN-HH from July 2001 and Governmental Decision on April 2002 for permanently shutdown, the first three revisions of DP were developed during November 2002 to April 2003 in **safe enclosure strategy** with the release of the site to green field level. Revision four and five of DP were developed during May 2003 –December 2003 in **immediate dismantling strategy**. The immediate dismantling strategy was chosen based on the Decommissioning Plan and the Project Management (brown field).
- At present the operator (IFIN-HH) has a license for preservation of the reactor and storage of SNF in the pools (one in the reactor hall and four in a special building).

Decommissioning Plan

- In 2005 was elaborated by Institute for Nuclear Research the first **conceptual decommissioning plan for TRIGA reactor** that was approved by CNCAN with observations in September 11, 2005. The observations must be accomplished at next revision in 2010.
- The IAEA assisted the operator (IFIN-HH) in the **preparation for decommissioning and development of a final decommissioning plan** since 1995 through two Technical Cooperation (TC) projects ROM/9/017 (1994-1998) and ROM/4/029 (2003-2007).
- The current TC project ROM/4/029 **“Strengthening the Infrastructure for the Decommissioning of the Research Reactor at Magurele-Bucharest”** has the objective to complete a **final detailed decommissioning plan** and the entire infrastructure required for decommissioning, including completion of pre-decommissioning activities to support the decommissioning programme of VVR-S research reactor. This technical assistance covered expert advice, delivery of equipment and training of the IFIN-HH staff. Revision 6 of DP in immediate dismantling strategy under technical assistance of IAEA began in May 2004.

Decommissioning Plan (cont.)

- The Decommissioning Plan and supporting documents of the VVR-S are elaborated by IFIN-HH and CITON considering the document of the IAEA - Safety Reports Series No 45 for standard format and the content of Romanian Regulation –NSN - 15.
- The revision 8 of the draft decommissioning plan (DDP) was submitted to CNCAN and ANDRAD in July 2007 for review and approval.
- CNCAN asked the IAEA for an expert mission (10 to 14 September 2007) for “Review of the Draft Decommissioning Plan for the VVR-S Research Reactor in Romania” in accordance with the relevant IAEA safety standards and good practice in decommissioning. Expert mission had general observations and specific recommendations that must be implemented.
- The report from IAEA was received to CNCAN in October 16, 2007. CNCAN sent the report to IFIN-HH and ANDRAD at the end of October 2007.
- All chapters were analysed and recommendations must be implemented in the revision 9, that it is desirable to be the last one.
- The current version 8 of the DDP reflects the substantial work that has been incorporated by IFIN-HH which has resulted in substantial improvement in the document.
- The decommissioning process is envisaged to last **12 years**.

Financing

- The financial resources for decommissioning activities of nuclear facilities are separated from those for disposal of radioactive waste from operation and decommissioning activities.
- GO No. 1080/September 5, 2007, establishes formation and management of financial resources for management of radioactive waste (including that from decommissioning) and decommissioning activities. This GO is the base for calculations for nuclear power plant owners. For all other holders of authorization, named small radioactive waste producers (including nuclear research reactors) in the GO 1080 it is specified that are applied the provisions of the GO No. 11/2003, republished.
- As the state is the owner of the research reactors, the decommissioning activity is financed from State Budget or legal resources by contributions in an account of the holder of license. The funds are used only for the future decommissioning activity. In practice, for current decommissioning activities of the research reactors are emitted GD, as the specific legislation entered into force recently and were not gathered necessary funds for decommissioning.

Financing (cont.)

- There is not formally established long term funding mechanism, but from 1997 funding has been provided on a yearly basis.
- For 2005-2006 IFIN-HH received about 2 million Euros for VVR-S decommissioning project by Romanian Governmental Decision.
- Funding by R&D projects from National Programme for R&D obtained by competition (man power and procurement).
- Funding by R&D projects internal competition from R&D programme of IFIN-HH approved by ANCS (man power and procurement).
- IFIN-HH prepares a feasibility study which will provide the basis to request the estimated costs of 19 million Euro from Government as an investment objective. These funds is expected to be approved in 2008.
- For the period 2007-2009 there are additional funds from three PHARE projects:
 - Safe decommissioning of VVR-S, technical assistance and procurement for Phase 2;
 - Upgrading the Radioactive Waste Treatment Plant (STDR) - technical assistance and procurement;
 - Upgrading the national disposal facility for radioactive waste, Baita –Bihor;

Spent Fuel Management

- TRIGA – LEU Fuel Strategies: all TRIGA-LEU fuel is loaded now in SSR reactor. The spent fuel discharged from reactor till May 2016 may be sent in USA till 2019, after wet storage in the storage pool. If this strategy is not possible, after wet storage in the spent fuel storage pool for 20 to 30 years, is considered a dry storage that it is under development and, finally deep geological disposal in a future National Repository that will be commissioned by ANDRAD around 2055.
- The last 612 spent fuel TRIGA-HEU elements will be sent back in USA in 2008.
- As Romania get international technical assistance through Russian Research Reactor Fuel Return Program, USDOE – IAEA – Russian Federation – Romania, dedicated to return the S-36 spent fuel from VVR-S to Russia, the implementation of this arrangement is underway and it is expected that the shipment can be completed in 2009-2010.
- The future of spent fuel EK-10 is not defined yet and this is a milestone for the DP approval.
- To date it is not clear whether the high level waste from SNF reprocessing will be returned to Romania for storage or disposal.

Radioactive Waste Management

- The main radioactive wastes associated to the decommissioning phase of the TRIGA reactor are Low and Intermediate Level Liquid and Solid Wastes arising from the core internals, irradiation devices, experimental devices that will be processed at the radioactive waste facility on the INR site. The main solid radioactive wastes expected are: aluminum, graphite, beryllium and steel (small quantities). A better analysis of radioactive waste will be made in the next DP revision in 2010.
- Storage facilities located outside of STDR building from IFIN-HH (5 separate rooms) are currently being cleaned up from legacy waste to provide storage space for decommissioning waste from the VVR-S reactor.
- It is to mention that the presence of aluminum, graphite and beryllium wastes requires further researches to establish optimal solutions for disposal.

Radioactive Waste Management (cont.)

From VVR-S decommissioning are expected the next types of radioactive wastes:

Activated waste:

- Concrete: 35 500 kg
- Aluminum alloy: 650 kg
- Graphite: 4 700 kg

Contaminated waste:

- Aluminum alloy: 2 865 kg
- Cast iron: 131 700 kg
- Stainless steel: 6 620 kg
- Concrete: 5 000 kg
- Water : 500 000 liters
- Resins: 1 100 kg
- Textile and plastics: 5 000 kg

Radioactive Waste Management (cont.)

For STDR from IFIN-HH it is considered in the next five years to:

- put in function an installation for super-compaction of low density solid wastes that to replace/complete the incineration technology;
- install a new facility for liquid radioactive waste treatment in 2009;
- to put in function an installation for hot masticating of plastics.

Transition Activities Performed

The spent fuel was removed from reactor core.

Equipment procurement:

- Portable spectrometer NOMAD plus – Berthold AIV;
- Contamination monitoring equipment SMART 2000- Eberline;
- Survey-meter RO-07-Eberline;
- Aspirator with HEPA- NILFISK filter;
- Equipment for concrete scarifying of the building wall, floor;
- Equipment for cutting and drilling (Mechanical saw HILTI WSR 1200-PE, Diamond drill equipment for concrete core extraction - DD200 , Device for sampling through stamping, type TRUMPH Nibbler N-1000-0 , Discs for smears sampling).

Clean up activities:

- All instruments for research activities were removed from reactor hall;
- Linoleum from reactor hall was removed and the floor was covered by a resin;

Refurbishment activities:

- The access doors were replaced with others that to permit the returning of spent fuel to Russian Federation.
- The floor in the entrance area was consolidated to support the weight of the truck that will carry the container with spent fuel.

Other Considerations

- Radiation dose for release of VVR-S from regulatory control : 0.0003 mSv/h;
- End use of the site of VVR-S: Industrial application , R&D in the material sciences, radiological facility-linear accelerator ;
- For dismantling activities (concrete biological protection of the core) will be involved contractors with proper experience;
- A detailed Radiological Characterisation Plan was approved by CNCAN;
- A Radiological Characterisation Report was done as a supporting document to DP (revisions 7 and 8);
- Environmental Impact Study (including public debate and environmental agreement) was approved by Ministry of Environment;
- A Feasibility Study was made for financing approval by Governmental Decision in 2008;
- A study for storage of EK-10 spent fuel elements in Romania till deep geological repository will be in operation was proposed;

Radiological Characterisation

Summary

- A classification of contaminated areas from the basement of the Reactor Main Building was made;
- Laboratory area is clean.
- Primary circuit, ventilation system and radioactive leakage drainage, overflow and collecting system are highly contaminated.
- Radioactive leakage drainage, overflow and collecting system contains buried pipes and its decontamination must be analyzed.
- Expected radioactive inventory of Hot Cells: $5.5 \cdot 10^{11}$ Bq.
- Calculated radioactive inventory of the Reactor Block: $6.0 \cdot 10^{11}$ Bq.

- Further investigations are necessary for:
 - Metallic store and underground construction for 30 m^3 buffer tank
 - Reactor Hall
 - Reactor Block to improve the estimation of its radioactive inventory.

Baita-Bihor Repository

- **Capacity:** approx. 5.000 m^3 conditioned waste in about 21.000 standard containers (220 litre carbon steel drums);
- First disposals were made in 1985 and the current estimate is that disposals might continue for the next 20 to 35 years;
- Accepts LILW from industry, medicine and research activities. The waste include sludge, evaporates and ashes, solid waste, activated materials, ion exchange resins, spent sealed sources and components from the decommissioning research reactors;
- Wastes are generally conditioned using an Ordinary Portland Cement based grout;
- Disposal galleries are former uranium exploration galleries that have been enlarged;
- Disposal galleries are situated in the unsaturated zone, several hundred meters above the water table;
- Refurbishment of Baita-Bihor repository through the PHARE 2006 project "Upgrading of the Baita-Bihor Repository for Institutional Waste in Romania" is under development.
- This year were revised the acceptance criteria for low and intermediate level waste, including the waste from VVR-S decommissioning.
- A project for Government Decision for transferring in 2007 the administration of Baita-Bihor repository from IFIN-HH to ANDRAD was issued.

Conclusions

- In Romania there are implemented the provisions of the “Joint Convention on management of spent fuel and on the management of radioactive waste”.
- The decommissioning of nuclear research reactors is considered in national legislation that is under revision and completion.
- There are considered all necessary steps from regulation to disposal of radioactive waste for decommissioning of a nuclear facility.
- Regulatory framework, decommissioning plan with supporting documents and funds are considered the basics for a successful decommissioning activity.
- The regulatory body is independent by law from other authorities and operators from nuclear field.
- The financing of decommissioning activities is made by legislation.
- The decommissioning of VVR-S is the most important activity in the next years in Romania. It is a challenge for IFIN-HH, CNCAN and ANDRAD. The help of IAEA is inestimable.
- The transition phase is used for clean-up, refurbishment, procurement of equipment etc.
- A characterisation survey plan and report was made to support the DP.

THANK YOU FOR YOUR ATTENTION