RA Research Reactor Decommissioning

Project Planning and Management

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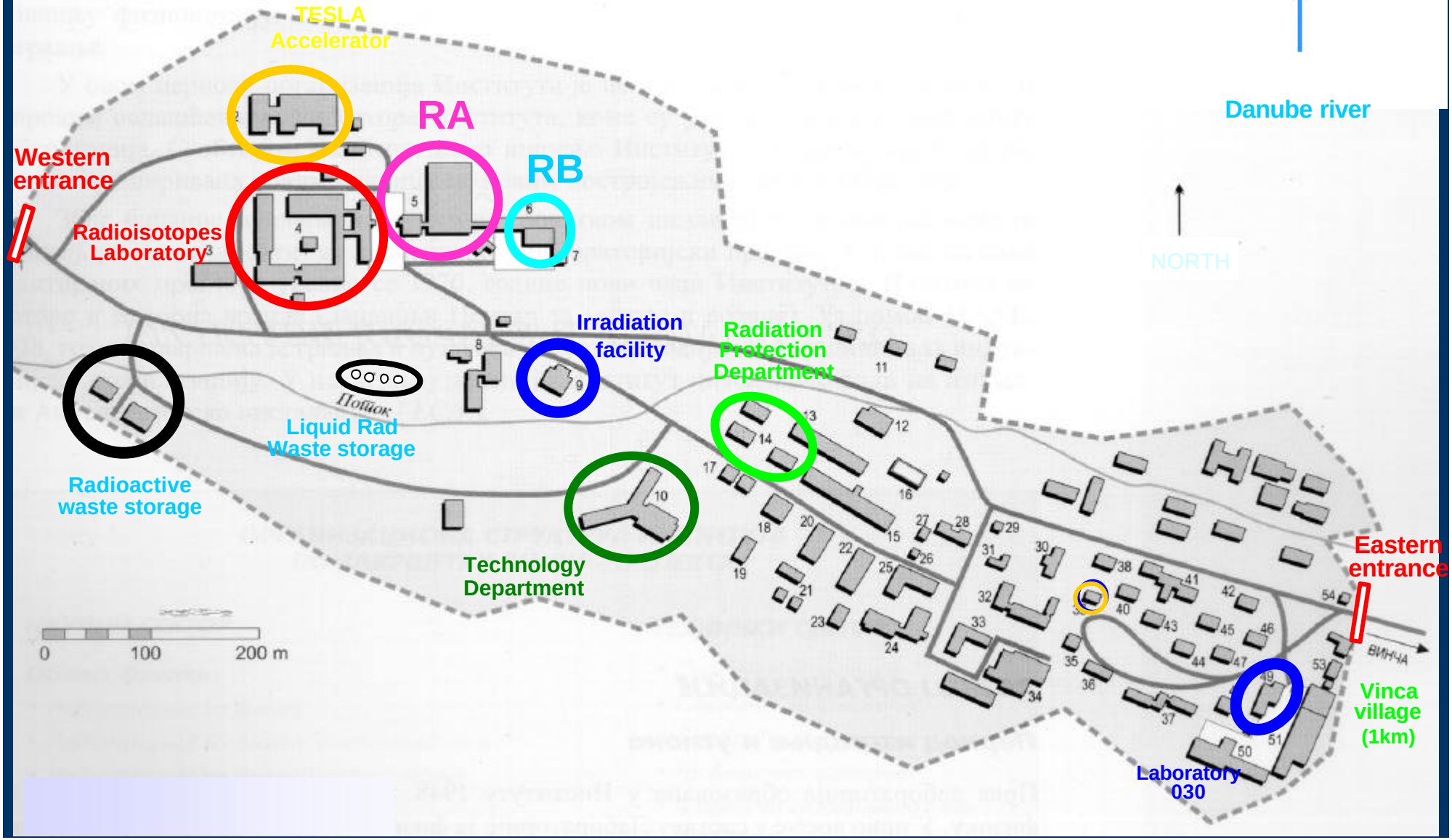
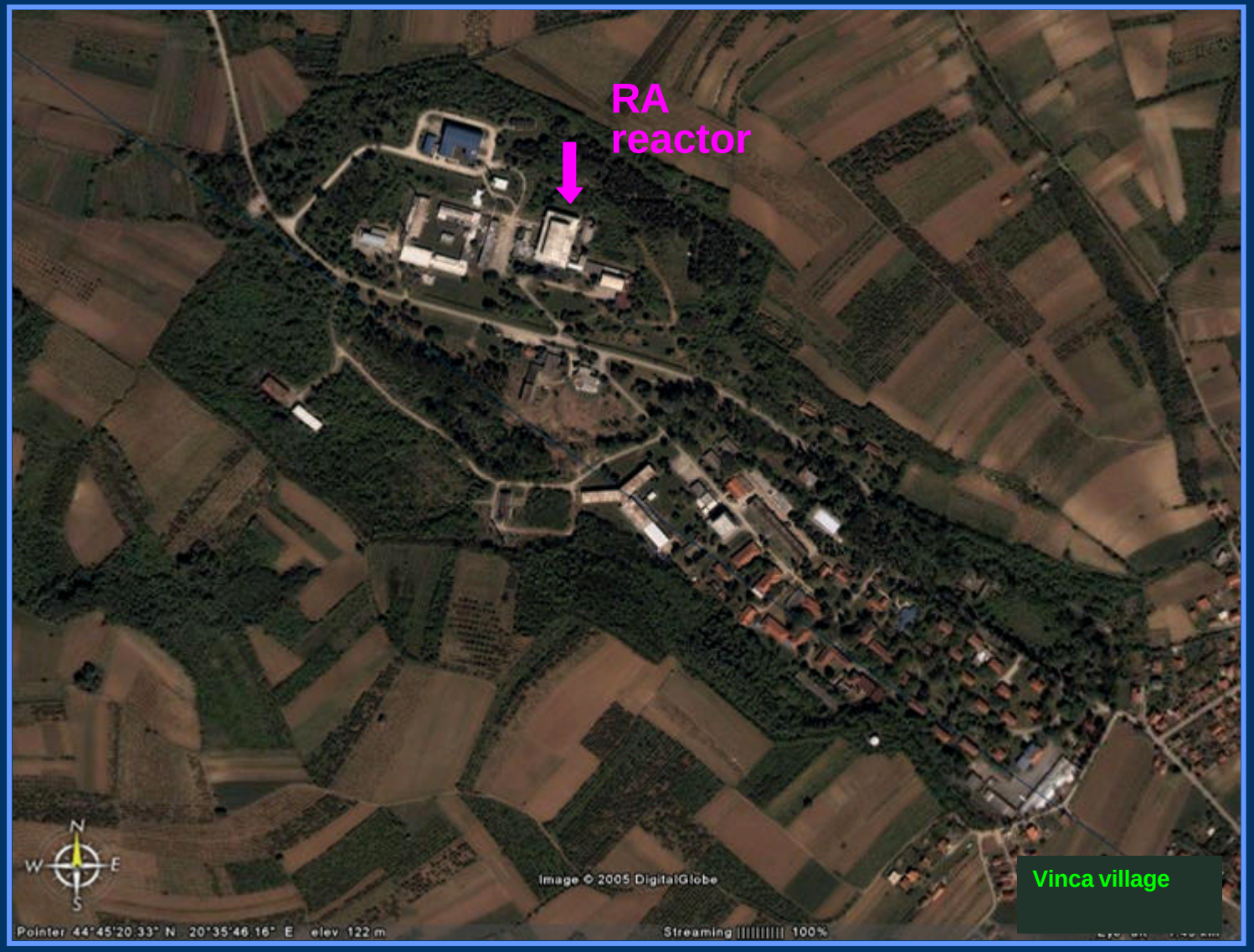
R^2D^2P: Project Planning, Management, Regulatory Review, and Safety Assessment
Manila, Philippines, September 2008

VINCA Institute of Nuclear Sciences

Plan of the site

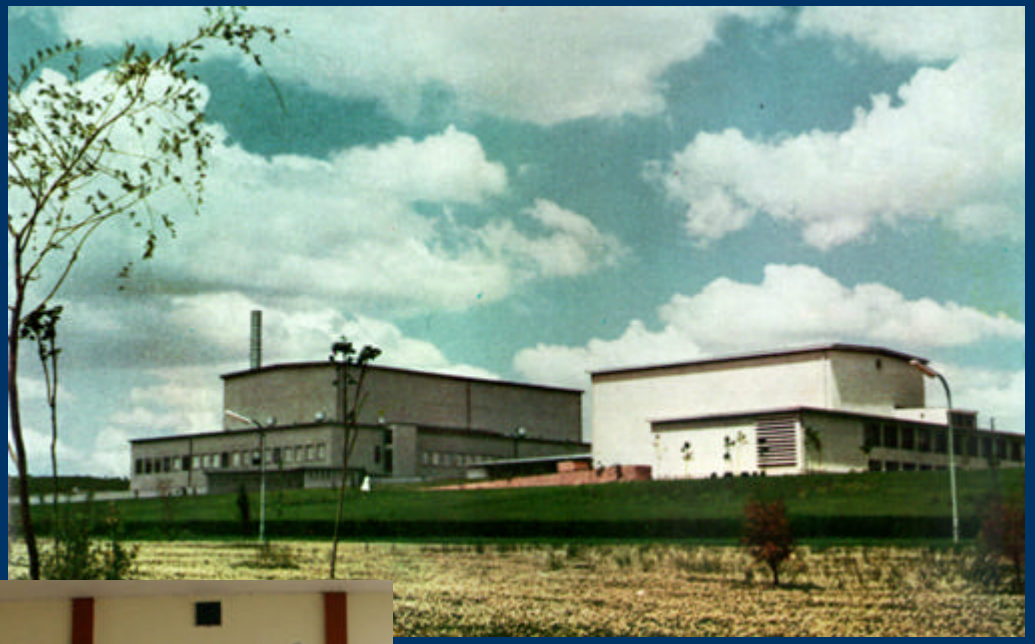


VINCA Institute of Nuclear Sciences
Satellite view



Site and Infrastructure

- 2 nuclear research reactors
- Radioactive waste storage buildings
- Underground liquid RW storage tanks
- Irradiation facility



RA PROJECT HISTORY

The RA research reactor

- The RA research reactor went critical in December 1959
- A tank type reactor using heavy water as the primary coolant and the moderator; the water from Danube river was used in the secondary cooling circuit
- Operated at nominal power of 6.5 MW , maximum power 10 MW
- From 1960 until 1975 the fuel was LEU (2% of ^{235}U)
- In 1976 the original fuel was gradually replaced by the HEU (80% of ^{235}U)
- Both types of fuel elements of the ex-USSR origin (known as the TVR-S type) and have the same shape, dimensions and approximately the same initial mass of ^{235}U
- The reactor was temporary shut down in 1984 to upgrade control and some utility systems

The Project history

- **1984 - 2002: Extended shutdown period (ES)**
- **July 2002: Final shutdown declared and decommissioning approved by Government**
- **2003: Commencement of the national IAEA TC project**

RA Reactor Decommissioning Project

1) **The first contract (YUG4028) in 2003 :**

"Initial Planning for the Decommissioning of the RA Research Reactor"

2) **The second contract in 2004 (SCG4004):**

"Radiological Characterisation of the RA Research Reactor and Decommissioning Planning"

3) **The third contract in 2007 (SRB3002), CLOSED:**

"Radiological Characterisation of the RA Research Reactor – Phase 2"

RA PROJECT ENVIRONMENT

VIND Programme
Vinca Nuclear Decommissioning Program

The Vinca Institute is a multi-content site

Main nuclear & radiation safety problems to be solved:

- **RA research reactor in the stage of an extended shutdown since 1984**
- **Spent nuclear fuel from the RA operation (highly irradiated) in the inadequate temporary storage (water pools) within the reactor building;**
- **Inadequate storage facilities for the low and intermediate radioactive wastes at the Vinca site in deteriorating condition and with insufficient capacity**

Objective of the VIND Programme:

to improve nuclear & radiation safety

VIND Programme
Vinca Nuclear Decommissioning Program

A coordinated and interrelated VIND Program, consisting of 3 projects:

1. **Spent Fuel Removal from the RA Reactor**
2. **RA Reactor Decommissioning Project**
3. **Radioactive Waste Management**

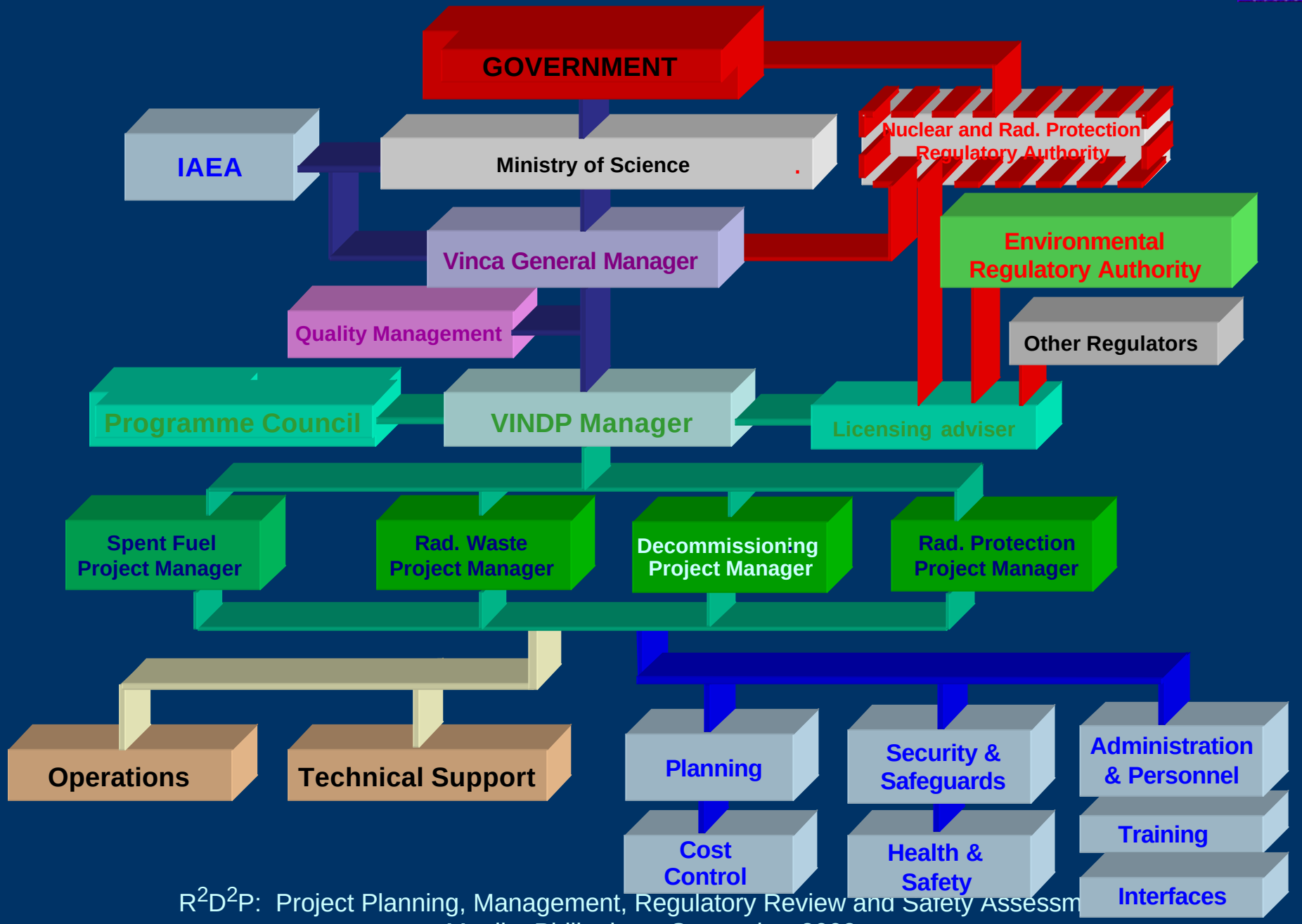
Activities accompanying all three projects:

Radiation Protection Project for the VIND Program

- **Radiation Protection**
- **Environmental Monitoring**

❑ **Administration Support**

Proposed Organisational Chart for the VIND Programme



1) Spent Nuclear Fuel Removal

Period of storage
20 - 40 years

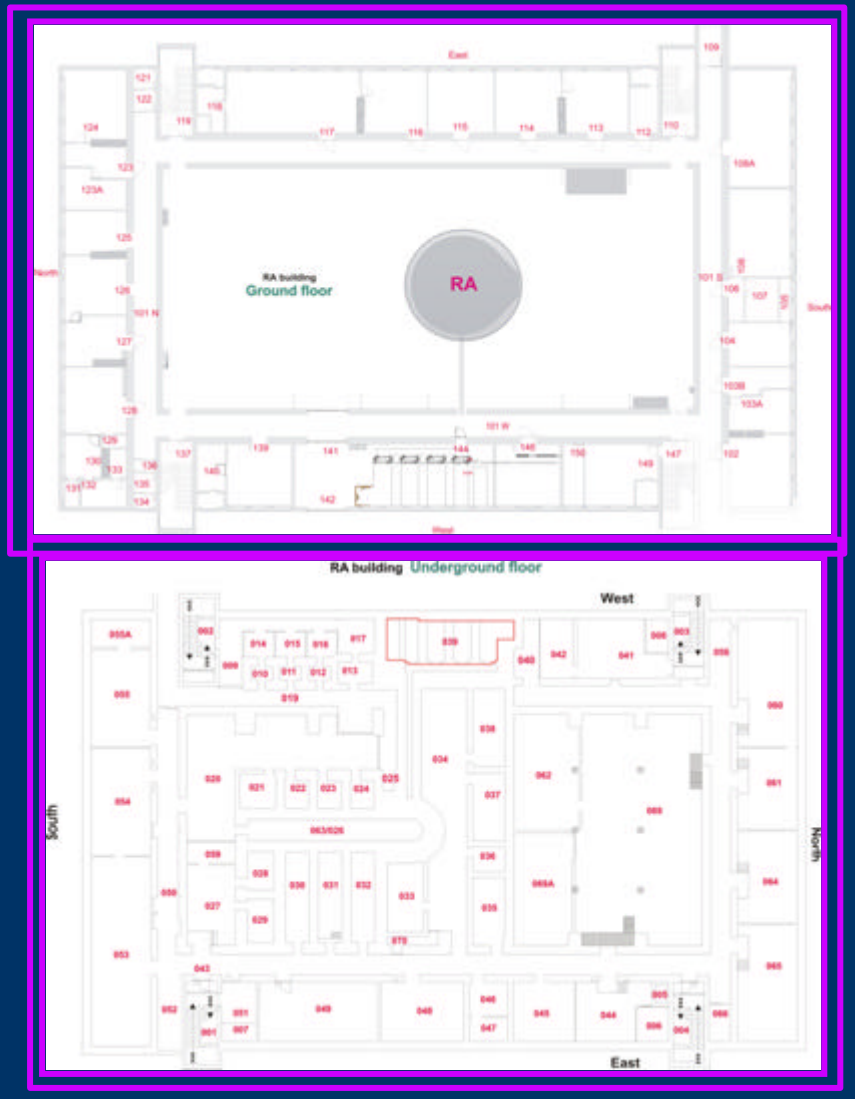
Packaging

- 304 tubular stainless steel containers
- 30 aluminium barrels

Spent fuel inventory

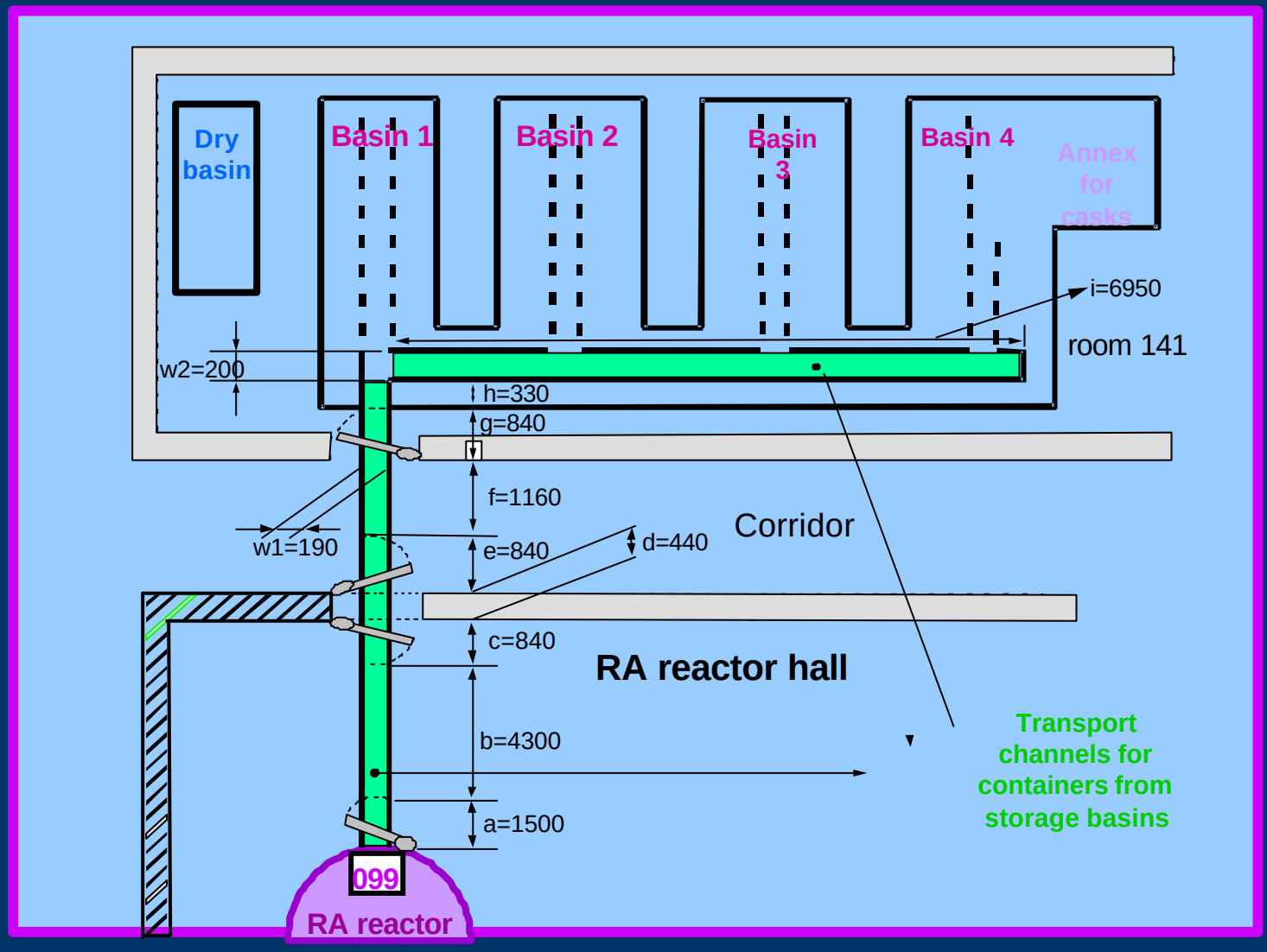
- **6656 LEU (2%) fuel elements (2.5 tones of metal uranium)**
- **894 HEU (80%) fuel elements (20 kg of UO2)**
- **480 HEU (80%) fuel elements remained in the RA reactor core**

1) Spent Nuclear Fuel Removal contd.



Schematic disposition of the spent fuel storage at the ground and underground level of the RA reactor building

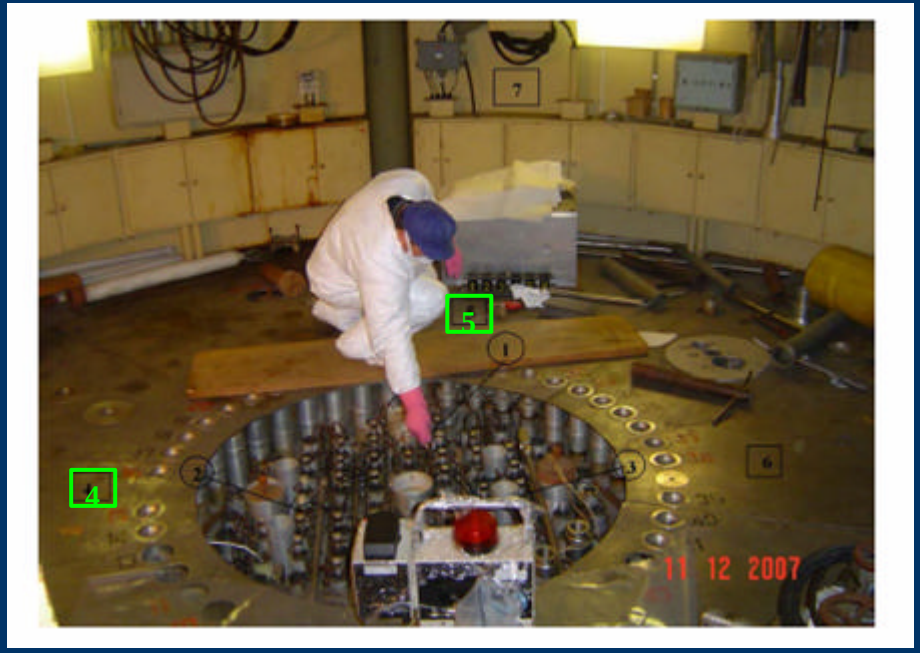
1) Spent Nuclear Fuel Removal contd.



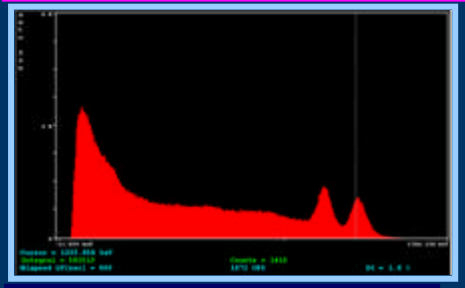
1) Spent Nuclear Fuel Removal contd.

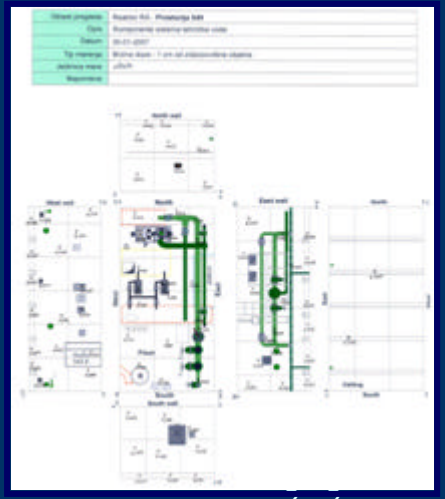
- Assess condition of the RA reactor spent nuclear fuel (mechanical, chemical and radiological)
- Identify criteria of the “Mayak” reprocessing plant (Ozersk, Russia) for acceptance of the RA reactor spent nuclear fuel (SNF)
- Develop conceptual design for SNF repackaging and shipment
- Complete Preliminary Safety Assessment Reports (SARs) for the SNF repackaging and for shipment
- Define technical requirements for the modifications of the RA facility systems and related Vinca Institute infrastructure
- Complete Final SARs for the SNF repackaging and for shipment

1) Spent Nuclear Fuel Removal contd.



2) RA Reactor Decommissioning





3) Radioactive Waste Management

National storage facility for Low and Intermediate waste

- **Two interim RAW storage facilities (hangars) at the "Vinca" site for low and intermediate level**
  - H1 - in extremely bad condition, totally loaded and closed
  - H2 - not sufficient for decommissioning waste
  - drums stored in both H1 and H2 facilities in bad condition, mainly corroded
- **Four underground tanks for the liquid waste storage**

3) Radioactive Waste Management contd.

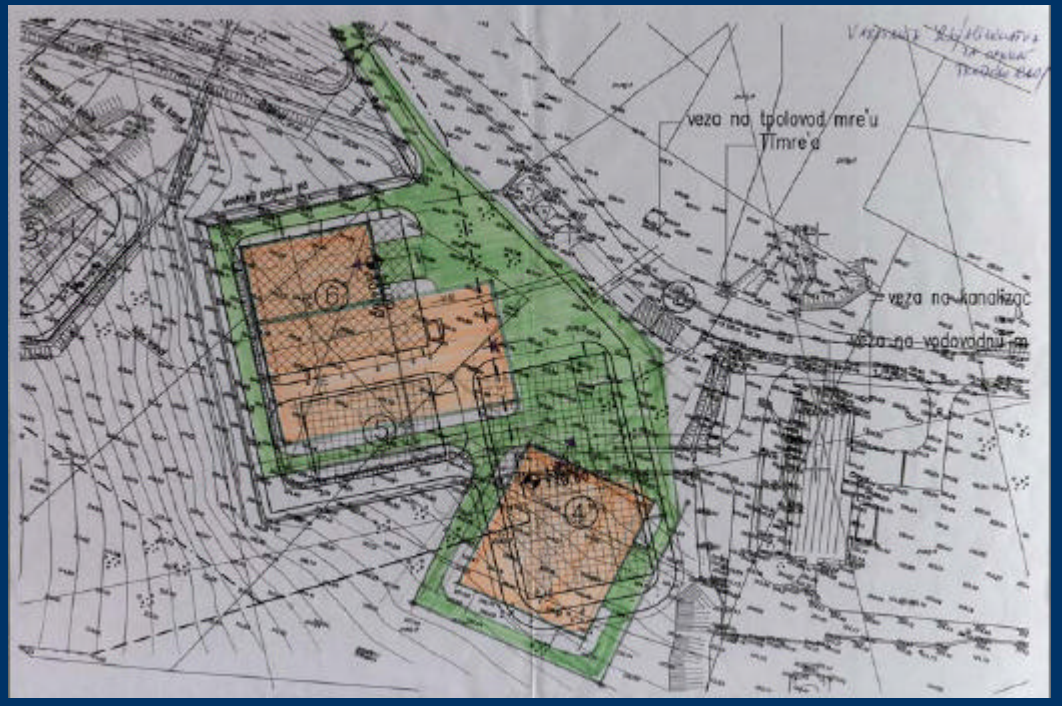
H2 - to be rearranged, repacked

H3 - to accept RAW from RA reactor

SS - to accept high activity sources

WPF - to treat new and historical RAW

Layout of the new RW facilities



LEGAL FRAMEWORK

Legal framework

Existing national regulations

Law on Protection against Ionising Radiation ("*Official Gazette of the FRY*", No. 46/96)

Decrees

- **The Requirements for the Sitting, Construction, Trial Run, Commissioning, Operation and Final shutdown of a nuclear facility ("*Official Gazette of the FRY*", No. 42/97)**
- **Drafting and content of the Nuclear Safety Report and other documents required for verifying the compliance with nuclear safety measures ("*Official Gazette of the FRY*", No. 42/97)**
- **The criteria for the assessment of a nuclear facility's safety ("*Official Gazette of the FRY*", No. 2/98)**
- **The requirements for the professionals employed to conduct process in nuclear facility and professionals that supervise the operation ("*Official Gazette of the FRY*", No. 2/98)**
- **Procedures and conditions for systematic monitoring of the radionuclide's presence in the environment surrounding nuclear facilities ("*Official Gazette of the FRY*", No. 42/97)**

Legal framework (contd)

Rulebooks

- **Methods and requirements for collecting, preserving, record keeping, storage, treatment and disposal of radioactive waste ("*Official Gazette of the FRY*", No. 9/99)**
- **Limits of radioactive contamination of the environment and decontamination methods ("*Official Gazette of the FRY*", No. 9/99)**

Environmental Protection

- **Law on Environmental Protection** ("*Official Gazette of the RS*", No135/2004)
- **Law on Environmental Impact Assessment Study** ("*Official Gazette of the RS*", No135/2004)
- **Law on the Strategic Environmental Impact Assessment Study ("*Official Gazette of the RS*", No135/2004)**
- **Law on Integrated Protection and Pollution Control of the Environmental ("*Official Gazette of the RS*", No135/2004)**

The NEW Law on Protection Against Ionising Radiation and Nuclear Safety

The new shall provide the legislative framework for the implementation of the VIND Programme by:

- **Developing the national programmes which are of multifold importance for the VIND Programme**
- **Establishing the Agency for Ionising Radiation Protection and Nuclear Safety for radiation and nuclear safety**

PLANNING

of the RA Research Reactor Decommissioning

Decommissioning Activities

Preparatory activities:

1) Assembling of the Decommissioning team and review of the available documents and records
2) Establishing the document control system
3) Evaluation of strategy options and selection of the RA decommissioning strategy
4) Definition of the scope and the content of the Decommissioning Plan
5) Preparation of radiological characterization plan
6) Preparation of the transition plan for the RA reactor
7) Maintenance of the RA reactor

Decommissioning Activities contd.

Continuous Activities

- Planning and preparation of documents & procedures
- Co-ordination with other VIND projects
- Surveillance and maintenance
- Decontamination
- Radiation protection
- Waste segregation and packaging
- Equipment purchase
- Quality assurance
- Record keeping
- Training

Decommissioning Activities in 2005 - 2008

1) Preparation and improvement of the Draft Decommissioning Plan and supporting documents

2) Completion of the RA reactor facility radiological characterization

3) Completion of the RA reactor surroundings radiological survey

4) Survey, characterisation and emoval of the equipment and waste from the RA reactor building

5) Surveillance and maintenance of the RA reactor

Content of the RA Decommissioning Plan

- Introduction
- Facility Description
- Decommissioning Strategy
- Project Management
- Decommissioning Activities
- Surveillance and Maintenance
- Waste Management
- Cost Estimate and Funding Mechanisms
- Health and Safety
- Quality Assurance
- Emergency Planning
- Physical Security and Safeguards
- Final Radiation Survey

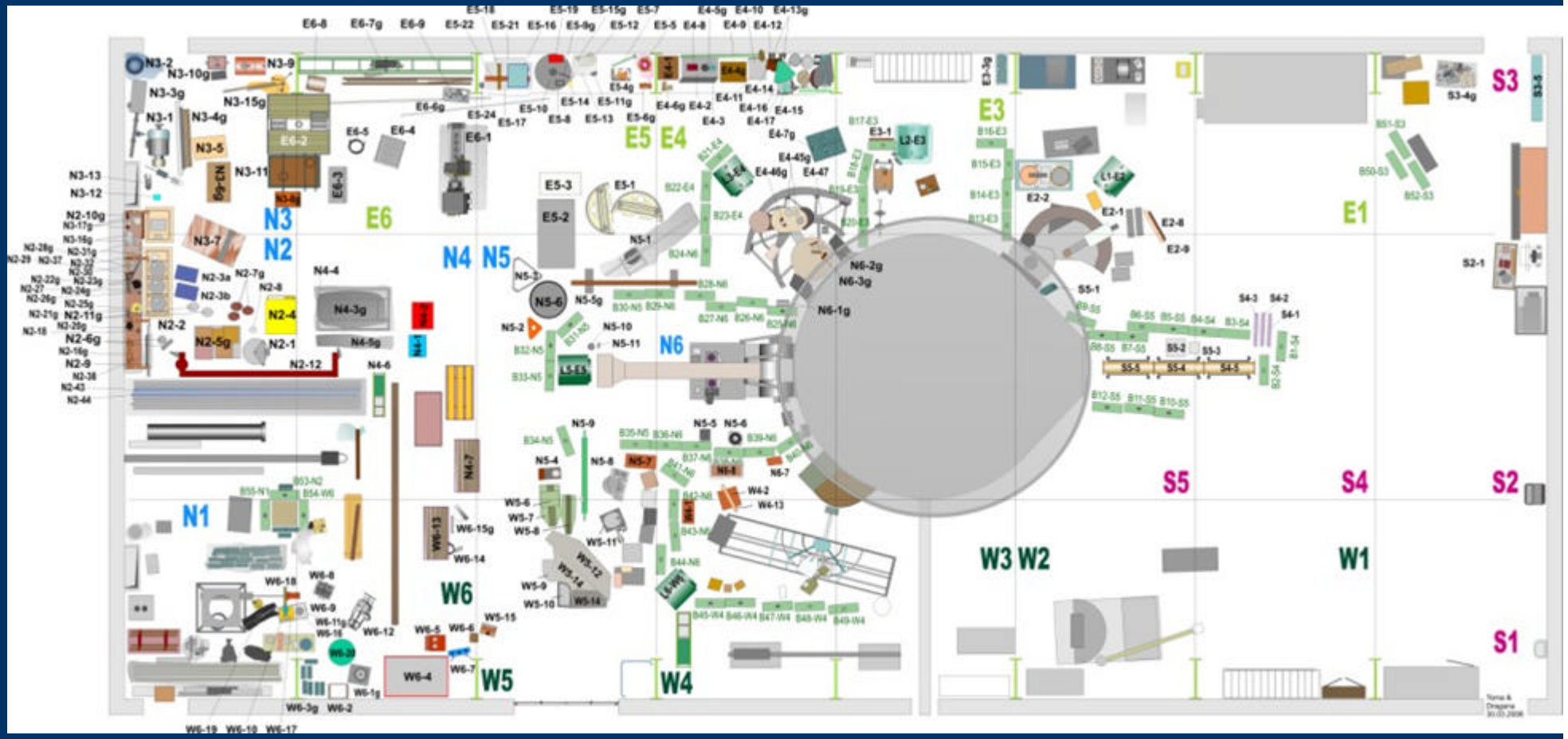
Content of the RA Decommissioning Plan
(contd.)

- **Safety Assessment**
- **Environmental Impact Assessment**
  (stand alone document)

Related documents:

- **Characterization Plan**
  - Amendment of the Characterization Plan
  - Characterization Plan for the RA reactor Surrounding
- **Characterization Reports**

Oprema i objekti u hali reaktora RA do sada evidentirani



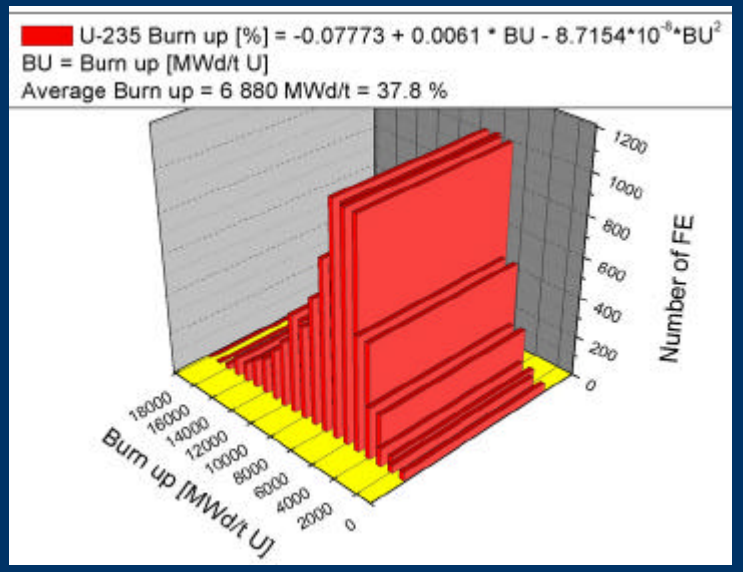
Experimental equipment, structures and waste at the RA reactor hall

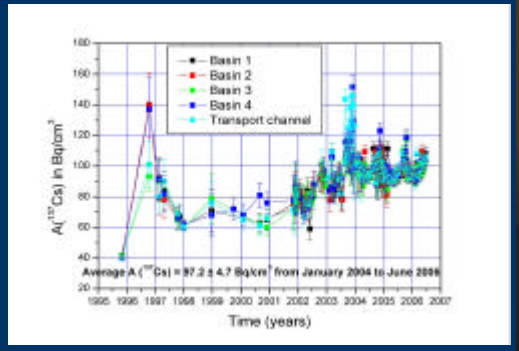
Drums with radioactive waste waiting to be transferred to hangar H2

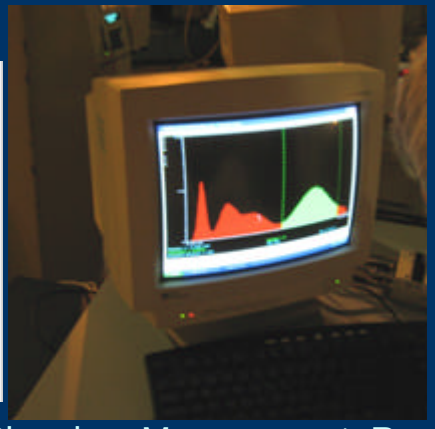
hir v and
Manila, Philippines, September 2008

Characterisation

- Nuclear reactor's kinetics and dynamics analysis
- Nuclear fuel management
- Safety analysis of nuclear facilities
- Environmental Impact Assessment
- Decommissioning of nuclear facilities
- Radioactive waste management
- Radiation protection
- Environmental protection
- Material science

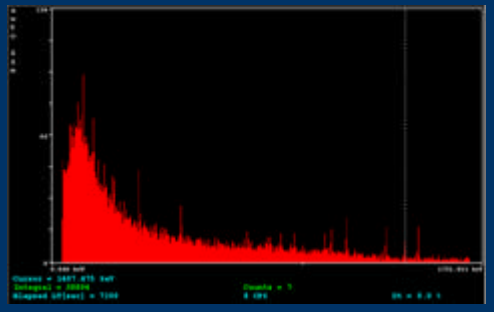


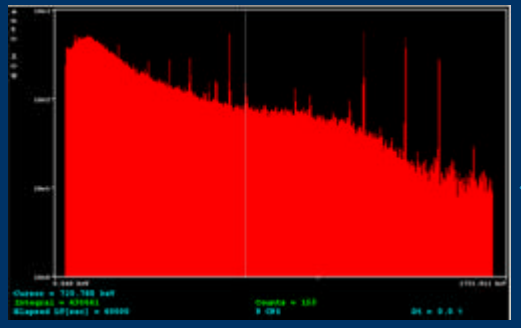


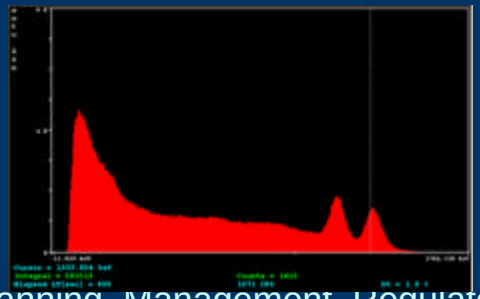


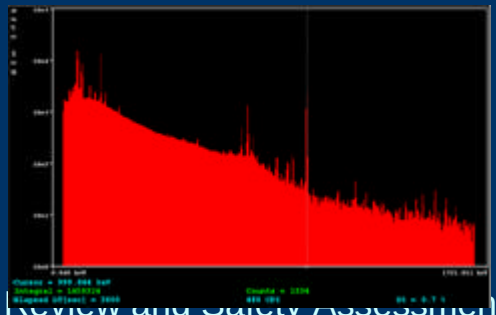
Merenja u hali reaktora RA:

Merenja u Laboratoriji:
Uzorci iz hale reaktora RA









SUMMARY & LESSONS LEARNED

- Organisation and co-ordination are the key success factors when multiple projects sharing the same resources are performed at the site
- An appropriate organisational structure of the decommissioning project should precisely define the roles of all the various parties, and establish authorities and responsibilities between various organisational units
- Project organisation and corporate/institutional organisation may overlap and introduce an ambiguity
- Explicit lines of communication among all interested parties has to be established
- In the absence of necessary regulations establish principles, processes and practices that should be used (i.e. Code of Practice)

SUMMARY & LESSONS LEARNED

- Start Cost Estimate immediately after a final shut down
- It is inevitable to have long term funds secure
- Provide appropriate human resource management
  - Retention of personnel with immediate personal knowledge of the facility is of major importance
  - Comprehensive management of change arrangements are vital - retaining adequate staff competency, maintaining the safety focus of the staff and sustaining the overall safety culture of the site
- Linking to other institutions carrying out decommissioning projects in order to exchange experiences and practices
- Co-operation with international organisations

The IAEA assistance is necessary

- To ensure safe and successful spent fuel transport from the RA storage pool to Russian Federation, which is a prerequisite for the actual start of decommissioning

- Enable international co-operation with other institutions carrying out decommissioning projects in order to exchange experiences and practices

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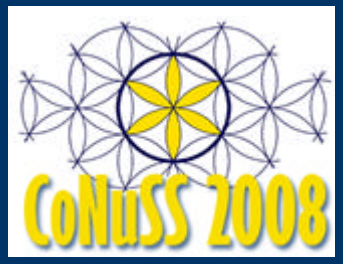
http://nss.vin.bg.ac.yu



http://nss.vin.bg.ac.yu/CoNuSS2008.htm

Thank You