Decommissioning Plan of VVR-S Research Reactor at Magurele –Bucharest-

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Outline

- Basics of decommissioning plan
- Presentation of decommissioning process;
- Radiological Characterization
- Wastes resulted from decommissioning

Basics of decommissioning plan

- IFIN-HH-operator and licensee, responsible for decommissioning VVR-S
- Ownership: state owned
- Principal characteristics of the research reactor VVR-S:
- -thermal neutrons research reactor, moderately, cooled and reflected by distilled water, fueled with enriched uranium 10% and then 36 %;

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-thermal power: 2,000 kW;
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- -total thermal (supply) energy-9.59 GWd;
- -flux of the thermal neutrons (n/cm-2.s) : 2x10-13
- -number of thermal column-1
- -number of horizontal experimental channels:9
- -number of vertical experimental channels: 16
- -number of biological channels: 3
- -number of circulating pumps: 5
- -number of heat exchangers: 2

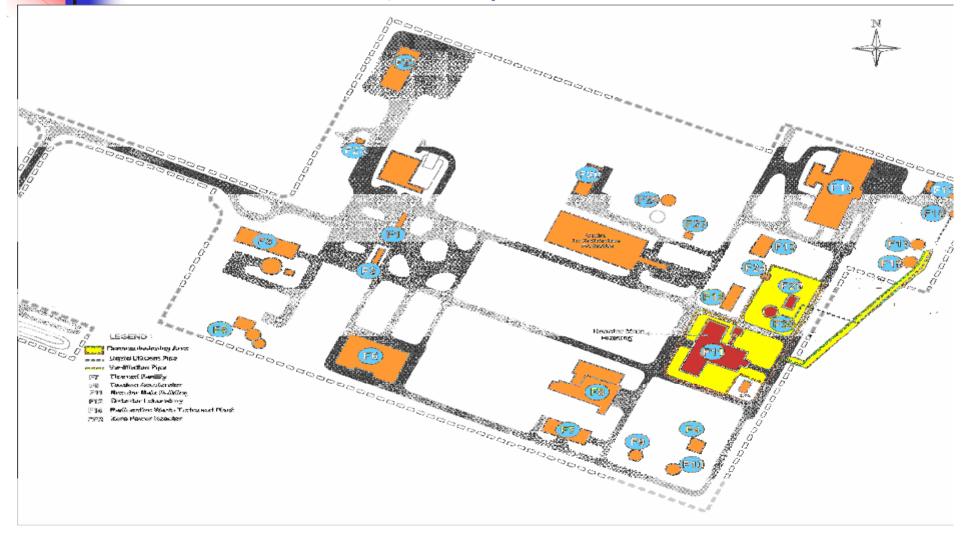
Basics of decommissioning plan (cont-1)

- VVR-S reactor is composed of the following systems and equipments:
- 1. Reactor block
- 2. Primary cooling system
- 3. Secondary cooling system
- 4. Instrumentation and control system
- 5. Distilled water system
- 6. Heating and ventilation system
- 7. Radioactive leakage drainage, overflow and collecting system
- 8. Central dose system
- 9. Electric system
- 10. Auxiliary equipments and systems
- -Hot cells
- -Hot cells decontamination installation
- -Storage for spent fuel elements
- Hoisting and transport equipment
- -Water supply system
- Industial and domestic drainage water system
- -Compressed-air and natural gas system.

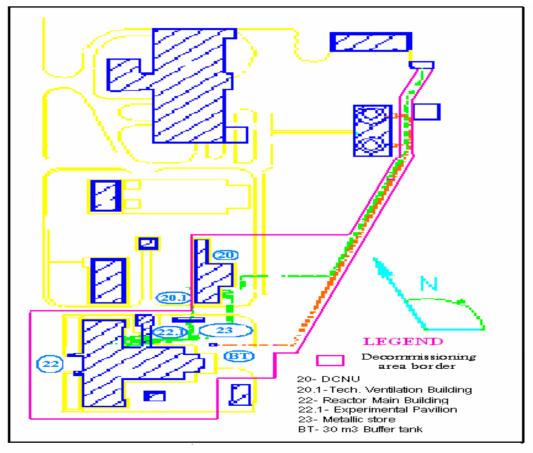
Basics of decommissioning plan (cont-2)

- References documents for elaboration of decommissioning plan: IAEA SRS-45/2005
- Immediate dismantling strategy for decommissioning of VVR-S
- Duration of decommissioning project: 12 y
- WBS- 7 phases, 5 work packages
- Radiation dose for release of VVR-S from regulatory control : 0.3 mSv/year
- End use: Industrial application, R&D in the material sciences, radiological facility-linear accelerator

Site of IFIN-HH , Group I

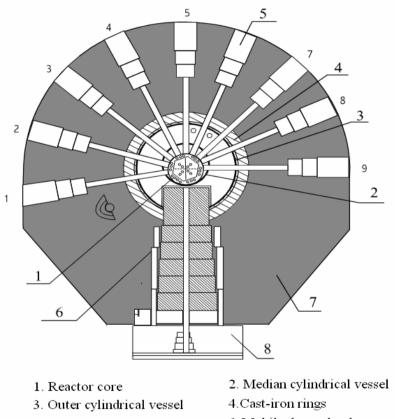


Borders of decommissioning



Decommissioning Area

Reactor Block VVR-S- Horizontal cross section

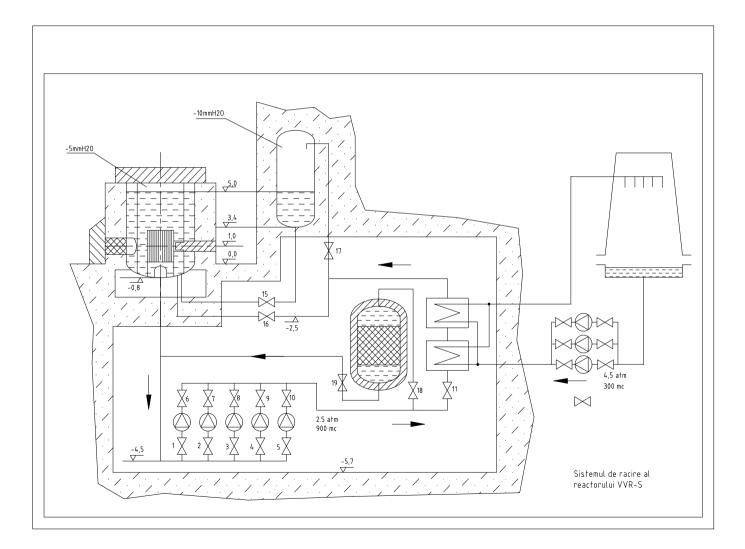


5. Beam tubes

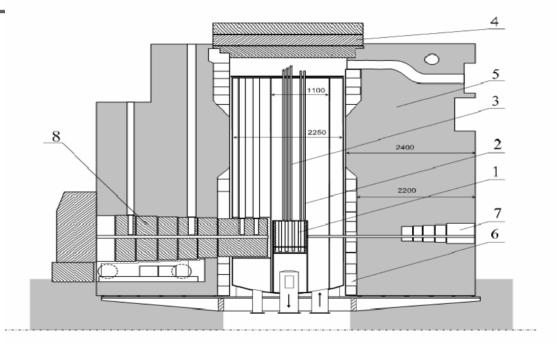
- 7. Concrete shieldind
- 6. Mobile thermal column8. Thermal column shielding

VVR-S REACTOR HORIZONTAL CROSS-SECTION

Cooling system of VVR-S



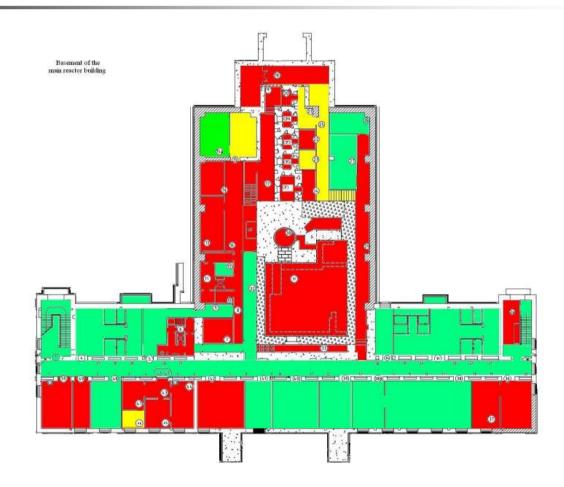
Reactor block vertical cross-section



- 1. Reactor core
- 3. Control rods channels
- 5. Concrete shielding
- 7. Horizontal channels
- 2. Vertical channels
- 4. Cast-iron rotating lids
- 6. Cast-iron shielding rings
- 8. Mobile thermal column

VVR-S REACTOR VERTICAL CROSS-SECTION

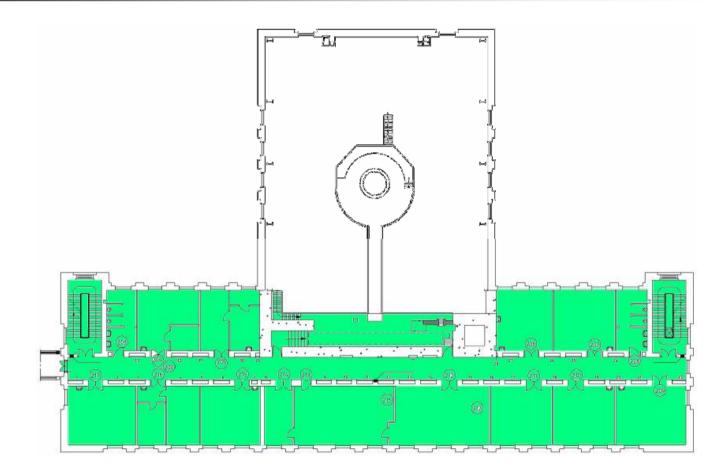
Rooms from basement contaminated three classes



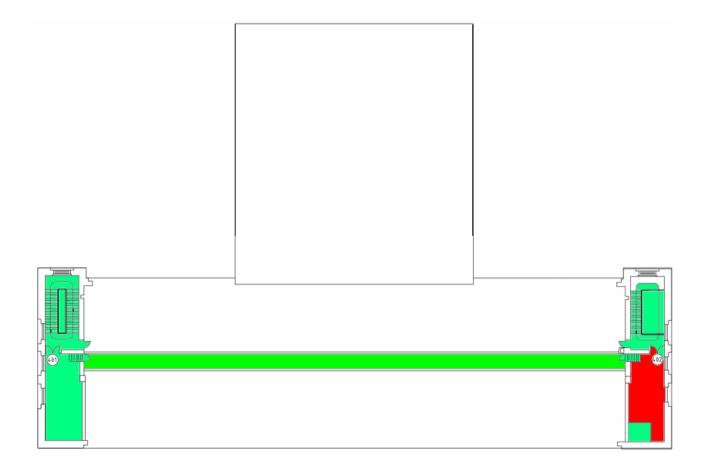
Ground floor of VVR-S



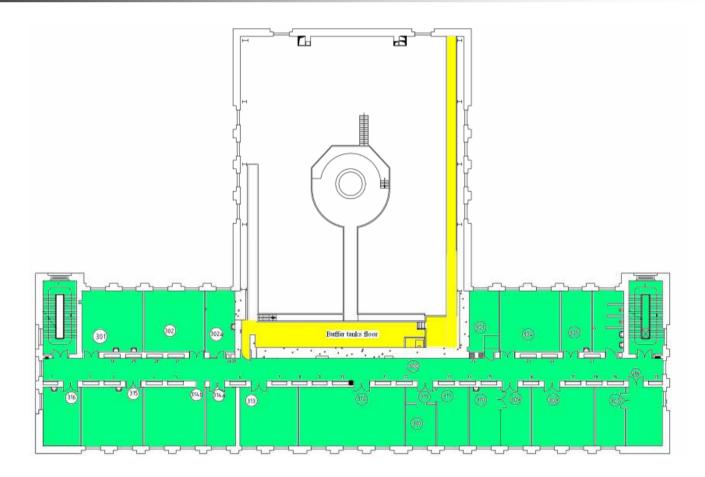
The first floor of VVR-S



The third floor of VVR-S



The second floor of VVR-S



Radioactive Inventory from Reactor Block

Material	Mass (Mg)	Activity (Bq)											
		Co-60	Fe-55	Ni-63	Ni-59	Eu-152	Eu-154	Eu-155	(Bq)				
Aluminum	4.78	2.06E+10	2.22E+11	3.40E+11	3.67E+09	0	7.00E+08	2.88E+08	5. 87E+11				
Cast iron	143	5.23E+09	2.10E+09	3.10E+08	0	0	0	0	7.64E+09				
Concrete	550	6.50E+08	2.9E+07	0	0	3.20E+08	0	0	1.00E+09				
Graphite	5.3	-		-	-	-	-	-	4. 00E+09				

Contamination of reactor systems

No Read		Reactor systems	Contamination level	Radionuclide	Remarks				
			$[Bq/cm^2]$	vector					
	1	Components of the reactor block	1001000	Co-60, Cs-137	Components of the reactor block are also highly activated.				
	2	Primary cooling circuit	101000	Co-60, Cs-137	Filter of the primary circuit is highly contaminated having a total activity of about 10 ⁹ Bq.				
	3	Secondary cooling circuit	0	-	This system is clean.				
	4	Ventilation system	01000	Co-60, Cs-137, Am-241	 -Laboratory ventilation system is contaminated with Am-241. - Technological ventilation system for hot cells is highly contaminated but the part connected to the other rooms is slightly contaminated. 				
	5	Radioactive leakage drainage, overflow and collecting system	01000	Co-60, Cs-137, Cs-134	This system is highly contaminated with isotopes from hot cells.				
	6	Instrumentation and control system	01000	Co-60, Cs-137	Control rods and ionization chambers are also highly activated.				
	7	Hot cells	inaccessible area	Co-60, Cs-134, Cs-137, Eu-152, Ir-192, Am-241	Hot cells are highly contaminated and contain inside a lot of radioactive sources.				
	8	Storage for spent fuel elements	inaccessible area	Cs-137	It contains spent fuel elements. Water is clean.				
	9	Other systems of the reactor	0	-	These systems are clean or very slightly contaminated.				

- Work Breakdown Structure
- Decommissioning Process in 7 phases during 12 years and 5 work packages

Work Breakdown Structure-

- Dismantling primary circuit up to reactor block (non activated parts)
- Dismantling core/absorber rods, drive assembly, core components, other internal components, thermal column, cooling pond
- Demolition of deaerator, hot cells, biological shield of reactor block
- Dismantling underground structure: secondary circuit, connected pipes between Reactor and effluents buffer (30 m3) tank
- Dismantling technological ventilation, active drainage, electrical for equipment used in decommissioning, air services
- Dismantling ancillary buildings (temporary structures for material storage)
- Final radiological survey for building and site

Work Breakdown Structure- Work Packages (WP)

- WP.1. Pre-decommissioning activities
- WP.2. Dismantling activities
- WP.3. Decontamination activities
- WP.4. Demolition activities
- WP.5. Radiological characterization, packaging, transportation, disposal, storage, free release, final survey, archiving

Work Packages (WP)

- WP.1. Pre-decommissioning activities
- Spent Nuclear Fuel management removal from site;
- Up-grading Radioactive Waste Treatment Plant and National Repository for Radioactive Waste;
- Commission the Radiological Characterization Laboratory & Free Release of materials for initial planning, packaging, storing, conditioning and un-conditioning release;
- Dose-meter system in site;
- Equipment for environmental protection and monitoring systems in/off site;

Work Packages (WP)

WP.1. Pre-decommissioning activities

- Commission mechanical workshop for cuting and light decontamination in Reactor Hall
- Funding mechanism;
- Elaboration of documentation: organizational, QMS, H&S, Safety & Security & Safeguards, Technical, Packages and Transport Specifications, Radiation Protection;
- Worker route in site;

Work Packages (WP)

WP.1. Pre-decommissioning activities

- Material route in/off site;
- Removal from site of equipment and materials resulted from research activities and radio-isotopes production;
- Drainage of water from primary & secondary circuit, cooling pond
- Authorization from regulatory bodies: in nuclear, environmental, industrial;
- Maintenances of SSC in transition period and during decommissioning;
- Training of workers, public relation plan, definition of stakeholders;

Work Packages (WP)

- WP.2. Dismantling activities
- Remove control/absorber rods, drive assembly, I&C system;
- Remove primary heat exchangers and piping, pumps, water purification system;
- Remove core components and internal vessels from reactor block;
- Remove control room equipment;
- Remove secondary circuit, buffer tank, pipes from active drainage, including underground part,
- Remove cooling pond
- Remove active drainage
- Remove ventilation system,

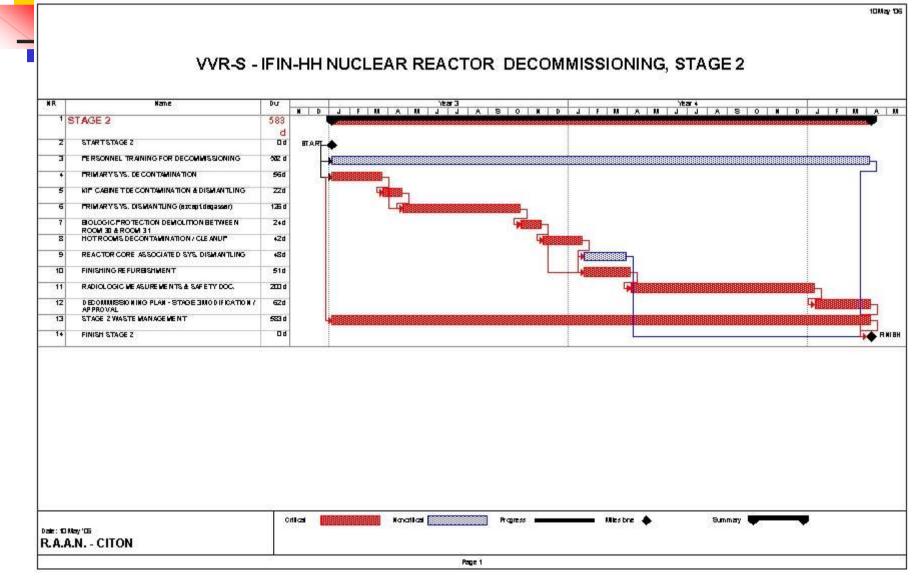
- Work Packages (WP)
- WP.3. Decontamination activities
- Decontamination of primary circuit (by washing with water and filtered in close circuit)
- Decontamination of liner from hot cells with dry methods
- Decontamination of walls, floors
- Decontamination of tools and equipment used in decommissioning
- Other large pieces will be transported in Radioactive Waste Treatment Plant for decontamination in special room

- Work Packages (WP)
- WP. 4. Demolition activities
- Demolition of biological shield from reactor block, hot cells, deaerator, stack
- WP.5. Radiological characterization, treatment, conditioning, packaging, transportation, disposal, storage, free release, final survey, archiving

Presentation of decommissioning

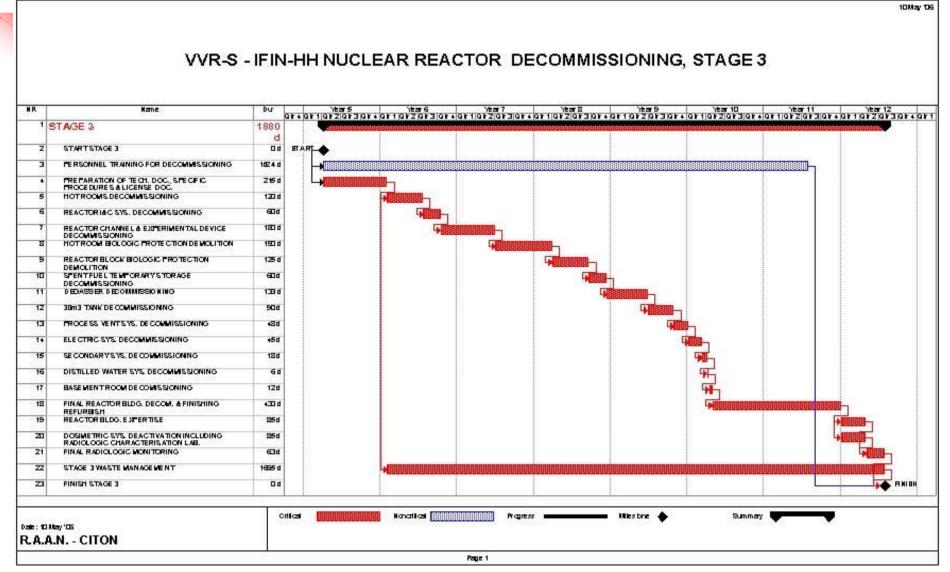
Drocess

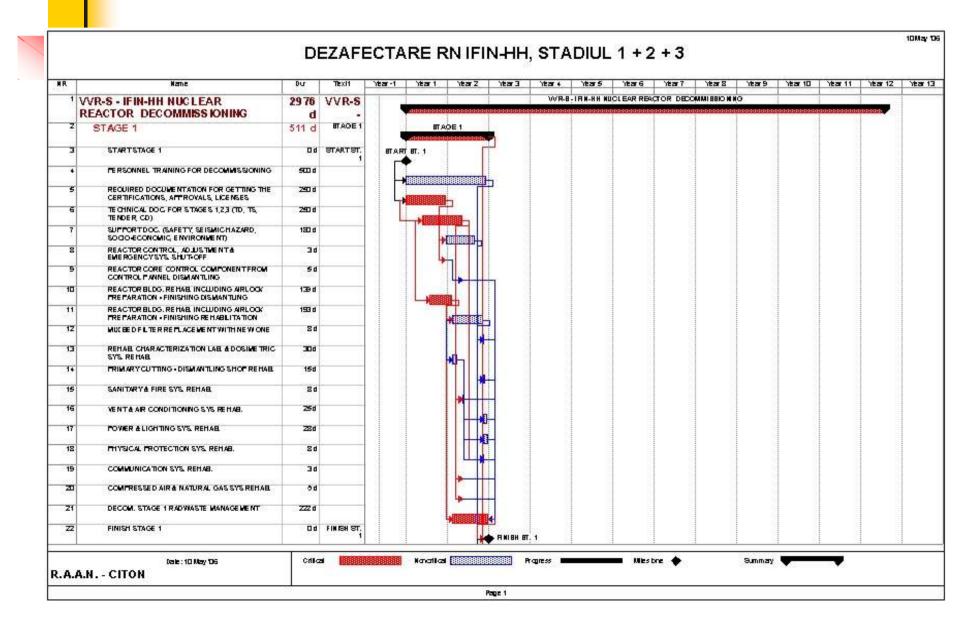
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6	FOWER & LIGHTING SYS. REHAB	28d	105.000 RO M	17 Nou 105	
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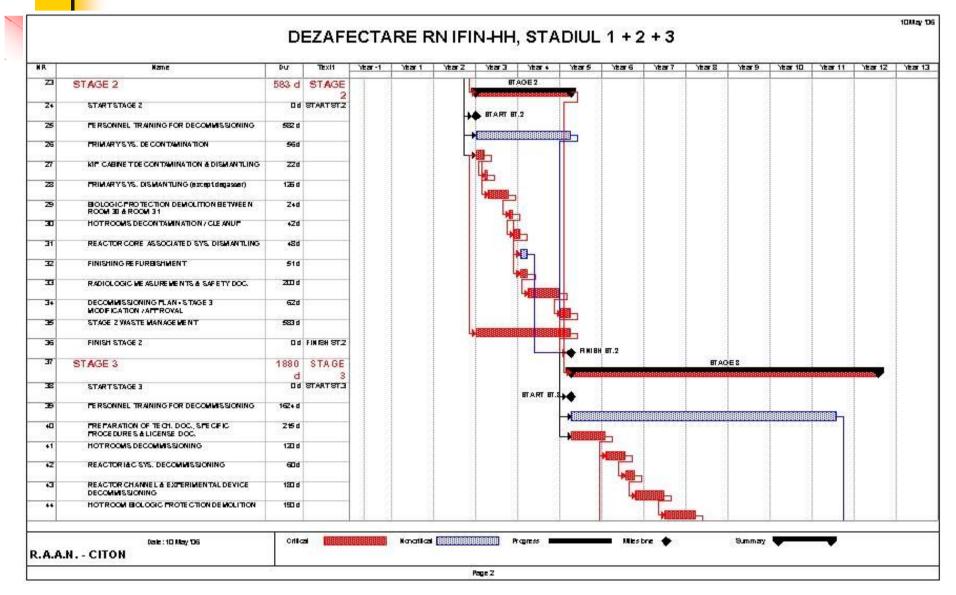


Presentation of decommissioning

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Wastes resulted from decommissioning

- 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