CURRENT TASKS OF THE DECOMMISSIONING PLANNING FOR THE KIEV'S RESEARCH REACTOR WWR-M

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The main nuclear installations in Ukraine

- WWER-440 (Rovno NPP)
- WWER-1000 (Zaporizhzhya NPP, Rovno NPP, South Ukraine NPP, Khmelnitsky NPP)
- РБМК-1000 (Chornobyl NPP)
- Research reactor (Nuclear Research Institute in Kiev, Sevastopol Nuclear Energy Institute)
- State special enterprises for RW management "Radon"
- Uranium mining enterprises

OVERVIEW OF THE REGULATORY FRAMEWORK

As a whole, the normative-legal basis of Ukraine is sufficient for the decision on present-day tasks connected with the provision of safety and protection of the personnel, population and environment at the decommissioning of NPPs and RRs in Ukraine. In this area the normative-legal basis is corresponding to the international practice, accounts the recommendations of IAEA, ICRP and other international organizations.

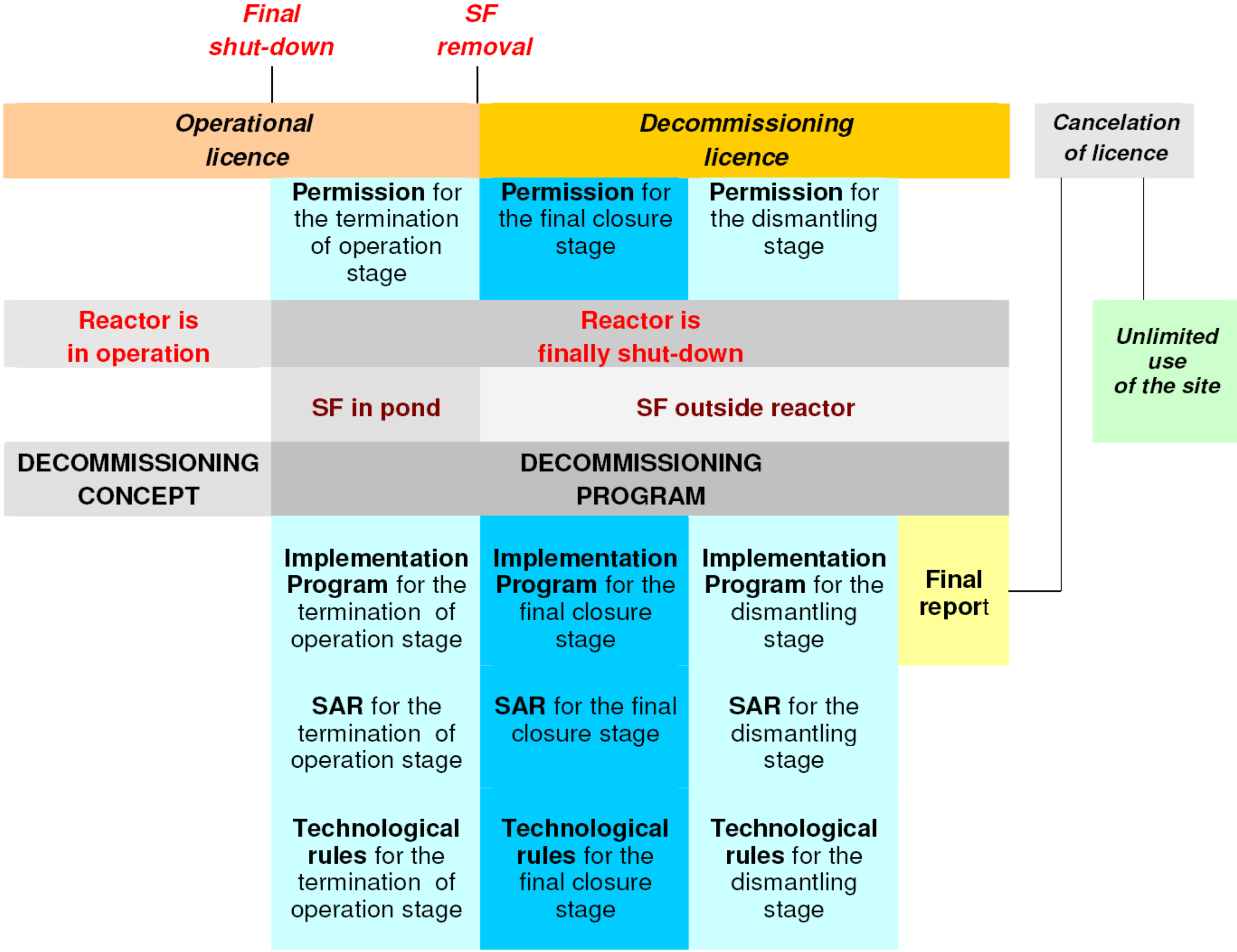
The definition of term “decommissioning”:

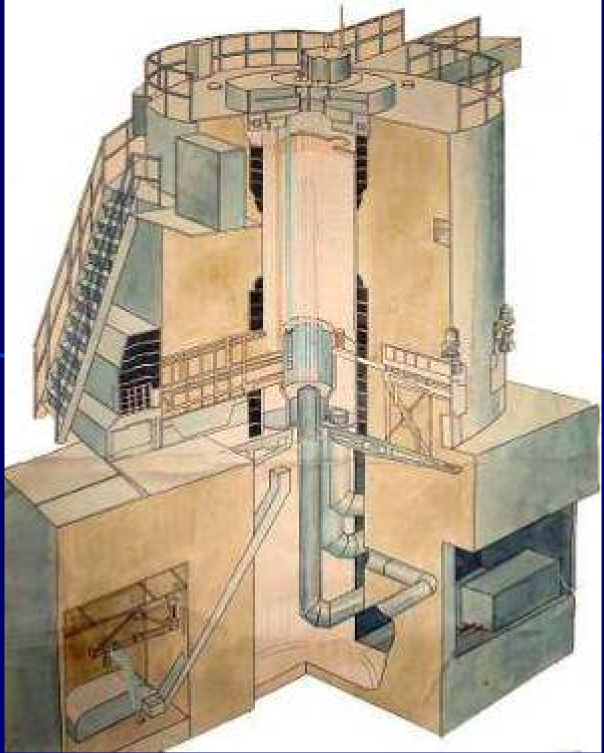
Decommissioning means such set of measures after nuclear fuel removal that excludes the operation of the facility in purposes for which it was constructed and provides personnel and the public safety and the environment security.

Following to this definition, the goal, scope and possible ways are determined:

- Decommissioning of the facility is undertaken for the excluding of the possibility of further use of the given facility with the purposes for which it was constructed.
- Decommissioning of the facility is undertaken for the achievement such site conditions that reduces maximally any restriction on the site use. It provides for:
  - stage-by-stage removal of the sources of ionizing radiation being subject to regulatory control;
  - abolishment of the restriction regime and reduction of radiation monitoring in the supervision zone and sanitary-protective zone of the facility.

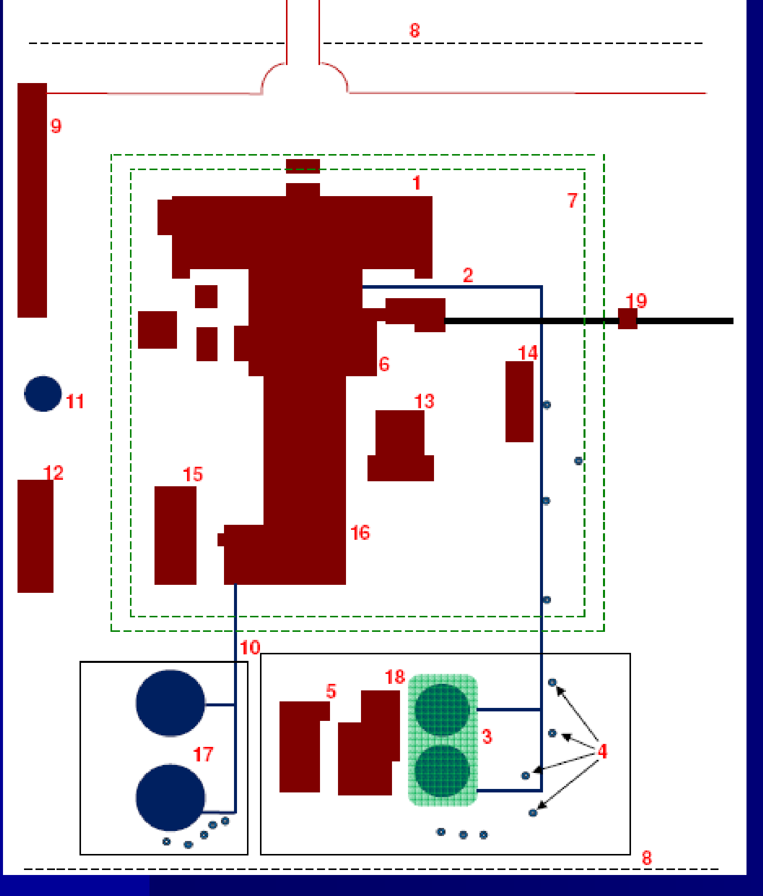
Normative Document NP 306.2.02/1/004-98 *"General Provisions on Safety Assurance of Decommissioning of NNPs and RRs"*





Current status of reactor

The WWR-M reactor is a heterogeneous water-moderated pool type research reactor operating with thermal neutrons at a power of 10 MW_{th}, giving a maximum neutron flux of 1.5×10^{14} $cm^{-2}s^{-1}$ at the core center.



Layout of the buildings and constructions on the reactor site:

1 – reactor building;
2 – reactor sewage system pipeline;
3 – reactor waste tanks;
4 - observation holes;
5 – workshop;
6 – tambour of reactor hall;
7 – physical protection fence;
8 – site wall;
9 - store building;
10 – hot cells sewage system pipeline;
11 - water-tower;
12 - cooling tower;
13 – ventilation center;
14 – gasholder;
15 – secondary circuit pump-house;
16 - hot cells building;
17 - hot cells waste tanks;
18 - evaporator installation;
19 – experimental hall on the horizontal channel

"*Strategic Plan for the use of research reactor WWR-M of the Institute for Nuclear Research*" was approved by the National Academy of Sciences of Ukraine in *July 2004*.

Plan determines the strategic goal as the *extension of the reactor operation till 2015*

Серія АВ

ЛІЦЕНЗІЯ

№ 483303

АРКУШ ЗМІН

до ліцензії ЕО № 000051

Зміна 4

2. Зміст п. 3.1.1 слід читати в редакції:

3. Зміст пункту 3.2.2 слід читати в редакції:

4. Зміст пункту 3.2.3 слід читати в редакції:

The term of operation was continued by the decree of the SNRCU's Board (*No 11 from 21 May 2009*) and then a new permission for the reactor operation will be issued:

- to continue the reactor operation till 31.12.2013;
- to convert the reactor on the stage "termination of operation" from 1.01.2014;
- in the case of the operator's decision concerning the reactor's further operation, to prepare and agreed with the SNCRU the possibilities and conditions of the reactor operation.

CURRENT STATUS OF DECOMMISSIONING PLANNING

Preparation for the further decommissioning of the Kiev's research reactor was started in the framework of the ***Decommissioning Concept*** issued in 2001.

This document contains a common decommissioning approach and measures, which must be detailed and updated with the goal of preparation of the justified decommissioning plan.

The next step of decommissioning planning is the development of the detailed ***Decommissioning Program***, which was elaborated during 2007-2009 and approved by the Regulatory Body decision from 4 November 2009.

This document determines and substantiates the main technical and organizational measures for the decommissioning preparation and implementation, the sequence of works and measures, necessary conditions for their execution and provision. Special attention is concentrated on the ***ecological safety*** of decommissioning due to the reactor location in the megapolis.

The most likely option will be the use of the reactor’s building with the “hot cells” as ***the separate laboratory for the development and application of radiation technologies***.

The variant of ***immediate dismantling*** was selected for the WWR-M reasoning based on the plans for the further site use with the removal of spent fuel and radwaste outside Kiev and site return for the unrestricted use.

In accordance with the preliminary estimations, the decommissioning timeframe will not exceed 6 years.

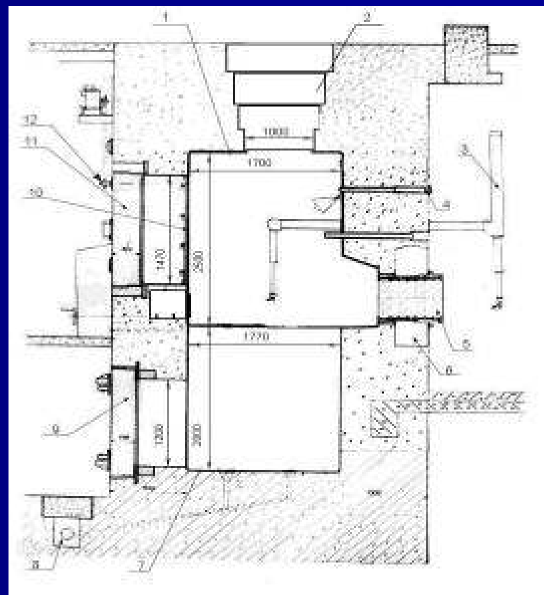
DECOMMISSIONING PROGRAM of the RESEARCH REACTOR WWR-M (2009)

Radiation Material Study Department

Available facilities:

- heavy hot cells allowing the investigations of samples with the activity up to 25000 Ci;
- light hot cells (up to 250 Ci).

The laboratories are fitted out with the remotely-operated equipment for the study of physical-mechanical characteristics of materials irradiated with the high neutron doses, surveillance specimens of the reactor vessel metals of the Ukrainian NPPs.



Radiation Material Study Department

INR has been appointed as the leading organization for the scientific support of the safe operation of the WWER-440 and WWER-1000 type reactor vessels.

Main directions of scientific activity:

- Determination of mechanisms of radiation damage of the solids, selection of the most advanced structural materials for nuclear reactor industry.
- Radiation material science aspects of operating reactors safety, investigation of the radiation embrittlement of the reactor vessel steels and determination of the WWER-1000 type reactor vessels safe operation lifetime in particular.

PRINCIPAL REACTOR SYSTEMS:

	SYSTEM	Complete dismantling	Utilization at the decommissioning	Utilization after decommissioning[a)]
1	Reactor vessel	+	-	-
2	Primary and secondary circuits	+	-	-
3	Water cleaning system (primary circuit)	+	-	-
4	Control rod system	+	-	-
5	Water supply system	+	-	-
6	Emergency cooling system	+	-	-
7	Electric power supply system	-	+	?
8	Special ventilation system	-	+	+
9	Radiation protection system	+	-	-
10	Radiation control system система	-	+	+
11	Special sewerage system	-	+	+
12	Fresh fuel storage	+	-	-
13	Spent fuel storage (CP-1)	+	-	-
14	Spent fuel storage (CP-2)	-	-	?
15	Experimental installations	+	-	-
16	“Hot-cells” (4 cells)	+	-	-
17	Fire protection system	-	+	+
18	Physical protection system	-	+	+
19	Loading tools (cranes)	-	+	+
20	Heat supply system	-	+	+

[a)] *in accordance with accepted decision for the utilization of the reactor building with the “hot-cells” as the separate laboratory (after the transfer of the main reactor building, the part of existing infrastructure and the auxiliary buildings to such laboratory)*

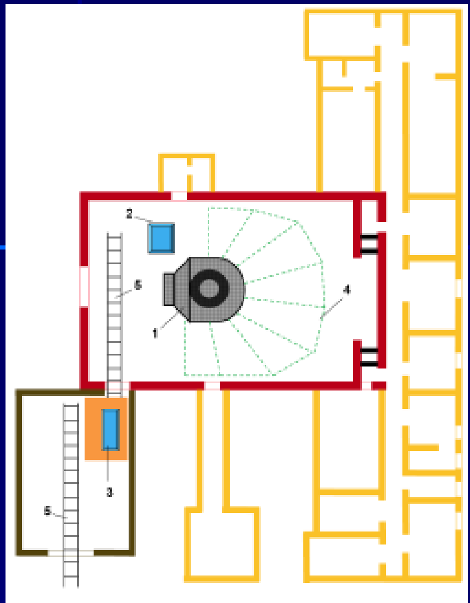
Activity for the preparation of decommissioning during the reactor operation

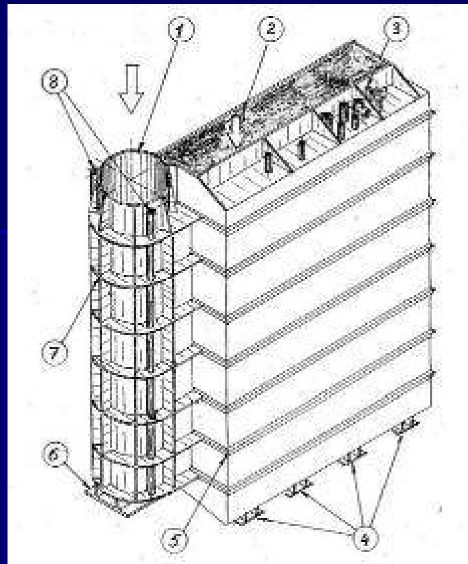
At the reactor operation it will be performed the set of works directed toward the preparation of decommissioning. The following measures are carried out permanently:

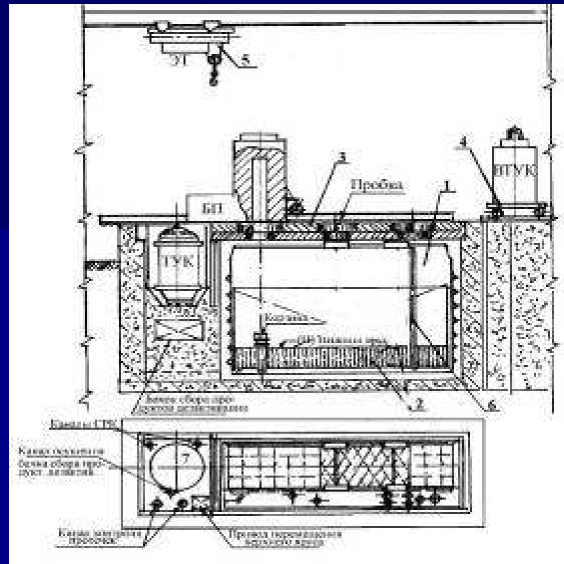
- classification, accounting and forecast of the radwaste volumes, which will be generated during the reactor operation and decommissioning;
- collection, processing and storage of information related to the buildings, the constructions and the reactor systems and elements, which will be required for the reactor decommissioning;
- works aimed on the preparation and removal of the spent nuclear fuel;
- gathering of the material and technical resources for the decommissioning;
- development of the decommissioning documentation;
- request and approval of the decommissioning license;
- public relations on the decommissioning problems.

Equipment type	*Main material*	*Weight (kg)*
REACTOR WWR-M		
1. Reactor vessel ∅2300×5705	CAB-1	3600
2. Beryllium reflector ∅920×570×500	beryllium	835
3. Thermal columns	steel, cast iron, graphite	15000
4. Thermal column rolling-off mechanism	steel	3884
5. Shieldingn with channels	steel, cast iron, lead	65000
6. Thermal column shield	steel, cast iron	30550
7. Deaerator ∅1620×5520	CAB-1, cast iron	4220
8. Distiller tanks 3200×2300×1500	steel 1X18H9T	1880×4=7520
9. Spent fuel storage 4000×2840×840	CAB-1, steel 1X18H9T	19000
	Total weight of materials (kg):	**149609**
PRIMARY CIRCUIT		
1. Main pipelines	steel 12X18H10T	6044
2. Circulation pump	steel 1X18H9T	837
3. Stop valves	steel 1X18H9T	5320
4. Heat-exchangers - 2 pieces	steel 12X18H10T	2×7694=15388
5. Cooling pipelines	steel 12X18H10T	1800
6. By-pass purification system	steel 12X18H10T	1337
7. Emergency cooling system	steel 12X18H10T	1700
	Total weight of materials (kg):	**32426**
SECONDARY CIRCUIT		
1. Main pipelines	steel 207	39222
2. Circulation pumps	steel, cast iron	773×3=2320
3. Stop valves	cast iron	7659
	Total weight of materials (kg):	**49201**
AUXILIARY SYSTEMS		
1. Special sewage system	steel 1X18H9T	12748
2. Reservoir - 2 pieces	steel 1X18H9T	22576
3. Ventilation chimney	brick	23580
4. External ventilation airways	steel 1X18H9T	19450
5. Ventilation unit of special ventilation system – 8 pieces	steel 3	3200
	Total weight of materials (kg):	**81554**
	TOTAL (kg):	**312790**

WORKS CARRIED OUT DURING 2009 - new SFSF



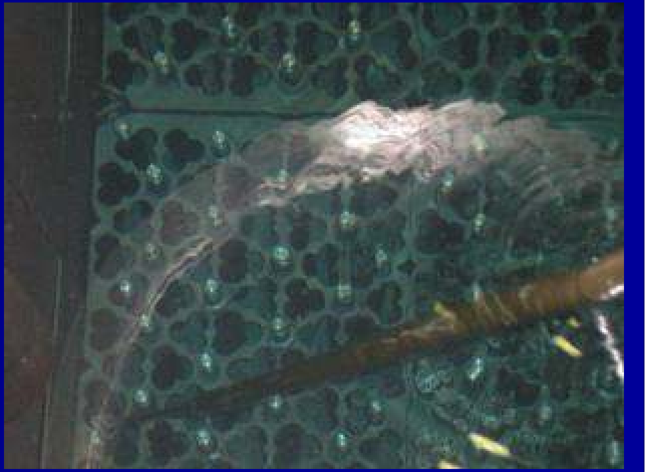




SF reloading operations (November 2009)





SF shipment (May 2010)

AVAILABLE DECOMMISSIONING EXPERIENCE

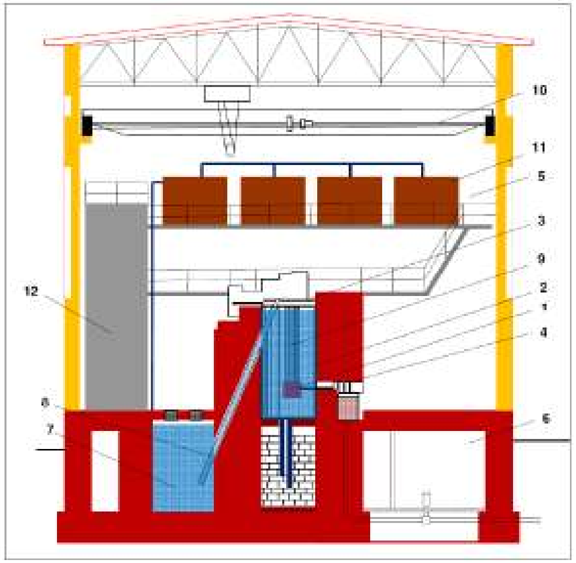


Fig.6. Vertical cross-section of the reactor building (axes: spent fuel storage tank – center of core – reactor hall - primary circuit pump house) . Legend: 1 – reactor core; 2 – reactor vessel; 3 – reactor cover plate; 4 – gate of horizontal experimental channel; 5 – reactor hall (height of 16.1 m); 6 – pump house of primary circuit; 7 – cooling pond; 8 – transport channel for spent fuel; 9 – control rod channels and vertical experimental channels; 10 - bridge crane (lifting power of 10 t); 11 – tanks with the reserve of distilled water; 12 – scrubber.

The exchange of heat-exchangers (4×95=380 м^2 → 2×329=658 м^2) and pipe-line segments.

Sequence:

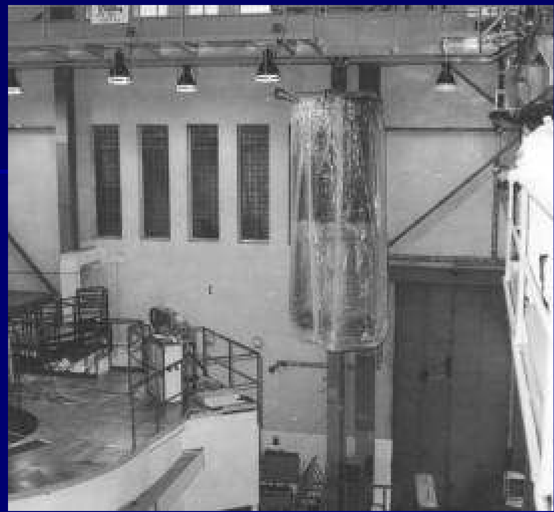
- the reactor core reloading and removal of heat-carrier to the special drainage system;
- the dismantling of experimental equipment at the horizontal channels located above the primary circuit pump-house;
- the dismantling of covering plates in the primary circuit pump-house;
- the dismantling of equipment and pipelines, which are a subject of replacement in the primary circuit pump-house;
- the removal of dismantled equipment from the primary circuit pump-house and reactor hall by means of load-lifting mechanisms (crane 10 t; telpher 10 t);
- the decontamination of external surfaces of the dismantled equipment and pipelines; packing into protective film;
- the loading on special transport car in the reactor hall tambour and transportation to the disposal place.

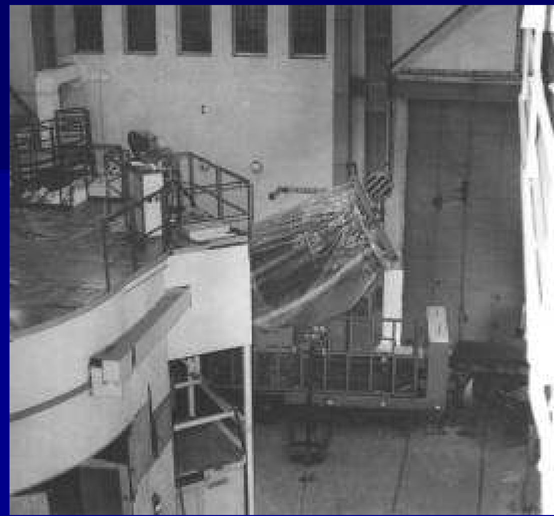
Total amount of removed contaminated equipment:

- heat-exchanger 4 items – 5000 kg×4 = 20000 kg
- pipelines - Ø 325×12 = 3500 kg

Altogether: 23500 kg

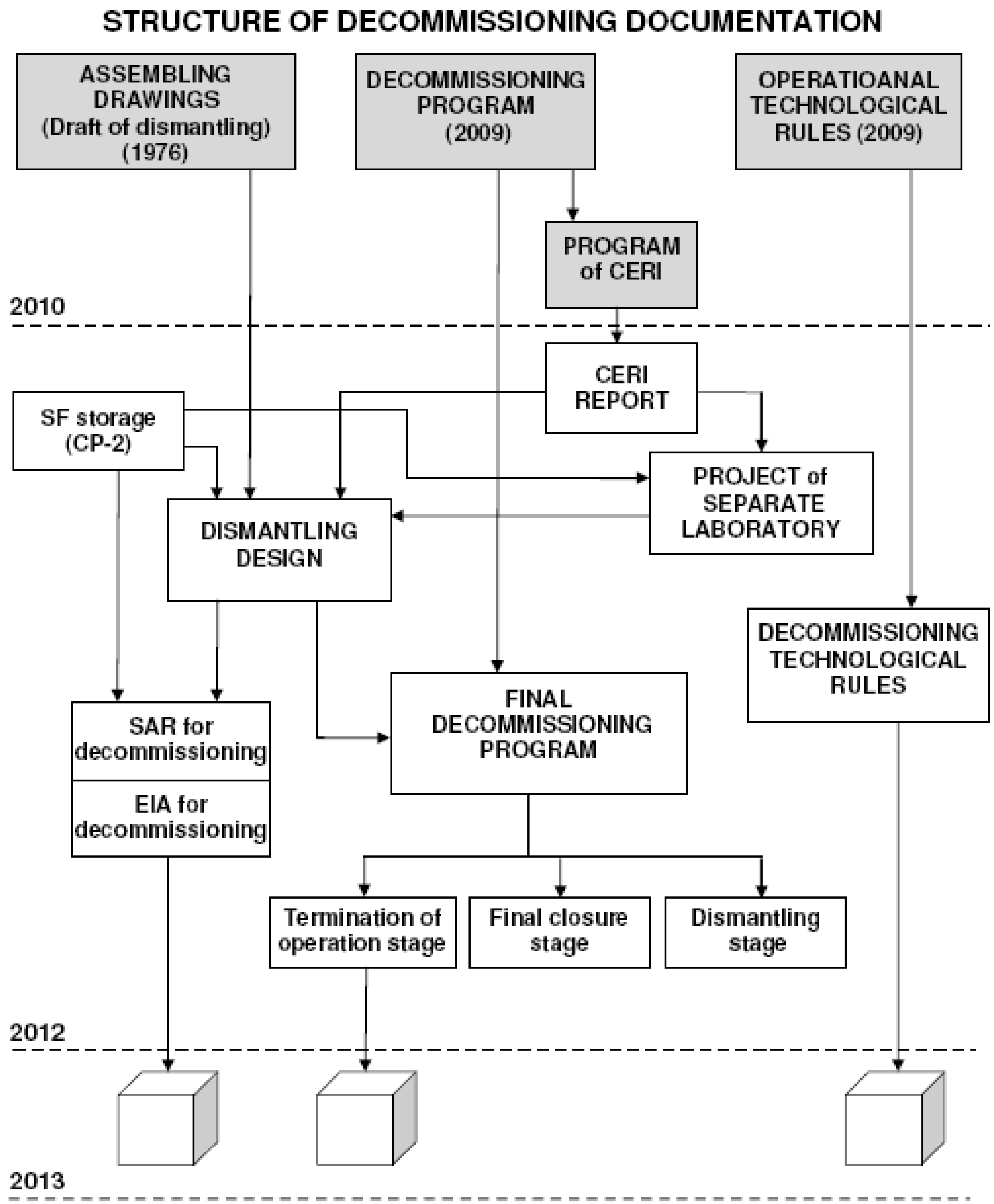
Removal of the reactor vessel (Rez, 1989; Rossendorf 2002)





FURTHER PLANS AND EXPECTED DIFFICULTIES

- removal of HEU fuel (*completed in May 2010*);
- elaboration and partial implementation of the **CERI** Program (*Complex engineering and radiation inspection = Radiological survey*);
- sequence of dismantling procedures (*inverted sequence of assembling*); dismantling design:
  - reactor internals;
  - reactor vessel;
  - concrete biological shield;
  - pump-house and primary circuit;
- SAR and EIA for decommissioning stages;
- cost estimations for sub-options



STRUCTURE OF DECOMMISSIONING DOCUMENTATION
ASSEMBLING DRAWINGS (Draft of dismantling) (1976)
DECOMMISSIONING PROGRAM (2009)
OPERATIOANAL TECHNOLOGICAL RULES (2009)
PROGRAM of CERI
2010
CERI REPORT
SF storage (CP-2)
PROJECT of SEPARATE LABORATORY
DISMANTLING DESIGN
DECOMMISSIONING TECHNOLOGICAL RULES
FINAL DECOMMISSIONING PROGRAM
SAR for decommissioning
EIA for decommissioning
Termination of operation stage
Final closure stage
Dismantling stage
2012
2013

Summary

- Further reactor operation is assumed now as the main task. Operation license will be in force till 2014.
- ***Decommissioning Program*** was approved by Regulatory Body at the end of 2009. This DP is considered as the intermediate stage of decommissioning planning.
- Development of necessary decommissioning documents and detail time schedule is in progress now. Prioritisation for such development is established.

AVAILABLE PUBLICATIONS

1) Yu.N.Lobach, E.V. Svarichevskaya, V.V.Trishin
Peculiarities of the environmental impact assessment at the decommissioning of the research reactor WWR-M
Nuclear and radiation safety, 11, No3 (2008) p.29-34

2) Yu.N.Lobach, T.G.Ludanova, M.V.Lysenko, V.N.Makarovsky, V.N.Shevel
Preparation for Decommissioning of WWR-M
Proceedings of the Int. Conf. “Decommissioning Challenges: an Industrial Reality?“,Sept. 28 to Oct.2, 2008, Avignon, ref.008

3) Yu.N.Lobach
Decommissioning planning for the Kiev’s research reactor WWR-M,
in **IAEA-TECDOC-1602** Innovative and adaptive technologies in decommissioning of nuclear facilities, 2008, p.251-266

4) Yu.N.Lobach, V.N.Makarovsky, V.N.Shevel
Radwaste management at the decommissioning of the WWR-M reactor
Proceedings of the 10th Int.Conference “Problems of the radioactive waste management in Ukraine”, 1-3 Oct. 2008, Kyiv, p.21-25

5) Yu.N.Lobach, T.G.Ludanova, M.V.Lysenko, V.N.Makarovsky, V.N.Shevel
Principal provisions of the decommissioning program for the WWR-M reactor
Proceedings of the 2nd Int. Conf.”Current Problems in Nuclear Physics and Atomic Energy", 9-15 June, 2008, Kyiv, p.670-673

6) Yu.N.Lobach, V.N.Shevel
Radiation protection tasks on the Kiev’s research reactor WWR-M
Nuclear technology and radiation protection, 24, No2 (2009) p.145-151

7) Yu.N.Lobach, M.V.Lysenko, V.N.Makarovsky
Substantiation of the decommissioning strategy selection for the research nuclear reactor WWR-M
Nuclear and radiation safety, 12, No3 (2009) p.46-51


THANK YOU !