

I- Graphite Programme at INPP progress

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NGKB

I- Graphite Programme at INPP

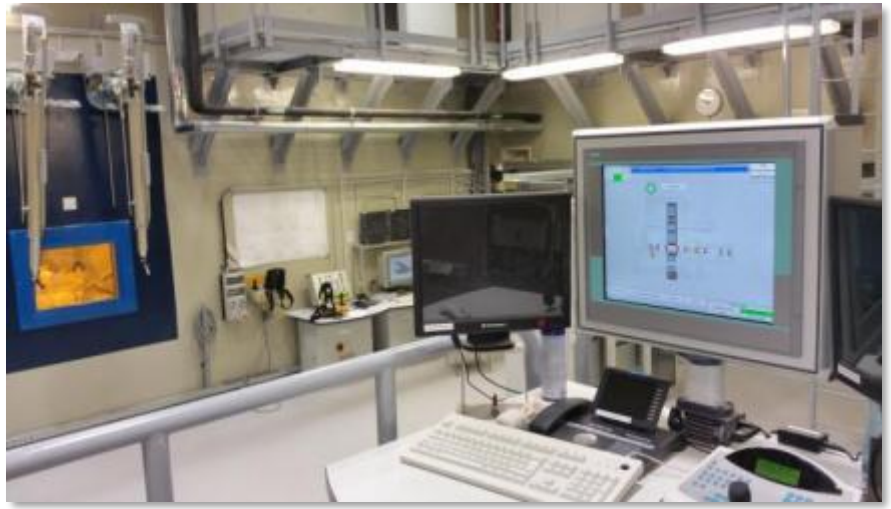
- Operational waste- Rings and sleeves
- Rings and sleeves R-1
- New project: Reactor dismantling and graphite storage
- Progress in waste management and characterization

B2/3/4 - Solid Waste Management & Storage Facility

B-3/4 “Hot Trials”









Operational waste of graphite

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view of intact (before removal) and crushed (after removal) graphite rings and sleeves of CPS channel



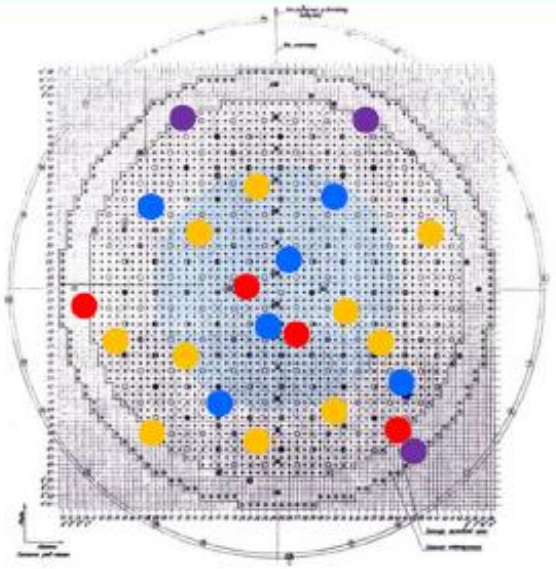


Water uptake (hydrophobic property)

The water uptake measurements were performed at the Ignalina NPP [12]. The irradiated graphite ring taken from TC of unit 1 was divided into 5 pieces and each put into desalted water for a period of 19–428 hours (1st piece for 19 h, 2nd piece for 115 h, 3rd piece for 139 h, 4th piece for 259 h and 5th piece for 428 h). The humidity of all samples just after the withdrawal was in the range of 3.2–4.3 %. After one day (24 h) of keeping the samples in open air atmosphere after the withdrawal, the humidity went out and did not changed noticeably during the rest of the keeping time. Therefore it is concluded, that the water uptake of irradiated GRP-2-125 graphite is insignificant, i.e. *the water does not enters deep into the graphite volume during the analysed period of immersion.*

Unit 2 graphite radiological characterization (2018-2019)

- review of historical information (mainly operational regimes)
- preparation of the sampling plan based on proven Unit 1 approach (2011-2013)
- Gaining access by channels removal
- performance of in situ measurements, sampling, laboratory analyses
- review and evaluation of the data obtained (ɣ-nuclides content)
- Analysis of “difficult to measure nuclides” concentration for Unit 2 graphite – under development. Target date – 2020.
- Comparison of radiological data of Unit 1 and Unit 2 features to estimate similarities/differences/planning for dismantling and waste management



- Top-to-bottom graphite sampling after Fuel Channels retrieval
- Top-to-bottom graphite sampling after Control and Protection Channels retrieval
- Locations for additional graphite sampling in future (if required)
- Locations of Reflector Cooling Channels retrieval





Unit 2 graphite radiological characterization (2018-2019)

Samples of Unit 2 graphite rings and sleeves are under laboratory measurements and analysis, forecast characterization report is drafted.

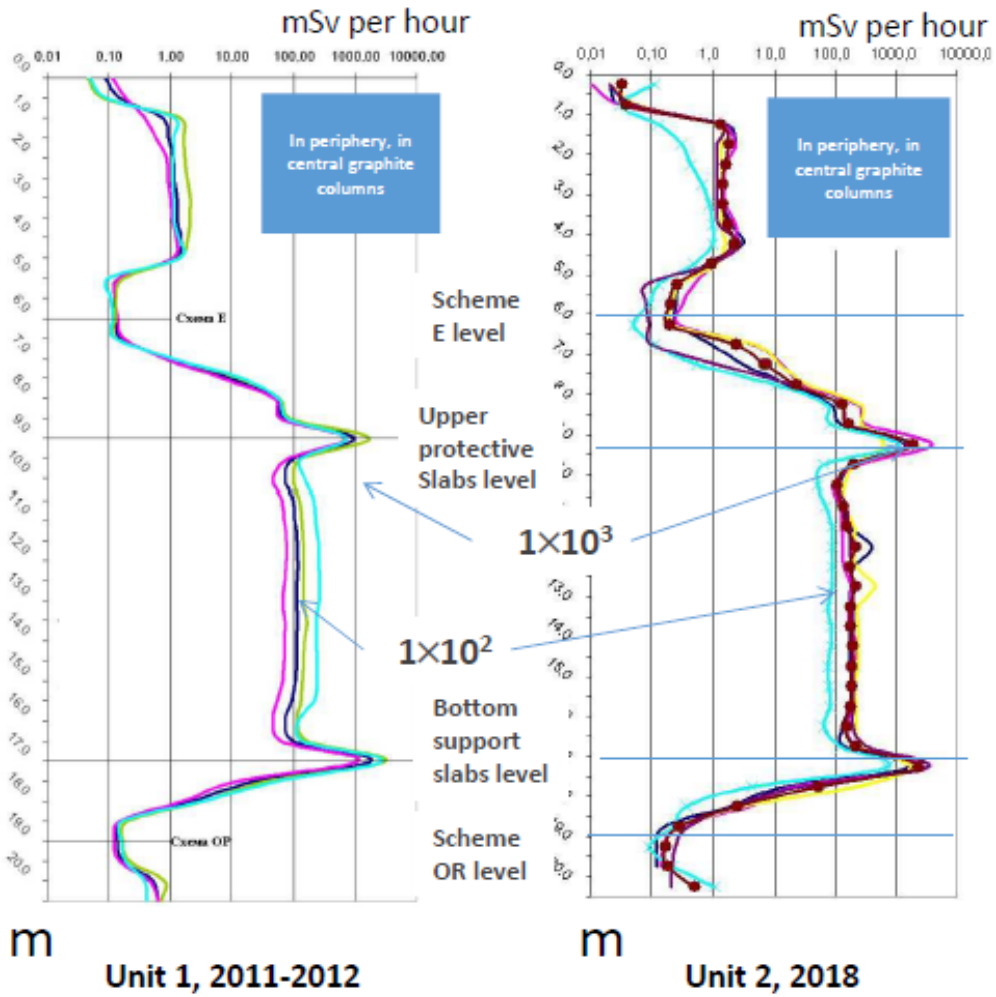
Samples of Unit 2 graphite bricks were measured, forecast characterization report was issued in 2019.

Parameters (after ~ 10 years after Reactor Final Shutdown)	Graphite stack of Unit 1 (in operation from 1983-2004)	Graphite stack of Unit 2 (in operation from 1987-2009)
Number of sampled graphite columns	18	14
Number of taken core samples	169	207
Co-60 mean activity, Bq/kg	1.94×10^7	2.31×10^7
Nb-94 mean activity, Bq/kg	2.02×10^4	1.24×10^4
Ba-133 mean activity, Bq/kg	1.03×10^6	9.15×10^5
Cs-134 mean activity, Bq/kg	2.68×10^5	1.70×10^5
Cs-137 mean activity, Bq/kg	2.03×10^5	2.19×10^5
Eu-154 mean activity, Bq/kg	1.09×10^6	5.48×10^5
Eu-155 mean activity, Bq/kg	7.82×10^5	3.50×10^5

Comparative measurements of Unit 1 and Unit 2 characteristics (in addition to i-graphite sampling)

Dose rates scanning of reactor core (without spent fuel):

- Level 0 = level of Central Hall floor +25.200;
- "top-to-bottom" scanning inside graphite columns after several channels' retrieval;
- Approx. 9 years after RFS of Reactors;
- Peak dose rates levels correlates with main steel components layout.
- Cumulative dose rate measurement
- Measurements are important to remove upper protective slabs and bottom support slabs of graphite stacks



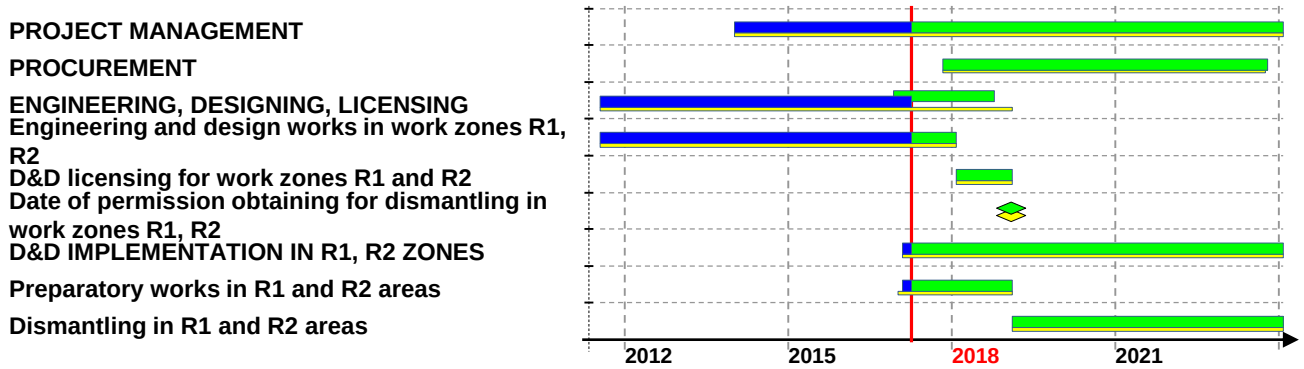
New project: Reactor dismantling and graphite storage – R1 and R2 areas

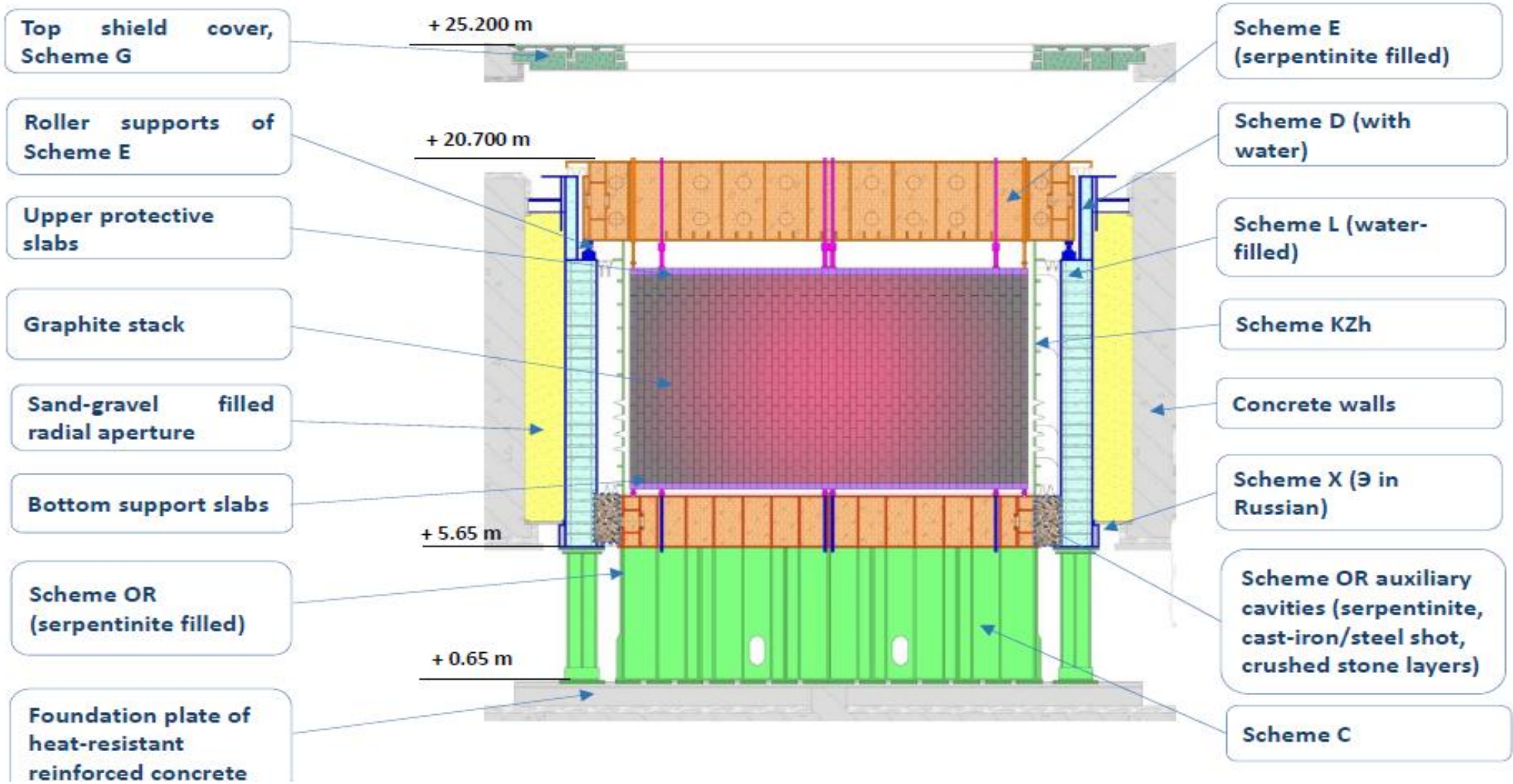
On February 2017 project 2101 (UP01) was divided into two independent projects: 2101 (scope: R1 and R2 areas) and 2103 (scope: R3 area).

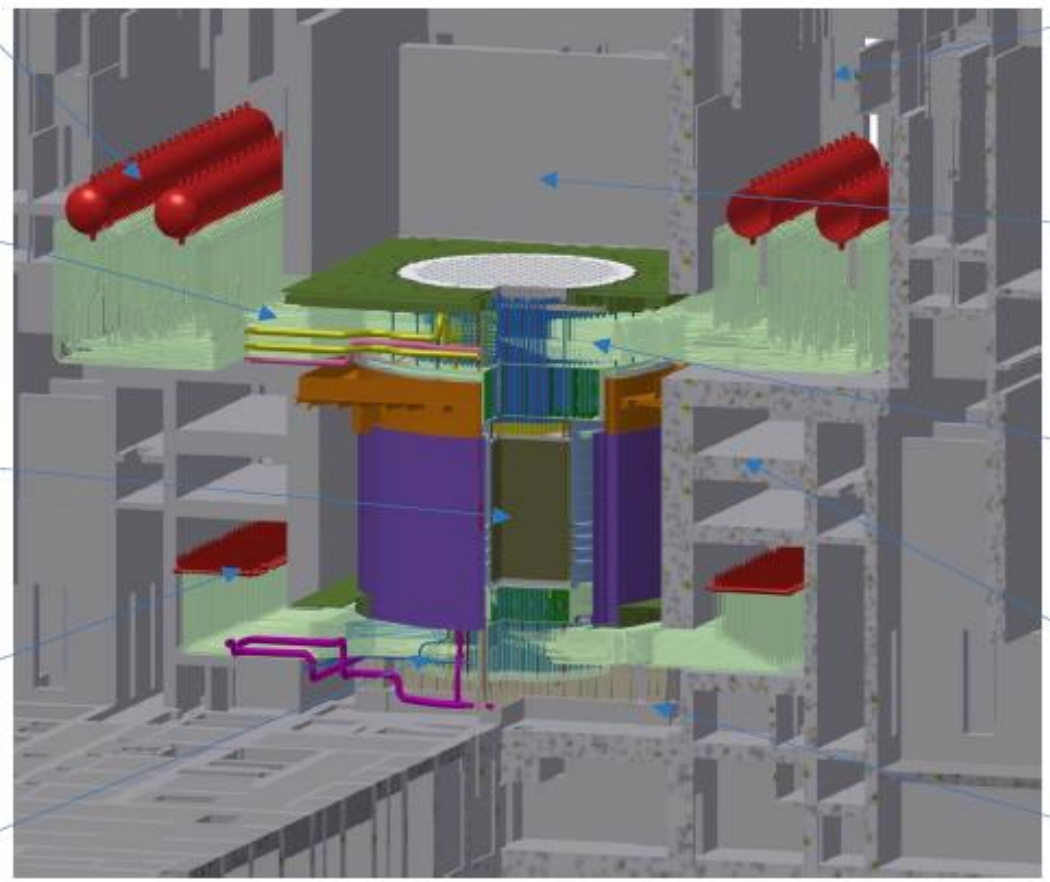
The project was divided for the purpose of more efficient UP01 project management.

Recent progress for R1 and R2 areas:

- Engineering and design works (TD & SAR) are ongoing - about 83%
- The existing technological solutions are being analyzed
- Completion of engineering and design activities in R1, R2 areas –
- Start of preparatory works in R1 and R2 areas
- SAR of build. 158/2 for temporary storage of graphite waste (sleeves and rings) -prepare
- **Next steps:**
- Licensing documents (TD & SAR) submission to VATESI - **February 2018**
- VATESI approval of TD & SAR and start of D&D – **December 2019**




Top shield cover, Scheme G
Roller supports of Scheme E
Upper protective slabs
Graphite stack
Sand-gravel filled radial aperture
Bottom support slabs
Scheme OR (serpentinite filled)
Foundation plate of heat-resistant reinforced concrete
+ 25.200 m
+ 20.700 m
+ 5.65 m
+ 0.65 m
Scheme E (serpentinite filled)
Scheme D (with water)
Scheme L (water-filled)
Scheme KZh
Concrete walls
Scheme X (Э in Russian)
Scheme OR auxiliary cavities (serpentinite, cast-iron/steel shot, crushed stone layers)
Scheme C


Drum separators
Upper pipeline network
Zone R3 with reactor core
Group Distributer Headers
Lower pipeline network
Drum separators compartments
Central Hall compartment
Upper reactor premises
Side premises
Lower reactor premises

Planned Tasks for R3 Optioneering , Concept Design and EIAR development

The activities in the project are subdivided into the following tasks under a single contracted:

Task 1: Development and submittal of contract implementation methodology;

Task 2: Optioneering and optimal solution.

Task 3: Conceptual design and Gap Analysis development;

Task 4: Environmental Impact Assessment Report (EIAR) development;

Task 5: Support to INPP during coordinating Tasks outputs with the regulatory bodies and financial stakeholders; during EIAR national approval and under Espoo convention.

Optioneering

1. **Gaining access**
2. **Dismantling/retrieval**
3. **Processing/packaging**
4. **Dispatch**
5. **Reactor Waste Interim Storage Facility (RWISF)**

- **Option 2.1: Techniques identified by INPP**

(1) Irradiated graphite capture/retrieval (in-air, limited crushing)

(a) brick-by-brick; (b) multi-brick; (c) column-by-column

(2) Steel cutting/retrieval

Cutting: (a) mechanical cutting; (b) thermal cutting; (c) alternative cutting

Retrieval: (a) final cutting *in-situ*; (b) pre-cutting and retrieval as large items

(3) Solid fillings

(a) Suction; (b) mechanical retrieval ; (c) solidification and cutting

(4) Water filling

Discharge by: (a) top-installed pump; (b) bottom-installed drain.

- **Option 2.2: Techniques identified by the consultant**
- **Option 2.3: Combination of fit-for-purpose Option 2.1 and 2.2.**

New project: Reactor R3 area dismantling and graphite storage

Recent progress for R3 area:

- Preparation FICHE and Technical Specification
- Completion of FICHE
- Completion of Technical specification development
- R3 D&D designing development by the Contractor – tendering
- VATESI approval of TD & SAR and start of D&D - **November 2023**





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