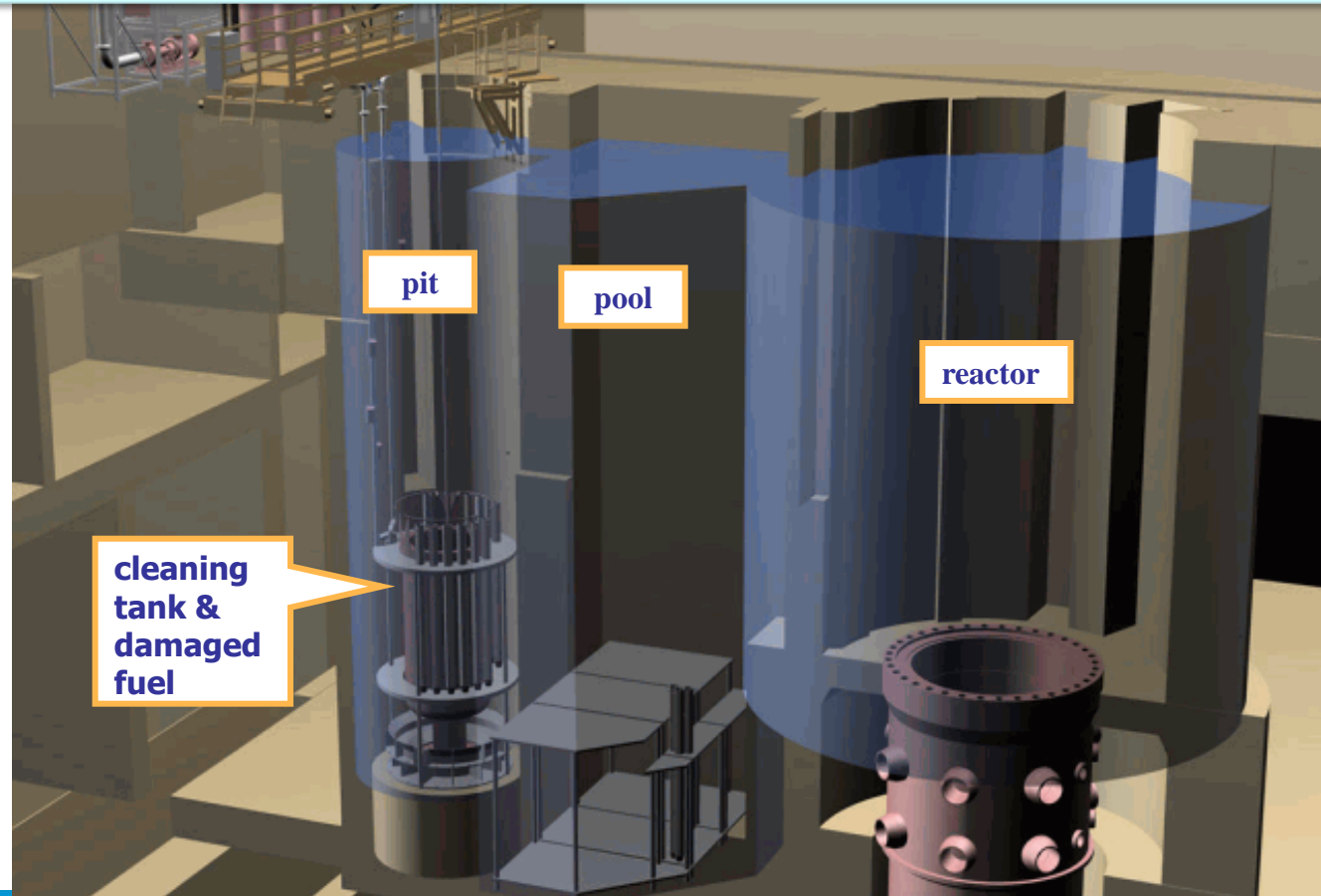
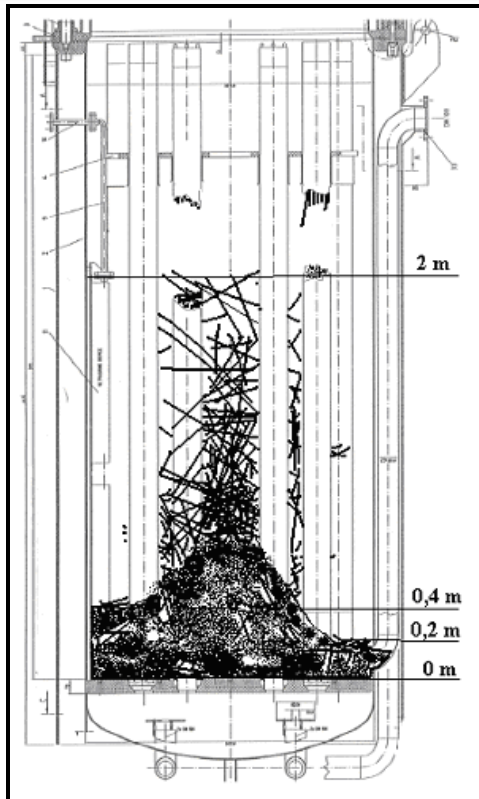


Shipment of the encapsulated fuel from Paks Nuclear Power Plant to Russia for reprocessing



**Larisa Szőke, head of Nuclear Fuel Section, „PAKS” NPP
Moscow, «ATOMEXPO 2015» 2015.06.03.**

- In 2002 the Units 1-3 were operated at lower power (the coolant flow rate had decreased due to magnetite deposits on the FA).
- Paks NPP made the decision to clean up the FA from the deposits during an annual outage.
- In April 2003 in course of cleaning of the fuel assemblies in a specially designed and manufactured cleaning tank, located in pit No. 1 of Unit 2 of Paks NPP, violation of the cooling regime took place with consequence of damage of the fuel assemblies





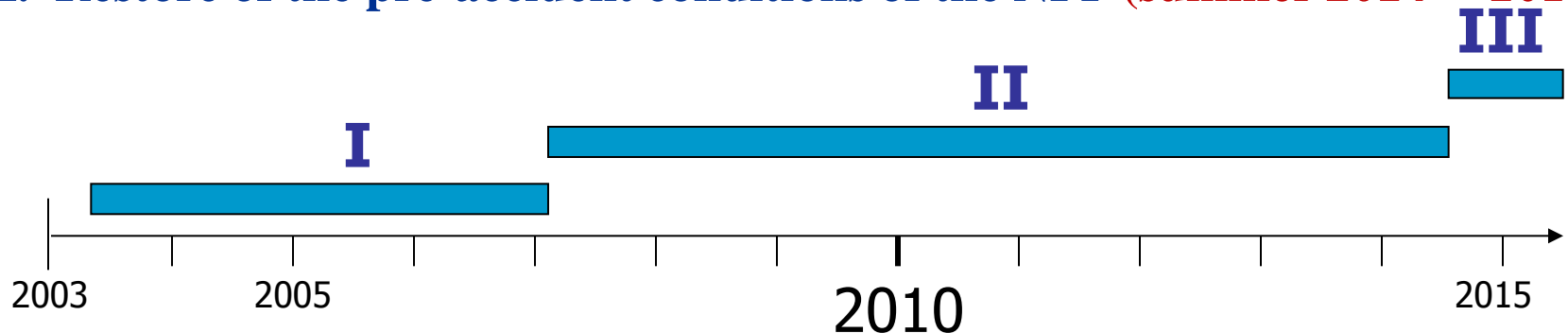
I. Recovery phase (April 2003 – beginning of 2007)

- Cause of an accident, initial conditions of the fuel and pit,
- Stabilizing, data management and analyses,
- Preparation phase of the recovery (design of equipment and tools, developing of technology),
- Fuel removal to special canisters, removal of encapsulated fuel to the spent fuel storage pool.

II. Long-term storage and management in NPP (beginning of 2007– summer of 2014)

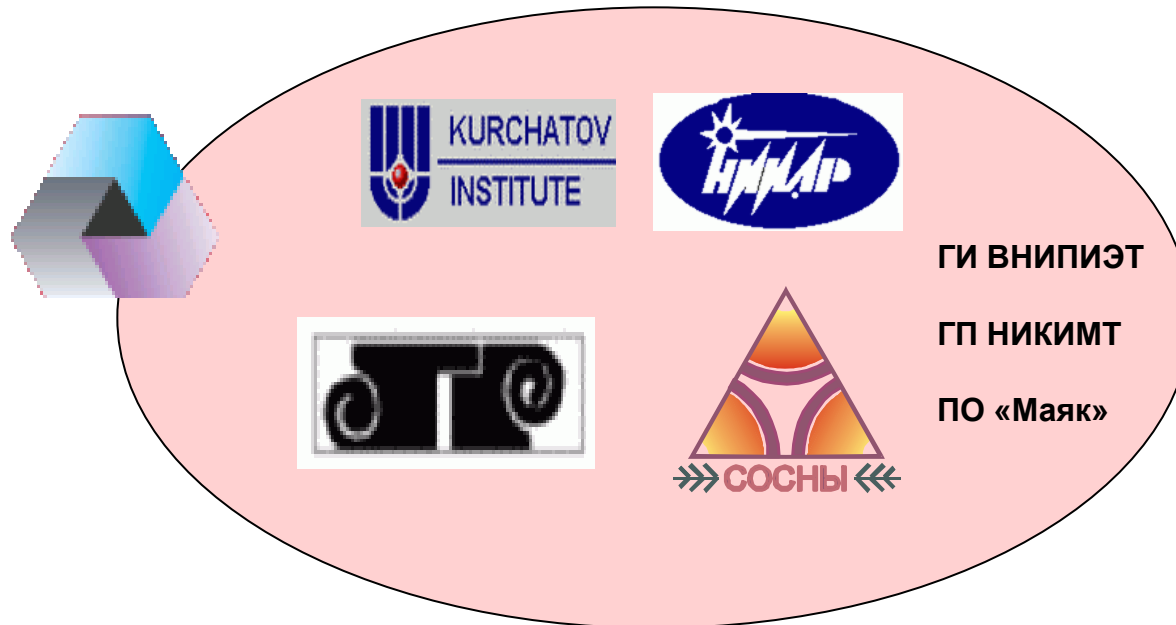
- Storage of encapsulated fuel in the spent fuel storage pool (monitoring of the canisters and the pool),
- Substantiation of the storage during more than 5 years,
- Substantiation of the transportation, elaboration and substantiation of the technology of drying and hermetical sealing of the canisters,
- Licensing works, designing and manufacturing of equipment,
- Concluding of contracts,
- Implementation of drying and sealing,
- Shipment of the encapsulated fuel to PO «Mayak».

•III. Restore of the pre-accident conditions of the NPP (summer 2014 – 2015 г.)



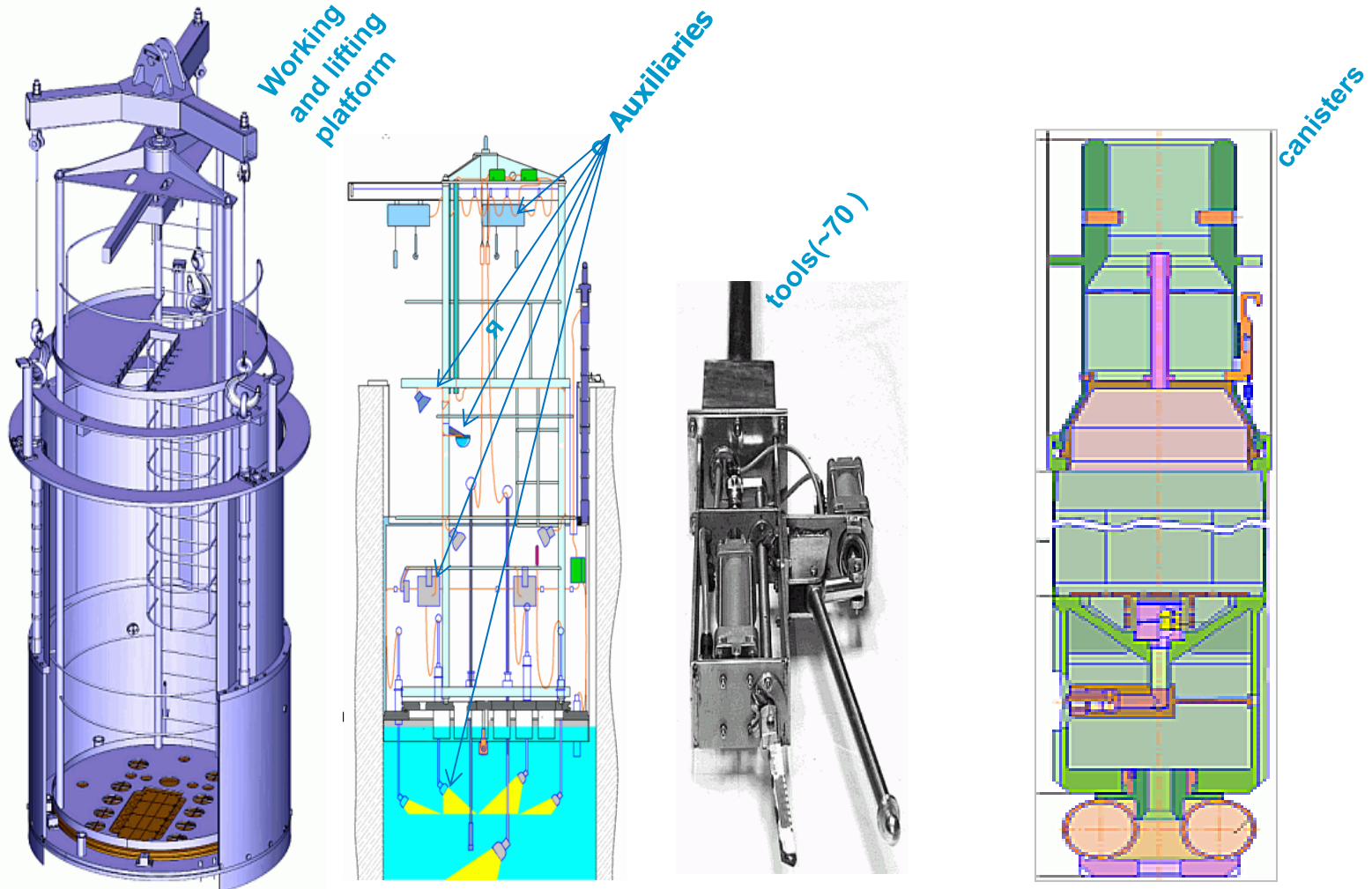
In fall 2003 OAO “TVEL” and Paks NPP entered into a contract, in accordance with which Russian specialist, in compliance with all requirements of nuclear and radiation safety had to elaborate technology for removal of the damaged fuel assemblies from the cleaning tank, emptying pit No. 1, as well as to perform the practical works.

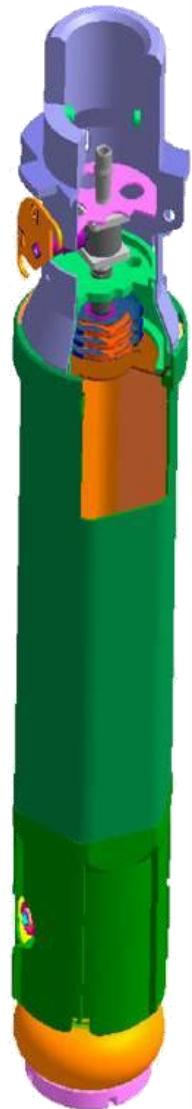
For solution of the tasks in Russia a team has been established under leadership of OAO “TVEL” including leading companies of the industry.



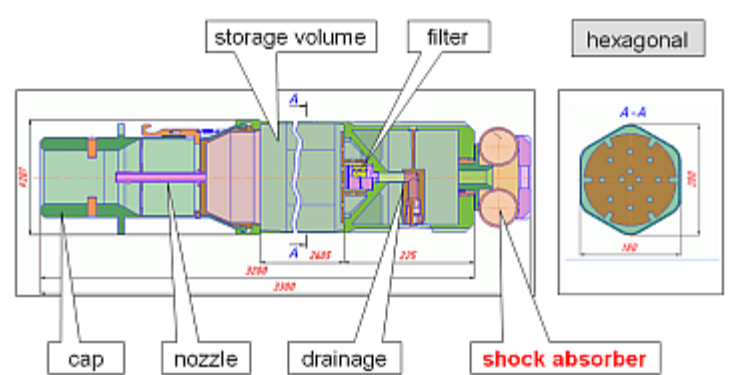
Main recovery equipment

Russian and Hungarian specialists in close cooperation with each other were able within a short period of time successfully perform the preparatory works, developed a unique technical solution, designed and manufactured the necessary complicated equipment.





Broad (28 type) canister



- for almost intact FA parts without head/leg
- fill limit 196 kg

13 A. Csébbati: Removal of the damaged fuel 7 Nov 2007

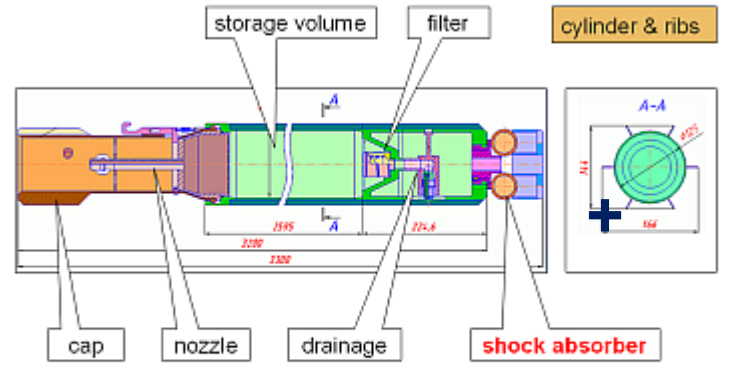
Solid radwaste cask



- For removed FA head /leg
 - head
 - = screwed in, fixed by milling
 - = for connection of refueling machine or crane
 - cloak
 - lower grid (to drain)
 - utilization in reactor hall vault storage

16 A. Csébbati: Removal of the damaged fuel 7 Nov 2007

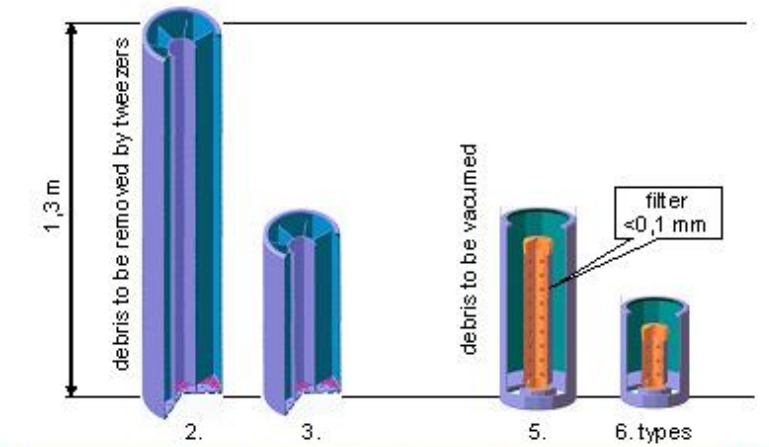
Narrow (29 type) canister



- for debris, loaded into space holders
- fill limit 70 kg

14 A. Csébbati: Removal of the damaged fuel 7 Nov 2007

Space holders



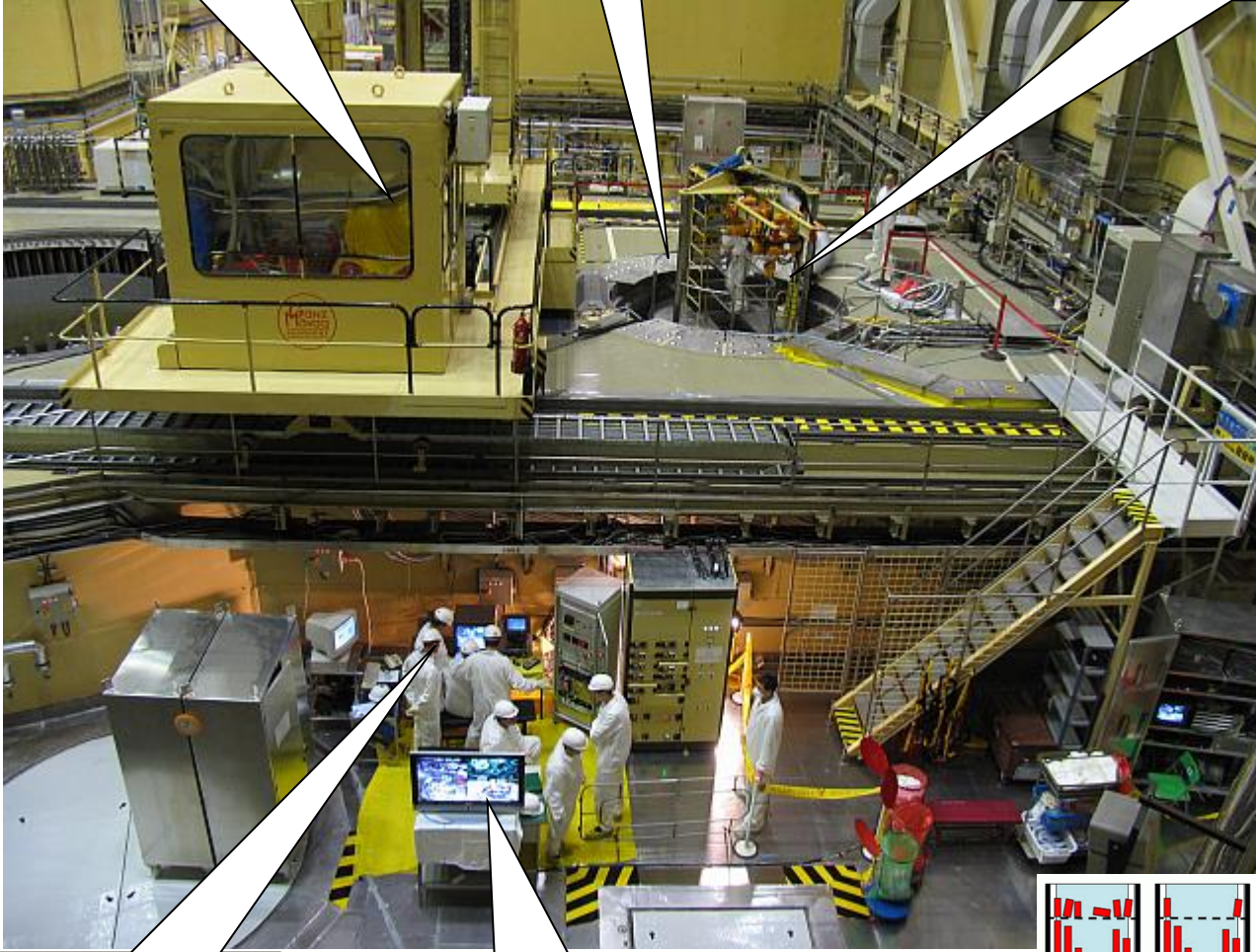
15 A. Csébbati: Removal of the damaged fuel 7 Nov 2007

Implementation of the recovery works

Refueling machine

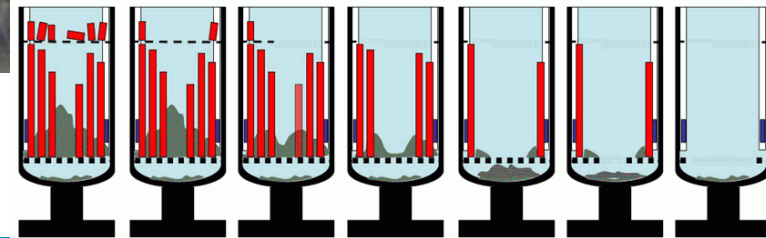
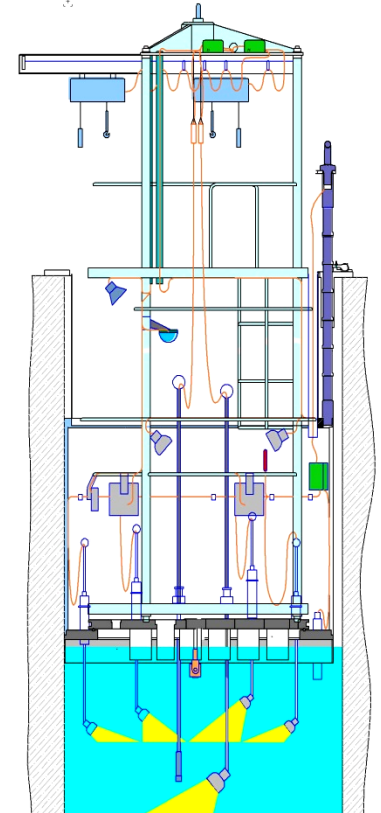
Pit

Working platform in the pit

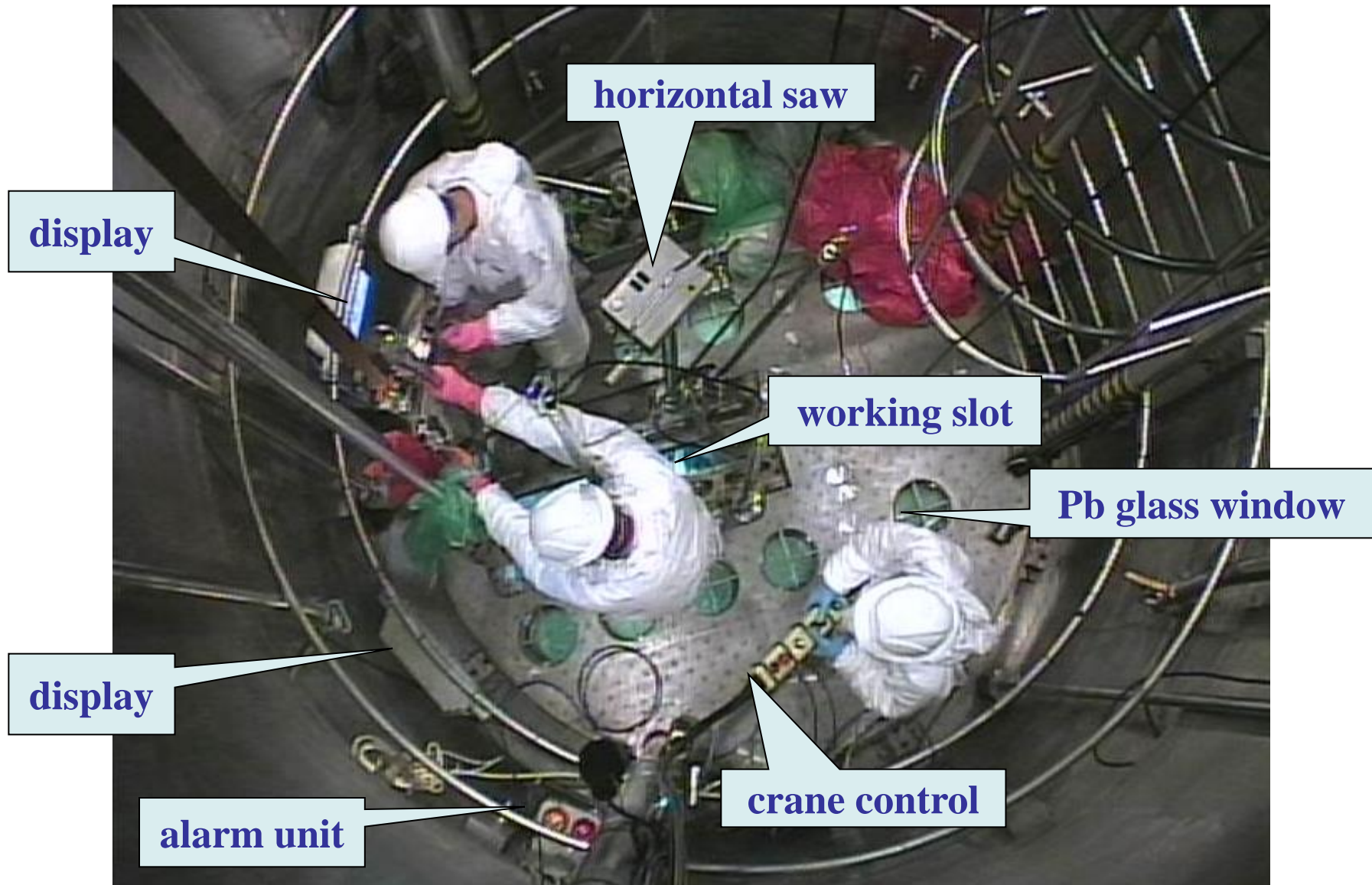


Control panel

Display



Upper view of the platform



End of the recovery phase

The practical works were carried out in late 2006, and in result of this the damaged fuel was loaded into special capsules.

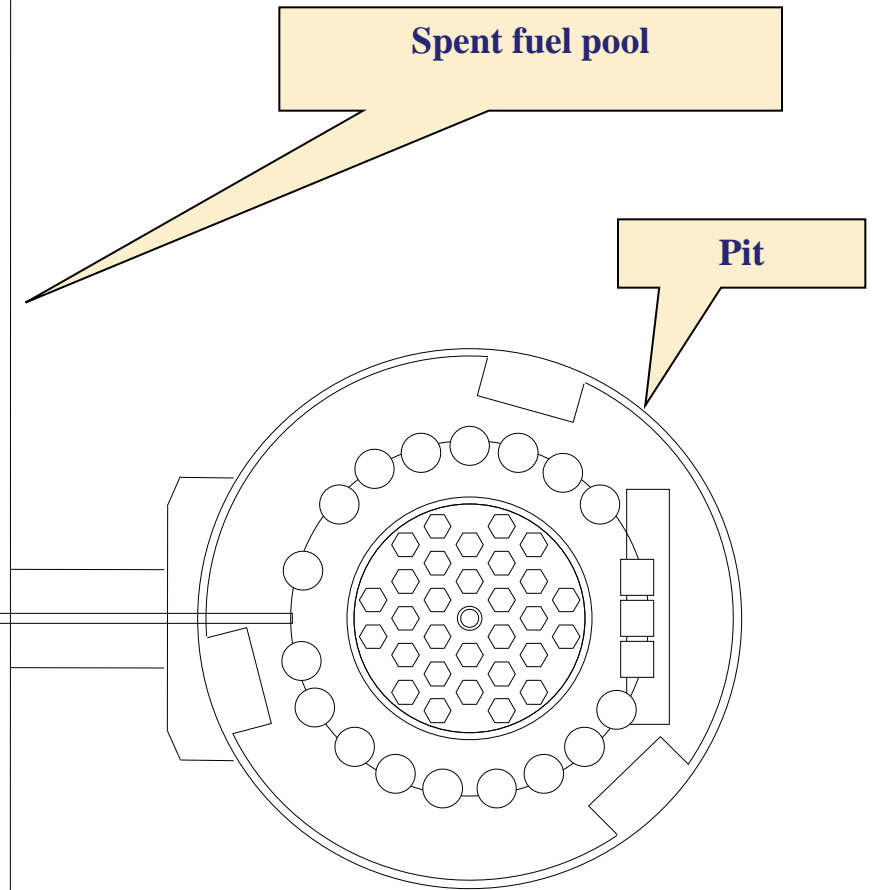


Canisters filled with water

**24 pieces
type 28**



44 pieces type 29



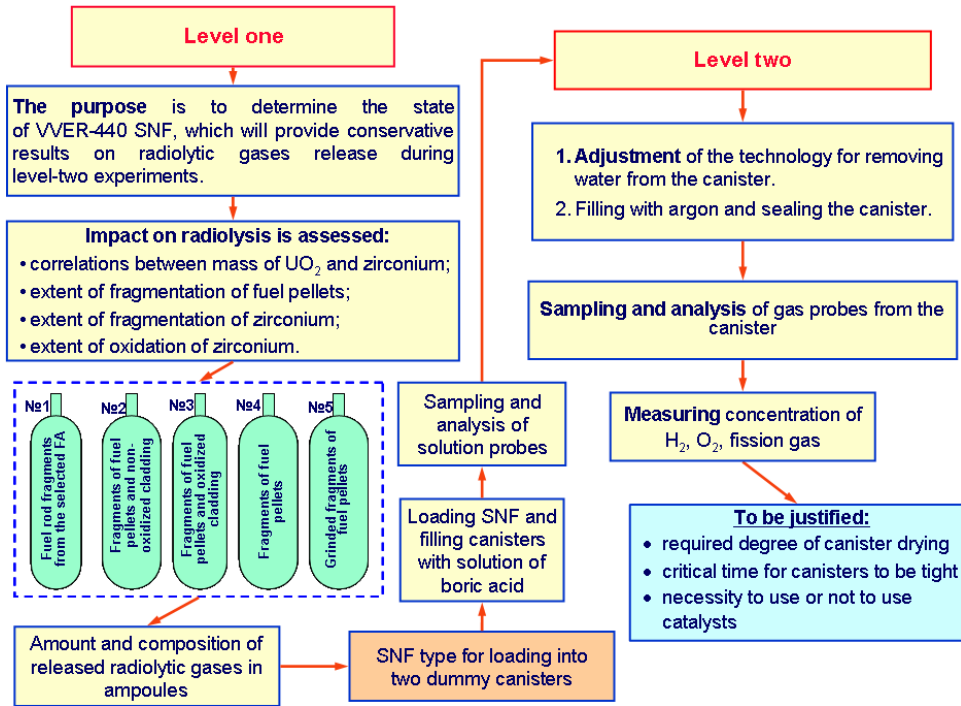
Following successful removal of the damaged fuel in late 2006 the cooperation between Paks NPP and the Russian organizations was moving on as well in course of next stages of full liquidation of consequences of the accident in 2003.

Already during early stages of development of the technology for liquidation of consequences of the accident analyses were started, related to evaluation of different solutions aimed to removal of the damaged fuel from the power plant site. Among many options also the possibility of shipment of the damaged fuel to PO “Mayak” for reprocessing was investigated.

Objective: to restore the conditions of the plant prior to the accident (removal of the canisters from the NPP)

The works on justification

In period from 2007 to 2009 the Russian company OOO NPF “Sosny”, involving also GNC “NIAR”, *has performed huge scope of scientific-technical work in field of investigation of behavior of the spent nuclear fuel in capsules, paying special attention to safety of transportation of the spent nuclear fuel, and to elaboration of principal technology for drying out the spent nuclear fuel within the capsules.* On the basis of works the possibility of safe shipment of the fuel for reprocessing has been justified, subject to appropriate drying out of the fuel and sealing of the capsules.



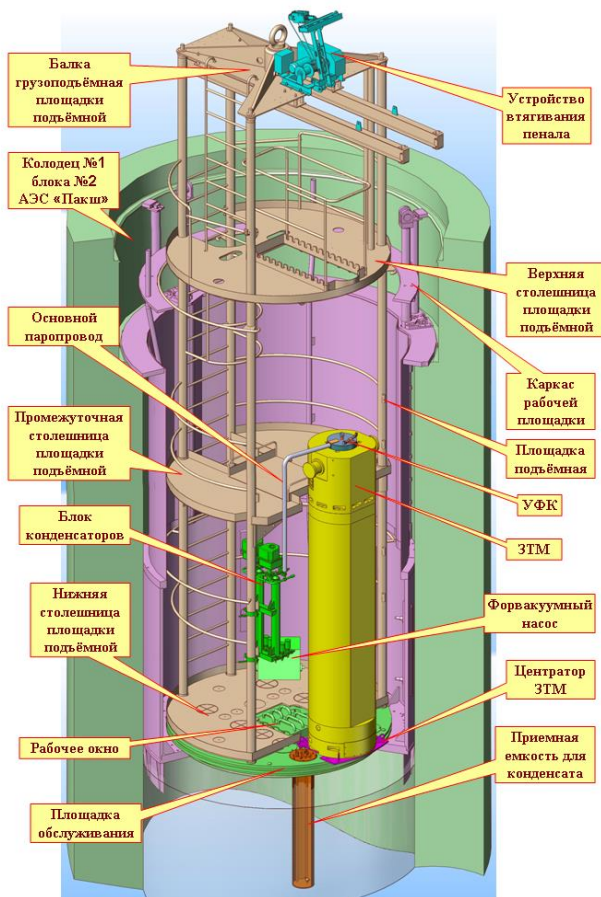
The option of shipment of the encapsulated fuel to Russia for reprocessing came to the first place and works related to preparation of the fuel for shipment was started.

With this aim Paks NPP and FGUP “FCNRS” signed a contract for elaboration of the documents for Unified Project, while **in 2009 foreign trade contract was signed between them for shipment of the encapsulated fuel to FGUP “PO “Mayak” for reprocessing, setting 2014 as the target date for the shipment. Euratom Supply Agency concluded the contract in April 2010.**

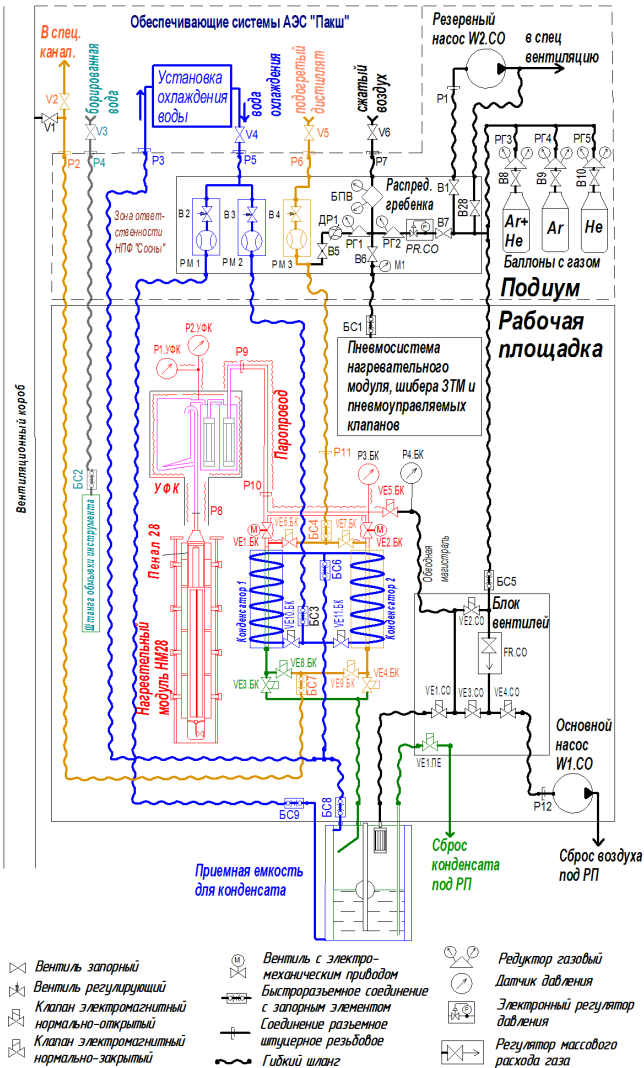
- Substantiation of safe transport in accordance with IAEA Safety Standard TS-R-1 and domestic regulations.
- Licensing of the transport means and mode in each country of concern: Russia, Ukraine, Hungary (RUS/3110/B(M)F-96T).
- Taking into consideration the requirements specified by the processing works (moisture content in the canister).
- The transportation has to be carried out with the use of existing and tested means of transport.



Cooperation with OOO NPF “Sosny” was continued for execution of works related to preparation of the fuel for shipment (drying and sealing).

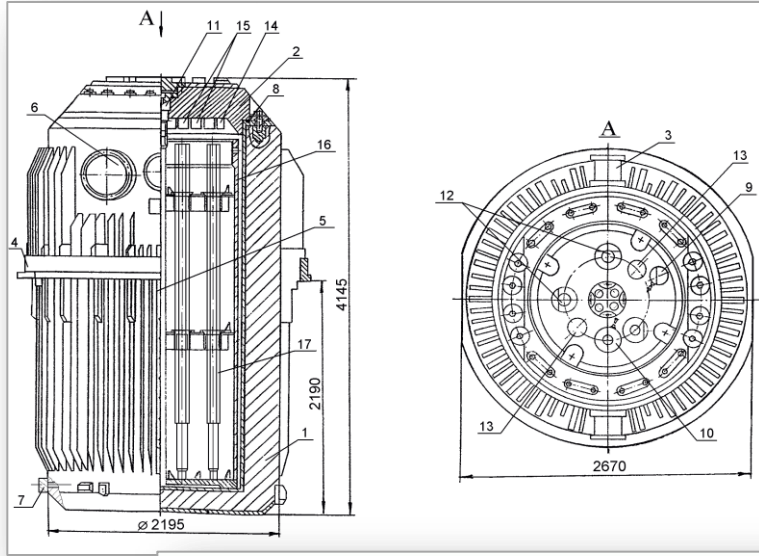


- By second half of 2013 assisted by OOO NPF “Sosny” the power plant has completed all the technical and organizational works, necessary for drying out and sealing of the capsules.
- In second half of 2013 all 68 capsules containing the spent fuel were successfully dried out.

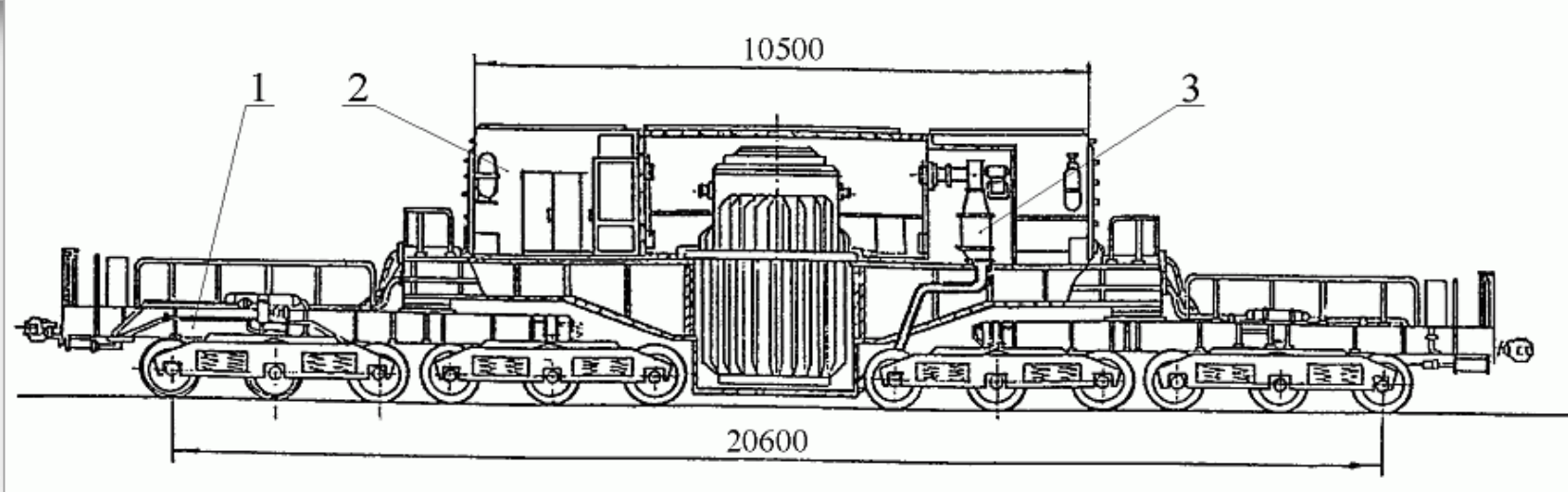


Result: the capsules are ready for the shipment

Transportation of spent nuclear fuel was carried out in a well-known TK-6 wagon container that had been used regularly until 1998.



weight (loaded) - 92 tons
diameter - 2670 mm
height - 4145 mm
filled with 1,8 bar N₂



In summer 2014, regardless of the complicated situation in the transit country, owing to special attention on behalf of Rosatom's management and to coordination measures taken by all competent bodies both in Russia and Hungary the capsules were successfully shipped to Russia, to FGUP "PO "Mayak". By this the project for full liquidation of the consequences of the accident of 2003 was successfully completed.



- **The experience of the eleven-year-long cooperation with Russian companies showed, that all the Russian partners worked on high level of professionalism and devotedness, and all the works, regardless to their unique character were completed by the determined deadlines.**
- **MVM Paks Nuclear Power Plant Ltd. is grateful to all its Russian partners for the valuable assistance provided in the works related to liquidation of consequences of the accident, however we would like specially highlight the work and thank to management and specialists of AO “TVEL”, NIC “Kuchatov Institute”, OKB “Gidropress”, OOO NPF “Sosny”, GNC “NIAR”, AO “FCNRS”, FGUP “PO “Mayak”, OOO NTC “Nuclon”.**



*Thank you for
your attention!*