International Conference on the Management of Spent Fuel from Nuclear Power Reactors: An Integrated Approach to the Back End of the Fuel Cycle
IAEA Headquarters, Vienna, Austria,

ГОСУДАРСТВЕННАЯ КОРПОРАЦИЯ ПО АТОМНОЙ ЭНЕРГИИ «РОСАТОМ»

Spent Nuclear Fuel Management System in the Russian Federation

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15 June 2015

Russian NPP on the map

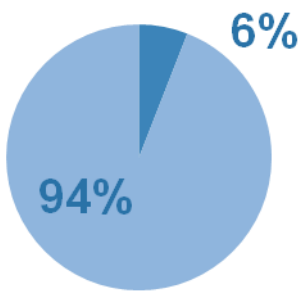
Russia operates 34 nuclear power units with the installed capacity of 25.2 GW

LONG-TERM PLANNING : one-time large-scale construction of 9 units
Commissioning of 16 units in 2020, and 38 units in 2030

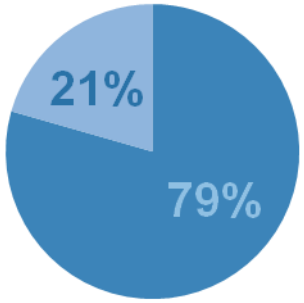
Peculiarity of Russian Practice in SNF Management

Residual operational lifetime of NPPs by sectors (reactor\year)

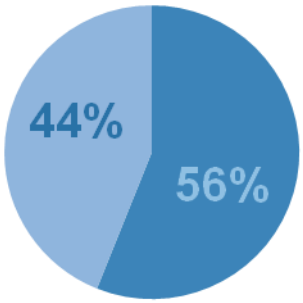
Sector of growth: VVER-1000, 1200



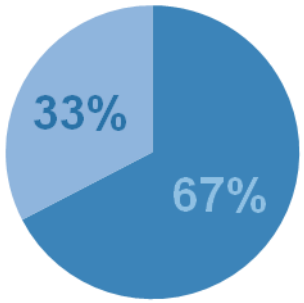
Sector of functioning: RBMK-1000



Phase-out sector: VVER-440, AMB, EGP



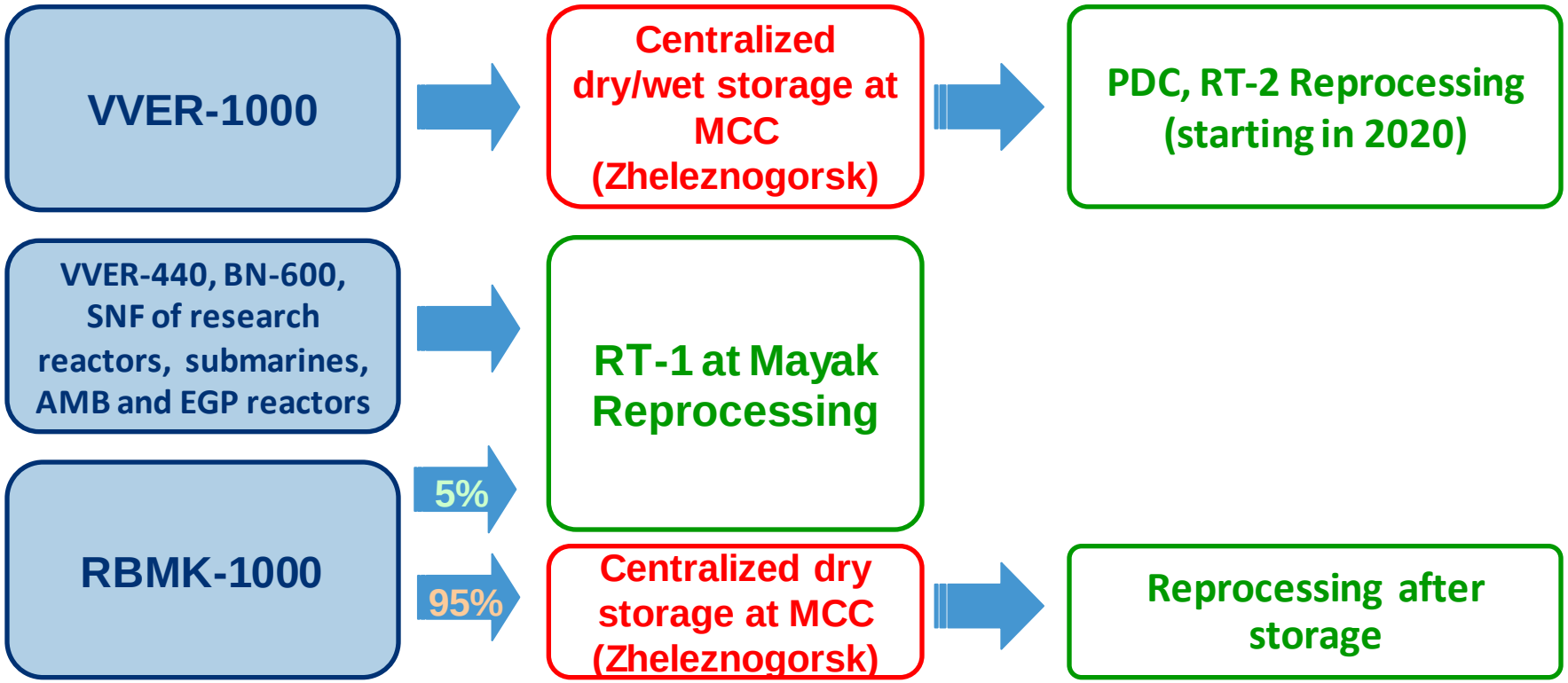
Development sector: Fast reactors



Accrued operational life
Residual lifetime

- **Fleet of various reactors should be equipped with different technologic facilities of SNF management**
- **Commissioning of numerous VVER-1000, 1200 NPP units**

Technologic Patterns of SNF Management: Temporal Storage and Reprocessing



The basis of the Russian Federation policy in the area of SNF management is the principle of **SNF reprocessing** in order to ensure ecologically acceptable management of nuclear fission products and return of the regenerated nuclear materials into the fuel cycle. The strategic areas in SNF management are establishment of a reliable system SNF storage, development of SNF reprocessing technologies, balanced involvement of the SNF regeneration products into the nuclear fuel cycle, final isolation (disposal) of radioactive waste generated after the reprocessing.

RT-1 SNF Reprocessing Plant in Ozersk. The first SNF Reprocessing Facility in Russia

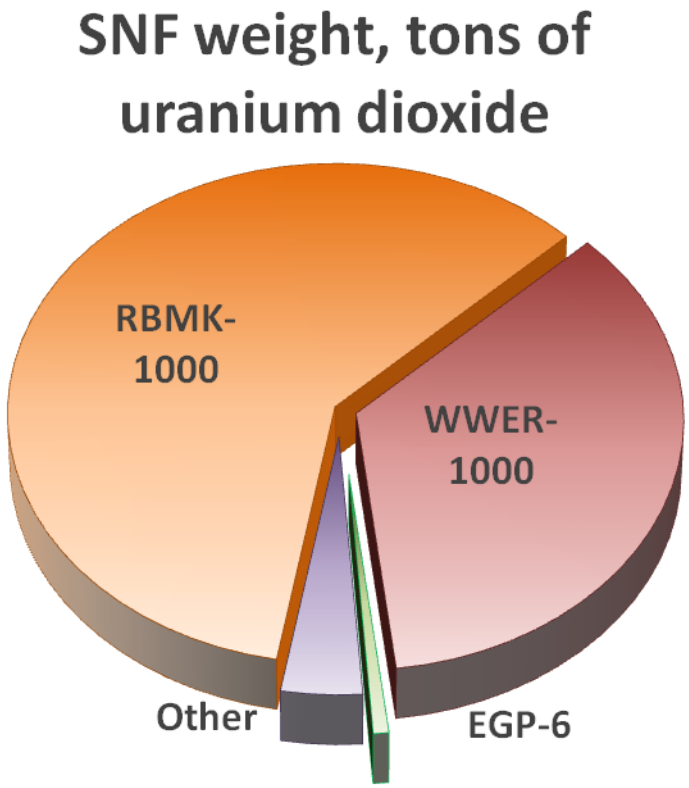
РОСАТОМ

RT-1 plant has been in operation since 1977:

- **Types of reprocessed SNF: WWER-440, BN-600, nuclear submarines, certain types of research reactor (RR) SNF.**
- **Necessary preparations are underway to enable the reprocessing of "damaged" SNF from RBMK-1000 units, AMB units, all types of RR units, transportation ship nuclear facilities.**
- **Environmental safety of RW management activities has been enhanced (operation of pilot and industrial facilities ensuring LRW minimization).**

- **RR SNF is shipped for reprocessing (RIAR, IPPE, NRC «Kurchatov Institute»).**

Accumulation of SNF from NPP

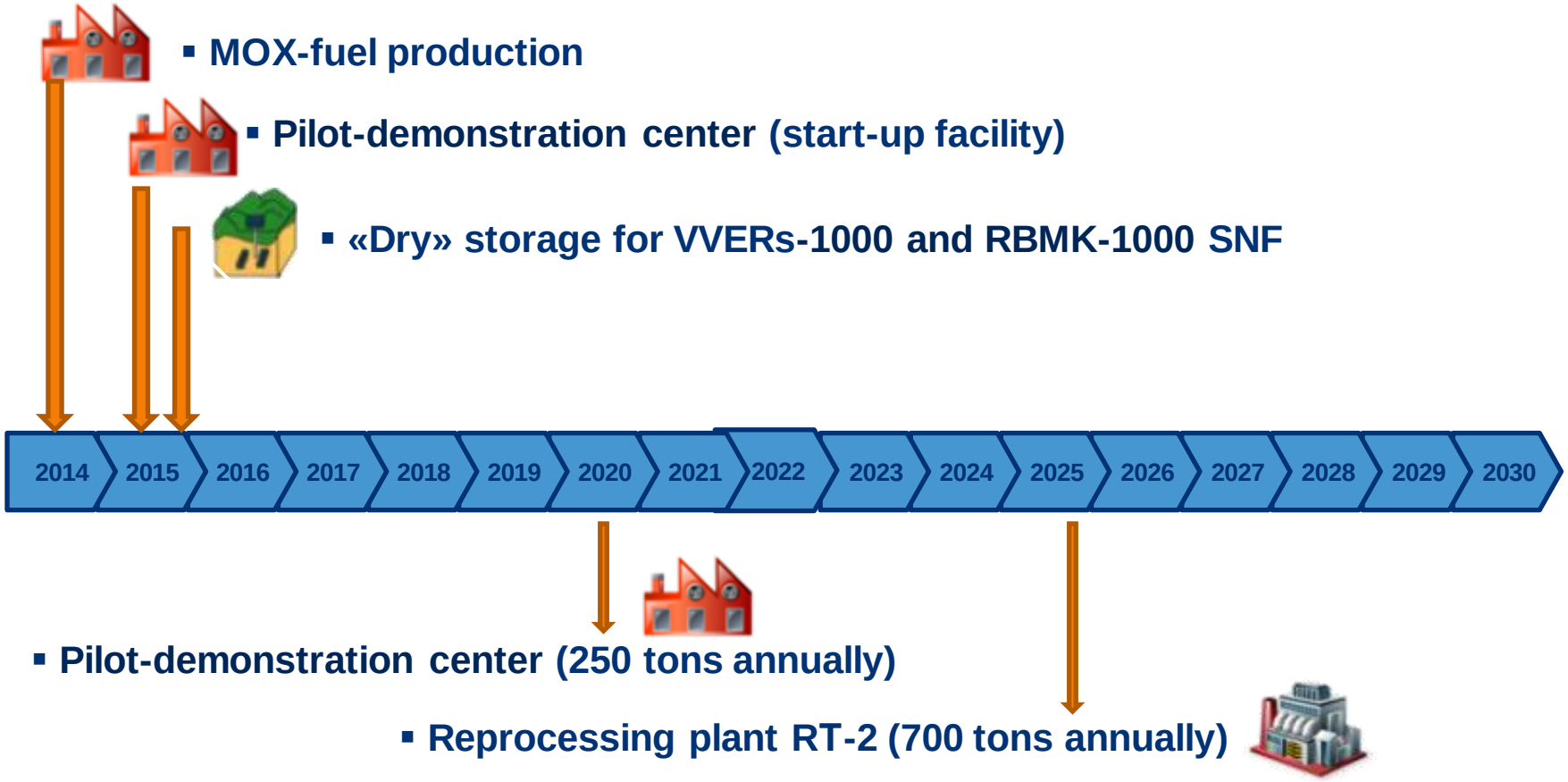


SNF sites:

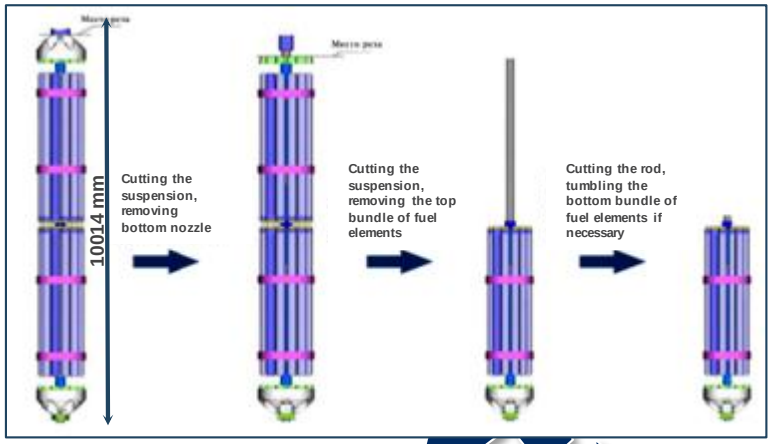
WWER-1000:
87% at MCC,13% at NPPs

RBMK-1000:
3% at MCC, 97% at NPPs

Roadmap:
Development of LWR SNF Management Infrastructure in Russia

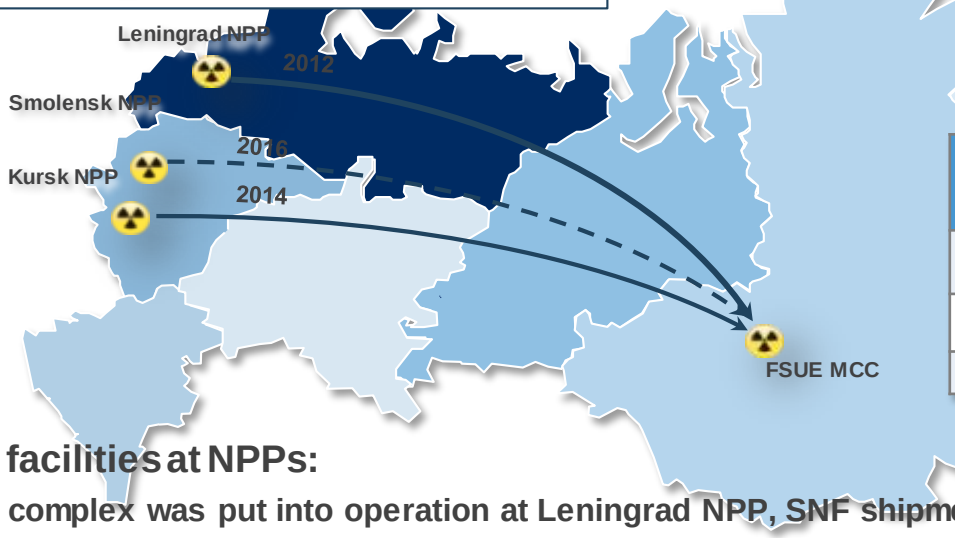


RBMK-1000 SNF – transfer to “dry” storage



The following tools have been designed to enable RBMK-1000 shipment:

- Transportation packages TUK-109 and TUK-109T (container, cover, ampoule);
- conveyor TM2-3 and TM-U.



NPP	Unit	Shutdown period
Leningrad	1-4	2018-2025
Kursk	1-4	2022-2035
Smolensk	1-3	2032-2040

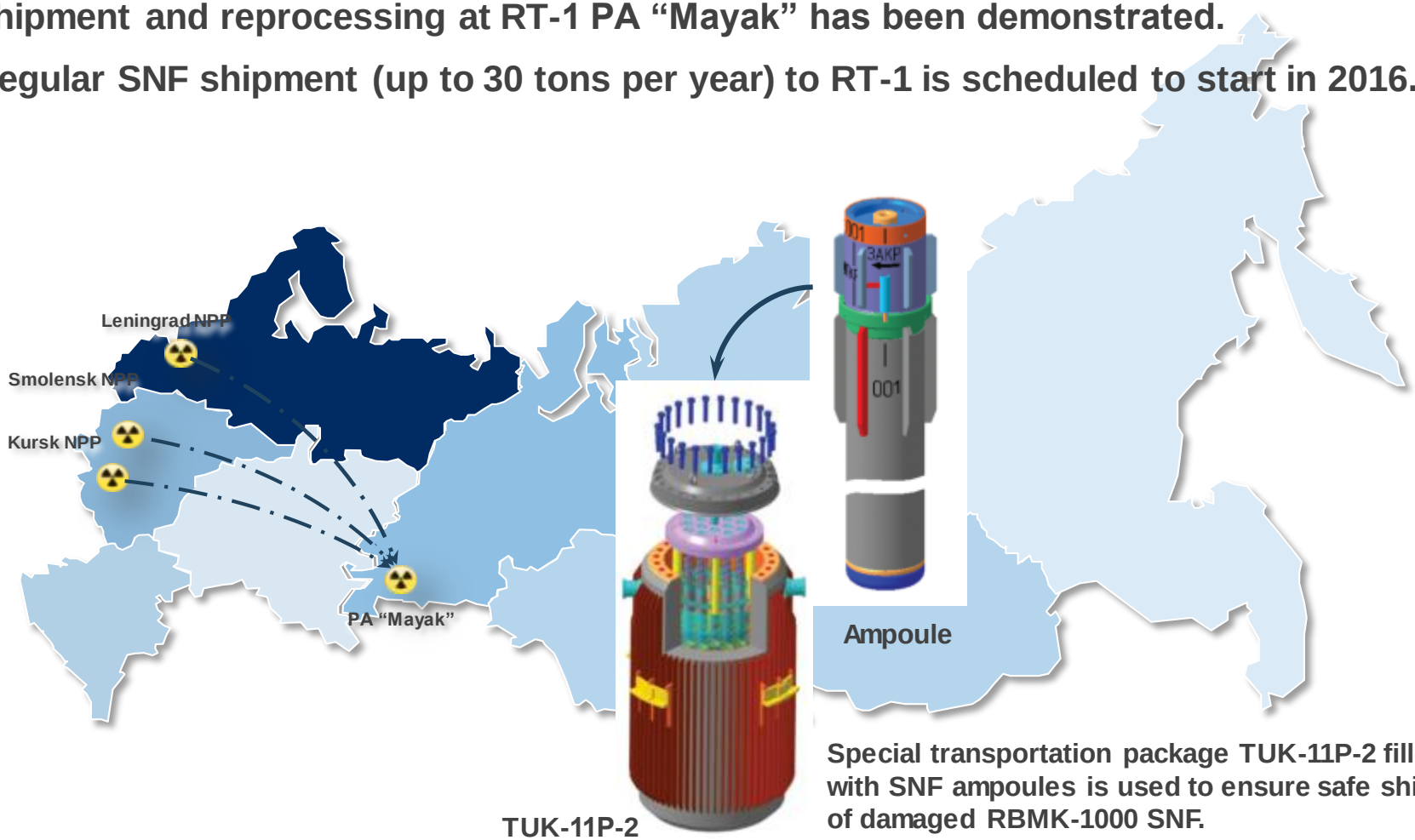
SNF cutting facilities at NPPs:

2012 – cutting complex was put into operation at Leningrad NPP, SNF shipment was started;

2014 – cutting complex was put into operation at Kursk NPP, SNF shipment was launched;
– construction of an SNF cutting complex is underway at Smolensk NPP (its commissioning is scheduled for 2016).

RBMK-1000 SNF – total amount and damaged fuel

- The amount of damaged SNF has been specified. Technological possibility of its shipment and reprocessing at RT-1 PA “Mayak” has been demonstrated.
- Regular SNF shipment (up to 30 tons per year) to RT-1 is scheduled to start in 2016.



Special transportation package TUK-11P-2 filled up with SNF ampoules is used to ensure safe shipment of damaged RBMK-1000 SNF.

Management of WWER-1000 SNF at MCC

SNF is routinely shipped from NPP sites (12 units are in operation, 7 units are under construction)

SNF wet storage facility (KhOT-1):

- Storage capacity has been increased to 8600 tons.

SNF dry storage facility (KhOT-2):

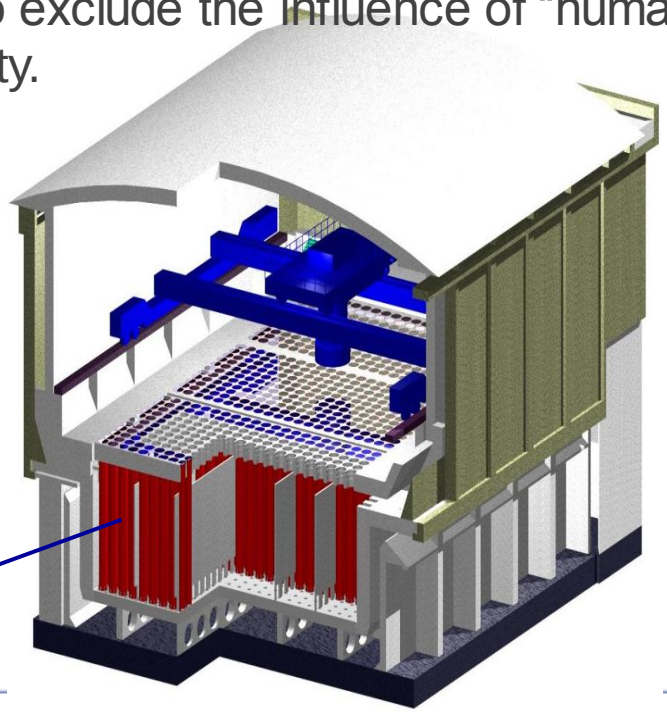
- 2015 – completion of the second unit of the "dry" storage facility for WWER-1000 SNF

Pilot and demonstration center for SNF reprocessing (PDC):

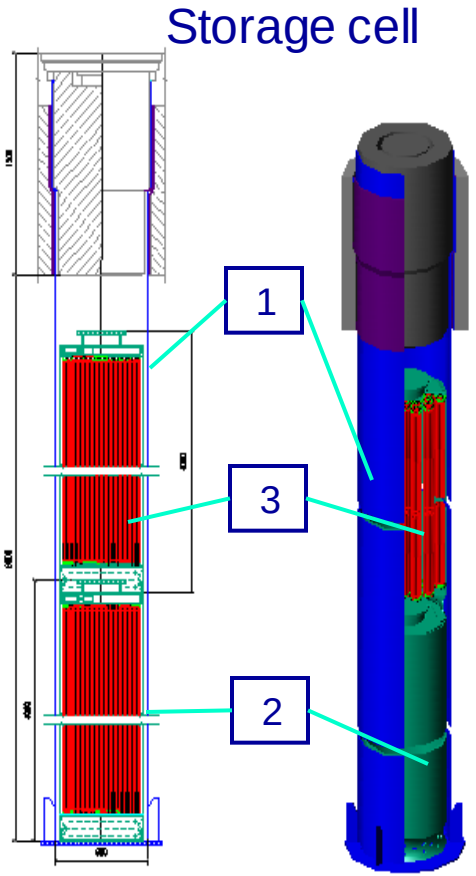
- PDC is being constructed (research hot cell complex will be commissioned in 2015).

“Dry” centralized storage

The “dry” storing technology is based on the **passive principle of safety protection**
in case of a power supply loss all conditions of safe SNF storing will be retained thanks to the **natural air-cooling convection.**
All engineering operations while transferring SNF to the storage as well as the storing process itself are fully automated to exclude the influence of “human factor” on SNF storage safety.



Storage cell



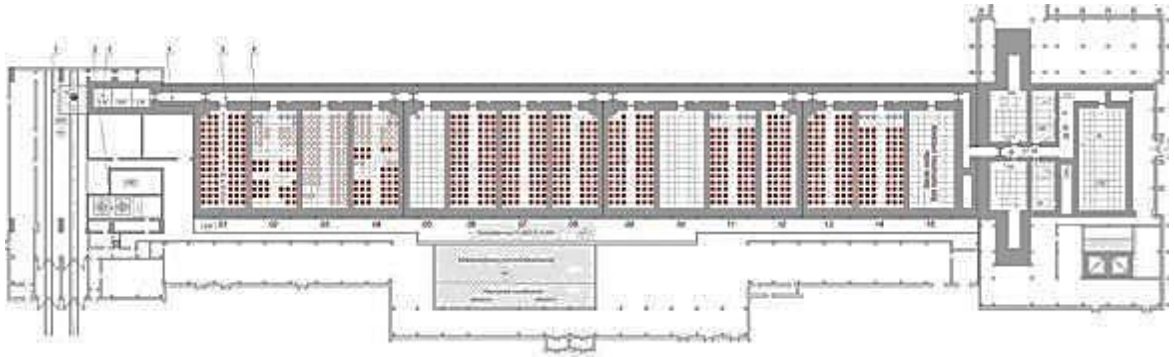
1 − storing seat;
2 − case with gas (N_2+He_2);
3 − fuel element of assembly

Lessons learned from Fukushima accident and relevant improvements at MCC

1. Geodynamic and seismic monitoring systems have been upgraded.
2. Full-scale geotechnical monitoring of buildings and constructions is being implemented.
3. Certain activities were carried out to manage beyond-design-basis accidents («crash-test» at «wet» and «dry» SNF storage facilities).

KhOT-1:

- Emergency cooling and irrigation systems are being installed in spent fuel assemblies compartments.



KhOT-2:

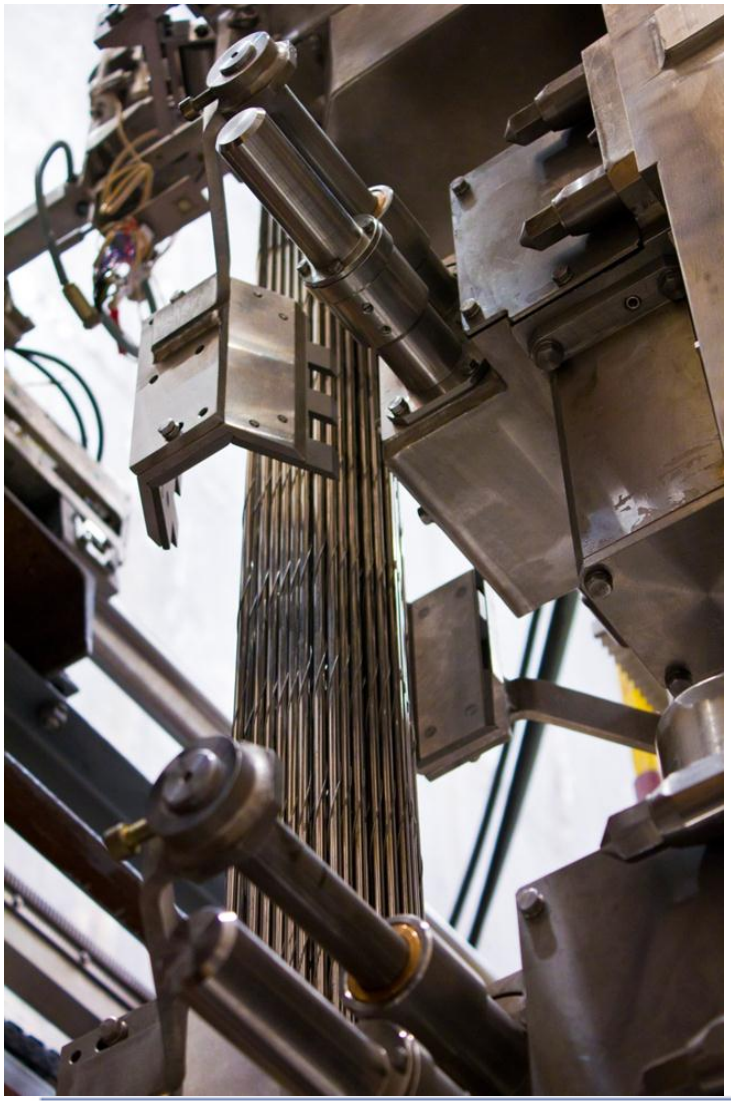
- Analysis of beyond-design-basis accidents has been carried out, efforts on managing beyond-design-basis accidents have been identified.
- Seismic resistance of KhOT-2 has been increased to 9.6 on MSK-64 scale.
- In case of blackout, existing passive systems will ensure adequate heat removal.

Pilot Demonstration Center for SNF reprocessing

2015 –The construction of the Pilot-demonstration center is currently in the progress, it is to be completed by 2015. The start-up facility incorporates research chambers (capacity -2-5 tons a year) , analytical center, and other elements of all necessary infrastructure. The purpose is to confirm the designed parameters of the new technological scheme.

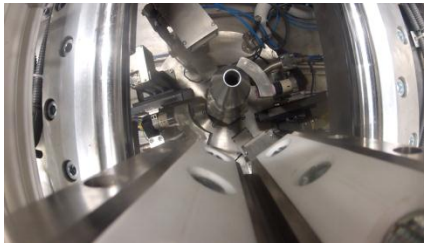
2020 – The second start-up facility to be put into operation – full radio-chemical plant with capacities of reprocessing up to 250 tons/year. Innovative technologies of VVER-1000 SNF treatment to be developed; initial data for designing the full-scale radio-chemical plant and technology replication to be obtained.

MOX-fuel production to fuel supply fast reactor BN-800



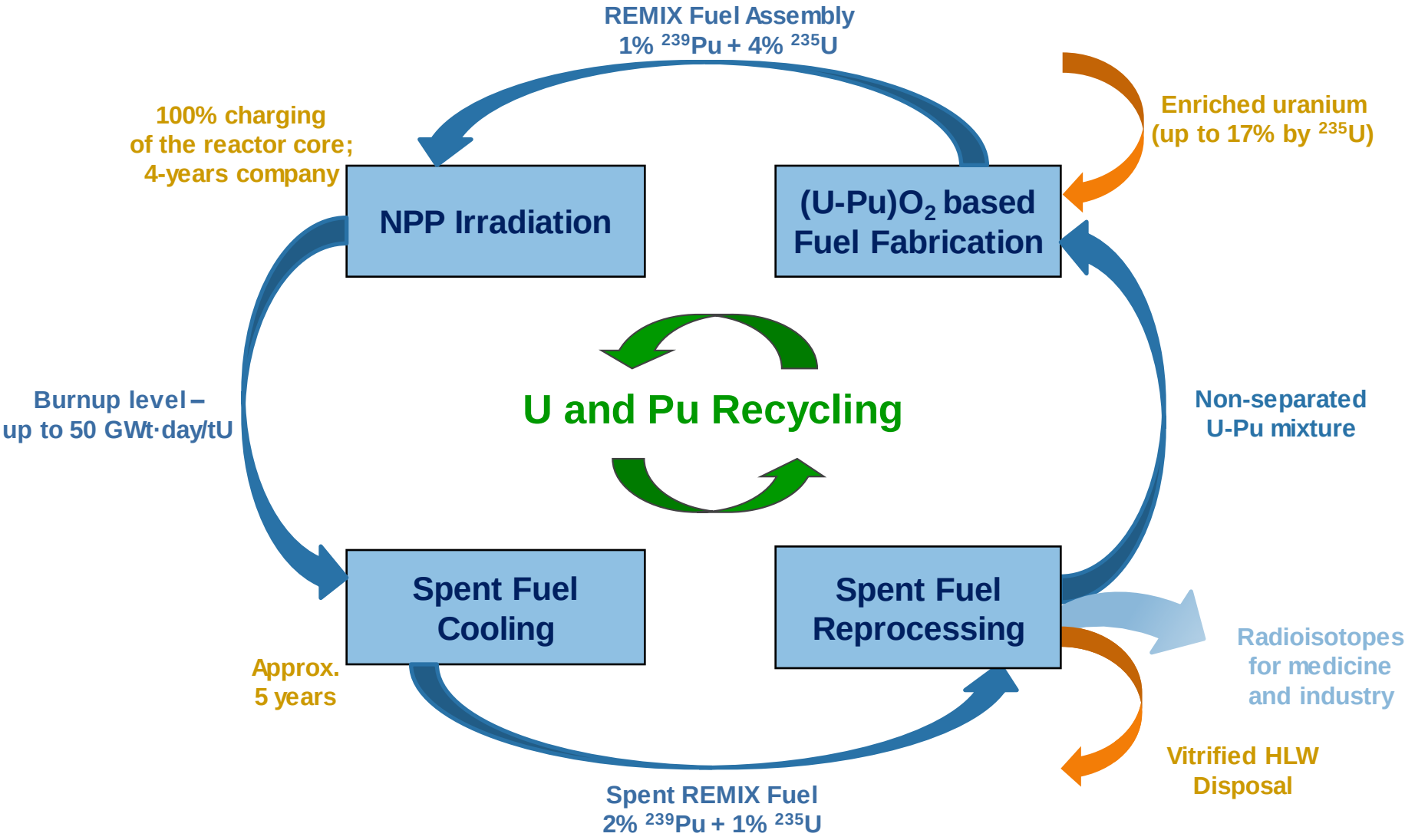
- Production plant of MOX-fuel assemblies was commissioned in December 2014 to supply fast BN-800 reactor
- The production site is located in MCC underground facilities. The rock is a natural containment ensuring protection from any external natural and anthropogenic threats.
- All the equipment is placed into a chain of protecting multi-barrier hot cells interconnected by transport-and-transfer devices.

robotized complex to retract fuel elements bundle into FA cladding.



REMIX Nuclear Fuel Cycle
Fission Materials Multi-Recycling in LWR

POCATOM



Thank you for your attention

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