Further Development of Radiochemical Reprocessing Activities at the Mayak PA

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Historical Background

1967 – start of RT-1 construction

1977 – start of SNF reprocessing

Over 5 650 tU SNF has been transported and reprocessed in total
Current Activities at RT-1 Plant

SNF transport and reprocessing (recovery) – up to 160 t/a:
- power reactors (VVER-440 and BN-600)
- naval propulsion reactors
- research reactors
- industrial reactors at FSUE Mayak PA

Commercial product manufactured:
- UNH (uranyl nitrate hexahydrate) (enrichment 1 %)
- Uranium (IV, VI) oxide (enrichment > 5 %)
- Plutonium dioxide
Expansion of SNF range acceptable for reprocessing

2013 – 2014

RBMK-1000

U-Be

BN (MOX)

Routine process at the plant

Storage, mechanical fragmentation, dissolution

Extraction and commercial product manufacturing

Radwaste treatment
Expansion of SNF range acceptable for reprocessing

SNF from NPP reactors

- VVER-1000, in 2017
- AMB in 2020; EGP-6, KS-150 in 2025
- $U_{\text{met}}$ in 2014; Nitride fuel in 2017

Heavy duty cutting machine AP-1000

Facility for NPP cutting and canister loading

Standard cutting machine with adjustable gas phase composition

Facility for NPP cutting and canister loading
Expansion of SNF range acceptable for reprocessing

Research reactor SNF, non-standard fuel compositions

U-Zr and others,
PuO\textsubscript{2}, Pu\textsubscript{met},
PuC, PuN, Pu-Ga and others
in 2018

Electrochemical dissolvers
Future activities at RT-1 plant

SNF reprocessing from domestic power reactors:
- VVER-440, VVER-1000, BN-600, BN-800
- RBMK-1000, AMB, EGP-6

SNF reprocessing up to 400 t/a

Reprocessing of SNF from domestic and foreign research and naval propulsion reactors, as well as of non-standard SNF
- UC, UN, U-Zr, PuO2, Pu_{met}
- U-Al, U-Be, U_{met}

Reprocessing of any damaged domestic and foreign SNF packed in canisters

SNF reprocessing from foreign power reactors:
- VVER-440, VVER-1000, BN-350, KS-150
- Bulgaria, Hungary, Slovakia, Armenia, Kazakhstan, Ukraine, Czech Republic
Plans for product output

**Uranium product**
- Uranyl nitrate hexahydrate (enrichment 1 to 3 %) – up to 400 t/a
  - Development of a process option is in progress providing U(IV, VI) oxide production with enrichment 1 to 3%
- U (IV, VI) oxide (enrichment > 5 %)

**Plutonium dioxide**
- For MOX fuel manufacturing for fast and thermal neutron reactors

**Radioisotopes**
- Cs-137, Kr-85, Am-241, Pu-238, Sr-90, Pm-147, Ce-144
RT-1 process optimization

New design of SNF extraction flow chart

U, Pu, Np, Tc

HLW raffinate + Np, Tc
Extraction → Re-extraction → U
Pu, Np, Tc

MLW raffinate + Np, Tc
Extraction → Re-extraction → Pu

Membrane-type system for suspension clarification

Spent extractant recovery

Federal State Unitary Enterprise MAYAK Production Association
Prospective radwaste treatment system

- **Pilot decontamination installation** in 2014

- **Decontamination facility** in 2020

- **Cement solidification facility** in 2015

- **New vitrification facility** in 2020

- **Electrical vitrification melter system** ЭП-500/5  in 2015

- **SNF reprocessing at RT-1 plant**

- **Solid radwaste reprocessing facility** in 2025

- **National operator for radwaste management**

- **Decontaminated water**

- **Concentrates**

- **LLW**

- **MLW**

- **HLW**
Conclusions

1. Implementation of above mentioned measures will result in universalization of RT-1 plant by 2018 as a radiochemical facility providing reprocessing of a wide range of spent nuclear fuels including damaged and out-of-specification fuels.

2. RT-1 plant is now ready for throughput enhancement in terms of VVER-440 SNF reprocessing from Russian and foreign NPPs.

3. In 2017 RT-1 plant will be available for VVER-1000 SNF reprocessing.

4. Establishment of new production facilities for radwaste treatment will provide the capability for RT-1 plant to considerably enhance environment safety.