Status and Prospects of Spent Nuclear Fuel Reprocessing at Mayak Plant

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2015
Historical Background

1977 – 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

Commercial product manufactured:
- UNH (uranyl nitrate hexahydrate) (enrichment 1 %)
- Uranium (IV, VI) oxide (enrichment > 5 %)
- Plutonium dioxide
- Radioisotopes (Cs-137, Kr-85, Am-241, Pu-238, Sr-90, Pm-147, Ce-144)
Implementation of the Russian Research Reactor Fuel Return Programme

2006-2014

Uzbekistan
Czech Republic
Bulgaria
Hungary
Latvia
Kazakhstan
Libya
Poland
Romania
Ukraine
Serbia
Vietnam
Belarus

2015-2017

Uzbekistan
Poland
Kazakhstan
During last 5 years reprocessing of new SNF types and fuel compositions has been adapted

- RBMK-1000
- U-Be, U-Mo
- 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
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SNF from NPP reactors

- **VVER-1000**, in 2017
- **AMB** in 2020; **EGP-6** 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
Expansion of SNF range acceptable for reprocessing

Research reactor SNF, non-standard fuel compositions

U-Zr and others, PuO$_2$, Pu$_{metr}$, PuC, PuN, 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

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-Mo
- U_{met}

SNF reprocessing up to 400 t/a

SNF reprocessing from foreign power reactors:

- VVER-440, VVER-1000, BN-350
- Bulgaria, Hungary, Slovakia, Armenia, Kazakhstan, Ukraine, Czech Republic

Reprocessing of any damaged domestic and foreign SNF packed in canisters

Federal State Unitary Enterprise MAYAK Production Association
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
Prospective radwaste treatment system

1. **Decontamination facility** in 2014
2. **Pilot decontamination installation** in 2014
3. **Decontamination facility** in 2020
4. **Cement solidification facility** in 2015
5. **New vitrification facility** in 2021
6. **Electrical vitrification melter system** ЭП-500/5 in 2015
7. **SNF reprocessing at RT-1 plant**
8. **Solid radwaste reprocessing facility** in 2025
9. **Liquid radwaste**
   - **Decontaminated water**
   - **Concentrates**
   - **Cement solidification facility** in 2015
   - **New vitrification facility** in 2021
   - **Electrical vitrification melter system** ЭП-500/5 in 2015
10. **Solid radwaste**
    - **Solid radwaste reprocessing facility** in 2025
11. **National operator for radwaste management**
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.