ROSATOM’s vision of Russia’s role in global molybdenum-99 supply

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ROSATOM Isotope Production Complex

- ROSATOM today is one of key players ensuring global radioisotope market development.
- Portfolio includes more than 200 isotope products. Some of them are sole produced by ROSATOM enterprises.

ROSATOM Isotope production complex includes 13 production facilities
- 5 research reactors,
- 2 industrial reactors,
- Power plant (4 units),
- Cyclotrons,
- Unique electromagnets and gas centrifuges for enrichment.

JSC ISOTOPE - authorized distributor of isotope products produced by ROSATOM state corporation
Mo-99 related activities

Existing

RIAR, Karpov IPC

Stable isotopes production

Perspective projects

Irradiation at NPP

Solution reactors

Activation method
Mo-99 existing production

5 years of supplies – since 2011
percent gained market share (according to the results of 2016)

3 reactors and 2 radiochemical complexes are involved in Mo-99 production
2 independent producers ensure secure backup supplies

**Karpov IPC** (Obninsk)
Reactor: VVR-c
Reactor & processing facilities
Max. production capacity:
350 six-day Ci per week

**RIAR** (Dimitrovgrad)
Reactors: RBT-6 and RBT-10a (pool type)
Reactor & processing facilities
Max. production capacity:
1000 six-day Ci per week

ROSATOM continues to invest in development of Mo-99 production sites:
- Continuous work on production capacity increase
- HEU-LEU conversion process
Today we supply Mo-99 on weekly basis to Latin America, Asia and Middle East
ROSATOM enterprise - ElectroChemical Plant owns unique production capabilities for large scale production of Mo-98 & Mo-100.

- **Performed supplies to:**
  - NorthStar Medical Radioisotopes LLC, USA, **Mo-98**

- **Potential supplies, to:**
  - Perma-fix, USA, **Mo-98**
  - NorthStar Medical Radioisotopes LLC, USA, **Mo-100**
  - ARTMS Products Inc (ex-Triumf), Canada, **Mo-100**
  - Advanced Cyclotron Systems, Inc, Canada, **Mo-100**.
Solution reactor

- In early 80th in USSR was developed and tested technology for Mo-99 production using solution reactor "Argus".
- "Argus" reactor was converted to LEU fuel in July 2014.
- In 2015 ROSATOM made a decision to construct a Proof-Of-Concept production site based on solution reactor in Sarov (500 km from Moscow).

2017
- Project design documentation and main design were developed
- Start of the construction

2018
- End of construction works (Q1)
- Equipment installation (Q3)
- First small-scale test batch

2019
- Start of operation

Dimensions: 1,5m × 1,5m × 2,7m
Power: 50 kW
Fuel: LEU
Fuel replacement: Once every 10 years
Production capacity: 250 Ci per week (6-day calibration)
Mo-99 (LEU) production on the RBMK-type reactors

Key features of RBMK reactor allows to irradiate isotope products without affecting energy generation.

Since 2001 Leningrad NPP has been irradiating starting material for isotope products (Co-60, Mo-99, I-125, I-131).

Smolensk NPP has been selected as the site of the project due to its young age (decommissioning in 2034).

New radiochemical complex is planned to locate on Karpov IPC.
2 radiopharmaceutical producers in Russia use activation method for production Tc-99m

- Radium Institute irradiate Mo-98 targets on RBMK-reactor (Leningrad NPP) and provides clinics of St. Petersburg with Tc-99m
- Tomsk Polytechnic University successfully supplies Tc-99m generators with a traditional design in Siberian region for more than 25 years

However, low specific activity of Mo-99 doesn’t allow to distribute these generators worldwide

Irradiation of Mo-98 in SM-3 high-flux (up to $5.0 \cdot 10^{15} \text{ cm}^{-2}\text{s}^{-1}$) reactor may allow to produce Mo-99 with higher specific activity
• ROSATOM today is involved in various activities connected with Mo-99 production.

• We are already supplying Mo-99 on a regular basis from 2 independent facilities, constantly developing them and also are working on HEU to LEU conversion.

• Furthermore, a lot of attention is paid to new projects:
  • NPP’s irradiation
  • Solution reactors
  • Non-fission methods.

• ROSATOM is proud of its technological and research base and will proceed to invest in its continuous development.
Thank you for attention!