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## **INVITED LECTURE - Review of Mo-99 and other reactor radionuclide production in RIAR in terms of world demands**

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Production of Mo-99 was established in Russia more than 20 years ago. First facilities were placed at the Institute of Physics and Power Engineering and Karpov Physico-Chemistry Research Institute (both in Obninsk city). They were focused on domestic supply and had limited production capacity. The IPPE facility was shut-down a few years ago. The Karpov Institute facility continues its operation.

Principal decision were made in late 2009 by Russian Government to establish a new production facility – modern, providing prospective needs of nuclear medicine actively developing in Russian Federation, and increasing export capabilities of Russian isotope producers as well. The concept of this new production plant is aimed in providing large-scale, reliable, sustainable and continuous supply of the product, which is fully complied with International Pharmacopeia requirements. The process should be realized on a contemporary equipment and control systems, comply with GMP requirements and be environmentally safe.

To provide continuous production two pool-type reactors (RBT-6 and RBT-10) are used for irradiation. Their current irradiation capacity allows for irradiation up to 4 targets/week, providing 2-2.2 kCi/target at EOB. The number of irradiation positions can be increased twice in a nearest future.

The facility for irradiated targets processing was constructed at Research Institute of Atomic Reactors site (Dimitrovgrad) during 2010 - mid 2012 jointly with Isotope Technology Dresden (ITD, Germany), that is a part of Gamma Service Group International, GmbH (Switzerland). The ITD Company has provided the ROMOL-99 process, and principal set of equipment for processing as well we radiation safety systems (Xe-trapping line, iodine filter tower). The first production line was designed and constructed by December, 2010, it was tested and improved during first half of 2011. The production was started in August, 2011, first batches of Mo-99 were supplied to Russian producer of <sup>99</sup>Mo/<sup>99m</sup>Tc-generators. During late 2011 –2012 considerable improvements were made in the process operation mode, ensuring Mo-99 radiochemical yield approx. 80%, and product quality corresponding to European Pharmacopeia requirements.

The second production line was installed in a new building, constructed during 2011-2012. The facility consists of two independent sets of equipment (dissolvers, vessels for solution, systems for Mo-99 isolation and purification) thus providing increased production capacity of the entire facility and reliable operation of the plant. Some equipment units (container transport system, targets, wastes handling, vessels for temporary storage etc.) that do not effect the production capacity, are used jointly thus decreasing cost of the entire facility. The second facility was assembled late June, 2012, and currently it is on the commissioning. Regular full-scale production is scheduled for November-December, this year.

For more than 30 years RIAR routinely produces wide spectrum of reactor radionuclides. The Institute is a principal (the only in Eastern hemisphere) producer <sup>252</sup>Cf and other transplutonium elements (Cm-244,248, Am-241,243, Bk-249). Production of these radionuclides is possible due to unique high-flux reactor SM operated by RIAR. They are supplied mainly as sealed sources, produced by original technologies. The recent achievement of RIAR is production of Cm-244 alpha-sources for APX spectrometer that was successfully landed on a Mars planet last August.

Availability of high-density neutron fluxes ( $>2.10^{15}$  cm<sup>-2</sup>s<sup>-1</sup>) allows for production of high-specific activity radionuclides, that is a principal feature of RIAR. They are Co-60 ( $>250$  Ci/g), Se-75 ( $>1200$  Ci/g), Ni-63 (up to 12 Ci/g), W-188 (up to 8 Ci/g), Lu-177 ( $>90$  kCi/g), n.c.a. I-131, I-125, etc. In a number of cases fast flux BOR-60 reactor is used for irradiation, producing Gd-153 ( $>100$  Ci/g), n.c.a. Sr-89 ( $>3000$  Ci/g).

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