Perspectives on the production of ^{99}Mo and ^{99m}Tc in the framework of IFMIF/ELAMAT facility

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Radioactive isotopes have an important place in nuclear medicine for imaging, therapy, biokinetics and pharmaceutical research and development (R\&D). The most important one is the Technetium-99m (^{99m}Tc), which is worldwide used more than 80% in diagnostics. However, Technetium has no stable isotope and ^{99m}Tc has to be artificially produced; for few decades, the usual route is the irradiation of high-enriched uranium targets (HEU) in nuclear research reactors so as to obtain Molybdenum-99 (^{99}Mo), precursor of ^{99m}Tc by radioactive decay. The worldwide supply of ^{99}Mo is mainly ensured (more than 90%) by only five nuclear research reactors that are more than forty years old. In 2009, extended shutdowns of two of them, Chalk river in Canada and Petten in Netherlands [1,2], led to a shortage of isotopes that raises an important concern on the production of ^{99m}Tc and its supply.

Following this medical isotopes crisis, international agencies (IAEA, OECD) have mandated groups of expert to find solutions for improving the reliability of ^{99}Mo/^{99m}Tc supply. One of alternative solutions proposed in ref. [3,4] is the use of accelerator-based neutron source using a deuteron beam so as to produce fast neutrons that induce the production of ^{99}Mo via the reaction ^{100}Mo(n,2n)^{99}Mo. IFMIF/ELAMAT facility fits perfectly with the neutron source characteristics required since it leads to a most probable neutron energy of 14 MeV coming from the primary interaction of 40 MeV deuterons with a liquid-Lithium target. Within this framework, assessment of the production of ^{99}Mo and ^{99m}Tc as close as possible to real conditions will be presented and discussed.

[1] T. Ruth, Nature 457 (2009) pp. 536-537
[2] R. Van Noorden, Nature 504, (2013), pp. 202-204
[3] International Atomic Energy Agency, IAEA Nuclear Energy Series No. NF-T-5.4, IAEA, Vienna (2013)
[4] OECD NUCLEAR ENERGY AGENCY, "The supply of Medical radioisotopes: Review of potential Molybdenum-99/Technetium-99m production technologies", OECD Publishing, Paris (2010)