PRODUCTION OF FISSION PRODUCT ^{99}Mo USING HIGH ENRICHED URANIUM PLATES IN RESEARCH REACTOR MARIA STATUS OF MOLYBDENUM PROGRAM

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The main objective of ^{235}U irradiation is to obtain the ^{99m}Tc isotope, which is widely used in the domain of medical diagnostics. The decisive factor determining its availability, despite its short life time, is a reaction of radioactive decay of ^{99}Mo into ^{99m}Tc. One of the possible sources of molybdenum can be achieved in course of the ^{235}U fission reaction.

The paper presents activities and the calculations results obtained upon the feasibility study on irradiation of ^{235}U targets for production of molybdenum in the MARIA Research Reactor. Since 2011 reactor MARIA joined the global net of reactors irradiated uranium targets for ^{99}Mo production. The main producers of highly enriched uranium targets offer the uranium targets from ^{235}U dispersed in aluminum: UAl_xAl as well as oxide's targets containing uranium at the form of UO_2. Bearing in mind the targets of this type a technology of their irradiation in MARIA research reactor has been developed. The relation of activity of ^{99}Mo is formed from the fission power generation in the plate-target. It is a basis for the development of irradiation technology for uranium plates in MARIA reactor. It has been directly used as relation between the fission power to be generated in uranium plates being irradiated and the activity of ^{99}Mo to be formed.

Neutronic calculations and thermal and flow analyses were performed to estimate the fission products activity for uranium plates which are irradiated in the reactor. Results of dummy targets irradiation as well as irradiation uranium plates have been presented. The new technology obtaining ^{99}Mo is based on irradiation of uranium plates in standard reactor fuel channel. Measurements of temperatures and the coolant flow in the molybdenum installation carried out in reactor SAREMA system give on-line information about the current fission power generated in uranium targets. The corrective factors were taken into account as the heat generation from gamma radiation from neighboring fuel elements as well as heat exchange between channels and the reactor pool. The factors were determined by calibration measurements conducted with aluminum mock-up of uranium plates.

The activities, including technical assumption, were focused on performing calculation for modeling of the target and irradiation device as well as adequate equipment and tools for processing in reactor. The presumed mode of the heat removal generated in the fuel charge of the reactor primary cooling circuit influences the construction of installation to be used for irradiation and the technological instrumentation.

Molybdenum-99 deficit, which occurred on the global market, and the pressure of international organizations for fuel conversion of nuclear reactors with highly enriched ^{235}U into low enriched one, but primarily, intention to remain independent of ^{99}Mo supply from unstable global markets, encouraged the management board of NCBJ to undertake action to design and build on the territory of Świerk Centre production complex consisting of plant for ^{99}Mo extraction from irradiated uranium targets in MARIA reactor and plant for production of $^{99}Mo/^{99m}Tc$ generators. The project is called "Molibden-Świerk" has been established. The project aims at ^{99}Mo production in two processing lines of the capacity of 500 Ci 6-day ^{99}Mo each. Generators production in the amount of around 500 items per week will be carried out in one technological line. The location of the Project is planned in the direct vicinity of MARIA reactor.