PHYSICS STUDY FOR A LEU MO TARGET IRRADIATION AT HANARO

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ABSTRACT

Studies on the target irradiation for fission Mo production at HANARO have been steadily progressed. Low enriched uranium foil, which is the most promising LEU target for fission Mo production and is now under development here, is adopted as a target. Physics concerns are reviewed in some detail with an assumption that the LEU foil target is being irradiated at the OR irradiation hole in HANARO. The LEU foil target geometry is decided considering the OR hole size and the domestic demand for Mo-99 activity. It is an annulus type and its thickness is 100μm. Reactivity change due to target loading is examined to confirm the reactor safety. It is estimated to be less than 0.8mk with a standard deviation of 0.24mk. Even the irradiation of the two targets gives only 1.6mk of a reactivity change including an uncertainty. This is much lower than the safety limit of an experiment. The target will be loaded and unloaded during the reactor operation. Considering the small reactivity effect of the target, the irradiation activities of the target will not cause severe reactivity induced accidents. The thermal neutron fluxes at the vertical irradiation holes and horizontal beam tubes in the reflector should not be perturbed much due to the target irradiation. Most of the fluxes are maintained within a 2% fluctuation. The calculated powers at one target are in the range of 30~36kW. This power can produce a specific activity of 45~54 Ci Mo-99/gU at the end of irradiation.

1. Introduction

Mo-99 is one of the most important radioisotopes in nuclear medicine. Even though the demand for Mo-99 is small, it is indispensable in cancer diagnosis. Mo-99 has a relatively short half-life of 66.7hrs. Thus, a continuous and constant supply is important. Currently, the domestic demand of Mo-99 has been totally fulfilled by imported ones. Since HANARO's first operation in 1995, a study on producing Mo-99 with a highly enriched uranium target has been conducted to fully utilize HANARO for several years[1,2]. Various target materials and geometries proper for the irradiation hole were studied to maximize fission Mo production. In addition, the chemical process for Mo extraction and the manufacture of the Cintichem type target were actively tested. However, use of HEU became difficult because of nuclear nonproliferation.

In the meantime, we launched a program for the development of fabrication technology for uranium foil which was considered as the most promising LEU target for fission Mo production, and succeeded in developing a trial product of the uranium foil of 100~200μm in thickness[3]. With the good R&D infrastructure through the HEU study and the LEU target fabrication technology, the program for fission Mo production was redirected to use the LEU target.

It is expected that there will be a gradual increase of the Mo-99 demand in the domestic fields according to the economic growth. An increase of the terror threat for air transportation changes the situation for a constant supply of Mo-99. A research reactor itself needs a periodic shutdown for maintenance. These