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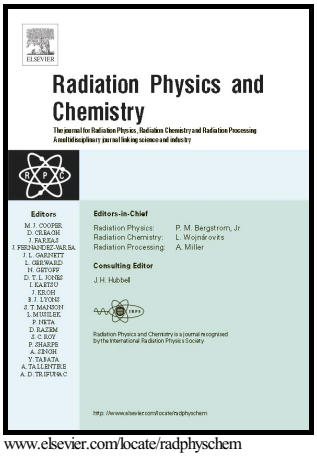

www.elsevier.com/locate/radphyschem

PII: S0969-806X(18)30290-1
DOI: https://doi.org/10.1016/j.radphyschem.2018.06.010
Reference: RPC7885

To appear in: *Radiation Physics and Chemistry*

Received date: 5 April 2018
Revised date: 5 June 2018
Accepted date: 7 June 2018

Cite this article as: Jamal Al Zain, O. El Hajjaji and T. El Bardouni, Calculation of the Activity Inventory for the MNSR Reactor Using DRAGON4 Code, *Radiation Physics and Chemistry,* https://doi.org/10.1016/j.radphyschem.2018.06.010

Calculation of the Activity Inventory for the MNSR Reactor Using DRAGON4 Code

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Abstract
A study on the fuel burnup and radioactive inventory of the Miniature Neutron Source Reactor (MNSR), after ten years of expected life of the reactor core, is conducted to validate the computer code DRAGON4 for the cluster geometry of the reactor. Excess reactivity of the reactor is calculated versus the fuel burnup time with different power levels 10, 15, 20, 25, and 30 KW. Furthermore, the concentrations and activities of the most important fission products, the actinide radionuclides accumulated, and the total radioactivity inventory of the MNSR core has been calculated using the DRAGON4 code and through comparison with the available results. A good agreement is observed between the present calculations of the DRAGON4 code, in addition to the previously published results of the GETERA and WIMSD4 codes.

Keywords: MNSR Reactor, DRAGON4 Code, Excess Reactivity, Fuel burnup, and ENDFB-IIV.1

Introduction
The operation of a nuclear fission reactor results in large formation of actinides and fission products. Their amount depends on the fuel residence time and core burnup, according to the specific core behavior. As the burnup and residence time increase, a lot of fission products are built up in the fuel element. A good knowledge of the fission products yield distributions is highly important not only for calculation of toxicity of residual of the products of fission(Solders et al., 2013), but as well for correct modeling of decay heat, and impact of fission products on fuel behavior during irradiation and later for a safe handling and shipment of the spent fuel. In addition, detailed analysis of the spent fuel's content is required to dispose it in an environmentally safe manner. The actinides and fissile products present in the spent fuel are calculated by several technical codes of computers. One of the most widely utilized point-depletion and radioactive decay computer codes to estimate the actinides and fission products contents of a spent fuel, and the resultant heat generation and radiation levels associated with such fuel is the DRAGON4 Code.

In this paper, the deterministic DRAGON4 code has been adopted as a powerful tool to generate the appropriate MNSR four-group cross-section libraries (ENDFB-VII.1) for the generic HEU (high enriched uranium) core. The radionuclide inventories, activity, and the reactivity decrease versus the burn-up time, which is calculated using the DRAGON4 code of the Syrian MNSR research reactor.

Reactor descriptions

The prototype Syrian MNSR is a thermal, light-water, under-moderated and cooled (by natural convection), tank-in-pool kind of low-power research reactor (CIAE, 1993). A secure nuclear