Comparative Assessment of Nuclear Criticality and Neutronic Performance Indicators of 12.1% and 12.6% Enriched LEU UO_2 Fuels for Conversion of the GHARR-1 MNSR facility

S. Anim-Sampong, B.T. Maakuu
Department of Nuclear Engineering & Materials Science
National Nuclear Research Institute, Ghana Atomic Energy Commission
P.O. Box LG 80, Legon, Accra, Ghana

G.K. Banini
National Centre for Mathematical Sciences
Ghana Atomic Energy Commission P.O. Box LG 80, Legon, Accra, Ghana

A. Andam
Department of Physics,
Kwame Nkrumah University of Science & Technology, Kumasi, Ghana

S.B. Attakorah, E. Amponsah-Amoako I. Lawson, R.B.M. Sogbadji,
G. A. Quao, H. C. Odoi, R.G. Abrefah
Department of Nuclear Engineering
School of Nuclear and Allied Sciences
University of Ghana, Legon, Accra, Ghana

J.J.R Liaw, J.E. Matos
RERTR Program, Division of Nuclear Engineering
Argonne National Laboratory
9700 South Cass Ave, Argonne, 60439, IL, USA

Abstract

Neutronic feasibility studies for converting the Ghana MNSR facility from HEU to LEU core have been performed using stochastic Monte Carlo particle transport methods. Several MCNP transport calculations using LEU UO_2 fuel of varying enrichments but same fuel element dimensions and core configuration as the reference HEU core have been made in this feasibility studies. A critical core with 344 LEU UO_2 fuel pins enriched to 12.6% has been reported for the Ghana MNSR. It has recently been reported that it is possible to achieve criticality with LEU UO_2 of reduced fuel element dimensions in a similar MNSR-based. Following this report and in support of on-going IAEA Coordinated Research Project activities on conversion of MNSR facilities to LEU cores, further neutronic analysis and feasibility studies have been made on MNSR cores using LEU UO_2 with reduced fuel element dimensions. In this paper, the results of the scoping studies for achieving nuclear criticality on the Ghana MNSR core with fuel element dimensions enriched to 12.1% is reported. The paper also presents results of other neutronic analysis of the *two candidate LEU cores* (12.1% and 12.6% enriched) from which a comparative assessment of the performance indicators are made.