

## Prompt neutron lifetime calculations for the NIRR-1 reactor

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**Abstract.** Prompt neutron lifetime calculations have been performed for the NIRR-1 reactor HEU and LEU cores using the  $1/\nu$  insertion and the Adjoint flux weighing methods. Results of calculations obtained for the HEU and LEU cores are respectively  $57.3 \pm 0.8$  and  $47.5 \pm 0.7$  for the  $1/\nu$  insertion and  $56.9 \pm 0.3$  and  $46.3 \pm 0.5$  for the Adjoint flux. There is a good agreement seen between the two methods for both cores. The prompt neutron lifetime was observed to be shorter in the LEU than for the HEU as expected. However, the Adjoint flux weighing method seemed to be the easiest method in calculating the prompt neutron lifetime for NIRR-1.

**Keywords:** prompt neutron lifetime; HEU; LEU; MCNP; enrichment; MNSR; neutron activation analysis

### 1. Introduction

The Nigeria Research Reactor-1 (NIRR-1) is a commercial version of the Miniature Neutron Source Reactor (MNSR) designed by China Institute of Atomic Energy (CIAE). It is a pool type reactor, with a compact core having a low critical mass of about 1 kg. It is fueled with HEU consisting of 347 fuel pins in a single fuel assembly enriched to about 90.2% in UAl metal alloy clad with Al.

The fuel assembly consists of ten concentric zones or rings of 350 fuel lattices distributed about a single central control rod. The rated power is 31 kW corresponding to a peak thermal flux of  $10^{12}$  n/cm<sup>2</sup>.s. The core is cooled and moderated (with H/U ratio=197) by light water with beryllium as the reflector making the reactor critical with a limited ( $1/2 \beta_{eff}$ ) built in clean cold excess reactivity of about 4 mk. It has large negative temperature coefficient of reactivity which boosts its inherent safety.

The reactor is designed specifically for Neutron Activation Analysis, Education and training

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