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Journal Name:	<a href="#">Physical Science International Journal</a>
Manuscript Number:	Ms_PSIJ_23545
Title of the Manuscript:	NEUTRONICS STUDY OF NIRR-1 FUELLED WITH 19.75% UO <sub>2</sub> MATERIAL USING VENTURE-PC AND SCALE 6.1 CODES
Type of the Article	Original Research Articles

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This journal's peer review policy states that **NO** manuscript should be rejected only on the basis of '**lack of Novelty**', provided the manuscript is scientifically robust and technically sound.

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**PART 1: Review Comments**

	Reviewer's comment	Author's comment (if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)
<b>Compulsory</b> REVISION comments	<p>It is important to convert HEU to LEU of NIRR-1 fuel, and this manuscript describes some features of the LEU core . Therefore it is interesting, but it is necessary to compare the main neutronics features in more detail between the HEU core and the LEU core. In discussing the control rod worth, the authors should describe the required reactivity worth and shutdown margin for the two cores (different or same?) . The reactivity versus shim thickness is shown in figure , but there is no explanation about the determined shim thickness that meets the design requirement.</p> <p>Also for flux distributions it is desirable to compare with those of HEU core , and discuss the differences between the two cores. This will make the difference more clear.</p>	<p>The basic design and performance features for the present HEU core and the proposed LEU core of the NIRR-1 reactor are summarized in table 1.0.</p> <p>The value of the total control rod worth obtained for this work from the four group calculation for the LEU core is 7.23mk which is in good agreement when compared to the experimental result of 7.0mk for the HEU core and with the similar results calculated by G.I Balogun using CITATION code (Balogun, 2003), S.A Jonah using MCNP code (Jonah et al., 2007) and S. Abdulhameed using VENTURE-PC code (Salawu, 2012). The total rod worth of about 7.25mk associated with 23cm travel length of NIRR-1 control rod from the 2007 MNCP calculation was used to make comparison with the result of the four group VENTURE-PC calculation for the LEU (UO<sub>2</sub>) fuel. The slight change in the total control rod worth for the two cores occurs as a result of difference in energy resolution between the different methods used.</p> <p>The value of reactivity worth of the top beryllium shim was obtained for each shim thickness ranging from 1.2cm to 10.95cm (see table 4.0). The model was able to calculate the shim reactivity worth for any thickness between the minimum (1.2cm) and the maximum thickness (10.95cm). The obtained value for the reactivity worth and shutdown margin for the new LEU core are 4.04mk and 3.19mk</p>



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		<p>respectively. This values are in good agreement with the design specification of 3.5mk – 4.0mk for MNSR as reported by (Chengzen, 1993), the Final Safety Analysis Report (FSAR, 2005) and HEU (UAl<sub>4</sub>) value reported by (Balogun, 2003). The slight difference between the measured and computed reactivity worth shows that during measurements the shim plates were stacked over each other and submerged in water. There is always a thin film of water remaining between the adjacent shim plates. Since the shim plates are in form of semi-circular plates, there is always some amount of water confined in the slot between each pair of semi-circular plates. The presence of water in beryllium therefore increases the thickness and the worth of beryllium being measured. During calculation no water was taken into account while modeling the beryllium shim plates in the shim tray. As a result of this the measured reactivities for the HEU core are higher than the computed reactivities for the proposed LEU core as given in table 4.0.</p> <p>The calculated magnitudes of axial distributions of thermal, epithermal, resonance and fast neutron flux in the inner and outer irradiation channels for the proposed LEU (19.75% UO<sub>2</sub>) core for NIRR-1 were plotted as shown in figures 2.0 and 3.0 respectively. The inner and outer irradiation channels locations were selected at radial distances of 16.77cm and 26.79cm from the core center. The figures (2.0 and 3.0) also shows the computed results of the 2-D vertical Y-directed neutrons flux profiles expected at various region within the NIRR-1 (MNSRs) core model for the potential LEU core (19.75% UO<sub>2</sub>). The thermal neutrons flux level, peak power density and maximum neutron density calculated in the</p>
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		<p>potential LEU core are <math>1.24 \times 10^{12} \text{ ncm}^{-2}\text{s}^{-1}</math>, <math>4.31033 \pm 00 \text{ W/cc}</math> and <math>6.94535 \pm 6 \text{ neutron/cc}</math> respectively. The calculated thermal neutron flux level is approximately equal to that of the present HEU core of <math>1.1 \times 10^{12} \text{ ncm}^{-2}\text{s}^{-1}</math>. We observed that the thermal neutrons flux level in the potential LEU core is slightly lower when compared with a similar neutrons flux in the HEU core due to hardening of the neutron spectrum. This implies that the total number of neutrons that were able to get to the thermal energy in the moderation or thermalization processes is lower in the LEU core than in the HEU core. The high energy neutrons flux level will be lower in the LEU core as compared to the HEU core. The slightly bottom peaked anti symmetric thermal neutron flux profile observed in the inner irradiation location is exactly what is expected in the proposed LEU core when compared with the present HEU core. This is due to the difference in beryllium reflector material at the top and bottom of the NIRR-1 core with a corresponding difference in the magnitude of the beryllium reflector peak at the two locations. Since the outer irradiation location is filled with water, we observed a symmetric neutron flux profile in this region. The difference in neutron flux level for the two cores can be attributed to relative increase in neutron absorption due to increased loading of U-238 in LEU core. We did not observed any reflector peak in the high energy neutron flux as shown in figures (2.0 and 3.0), this is due to the fact that fast neutrons are not affected on the average by the reflector materials (i.e. water or beryllium) in the NIRR-1 core.</p>
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<b><u>Minor</u></b> REVISION comments	<p>There are many miss-types in the manuscripts. Please revise!</p> <p>Check the line 23 (reactorsdue) Line 54 attempt → attempts 61 results used → results to be used 64 usedto → used to 66 ofNIRR → of NIRR 85 (3.0) put this number at the right hand side 115 show → shows 130 ccand → cc and 132 for the present HEU core. → Eliminate! 136 weobserved → we observed 154 different → difference 155 compare → compared</p>	<p>All the miss-types words in the manuscripts have been revised and each line has been corrected.</p>
<b><u>Optional/General</u></b> comments	<p>Please check the manuscript more carefully.</p>	<p>Have carefully checked the manuscript and critically take note of the miss-types words.</p>