CONVERSION OF KUCA DRY CORES WITH THE USE OF DISPERSED U7MO FUEL

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ABSTRACT

Under the US Department of Energy (DOE) Material Management and Minimization Program (M3), the Kyoto University Research Reactor Institute (KURRI) and Argonne National Laboratory (Argonne) continue a collaboration to optimize conversion of the Kyoto University Critical Assembly (KUCA [1]) from High Enriched Uranium (HEU) to Low Enriched Uranium (LEU) fuel.
Previous studies [2] demonstrated the feasibility of converting the 93% HEU KUCA cores to the use of 19.75% LEU U10Mo fuel by preserving the reactivity and central flux spectra. It was determined that the U10Mo fuel foils should be fabricated with a thickness as thin as 12 mils. This LEU KUCA core design would be very sensitive to eventual tolerances, especially associated with the thickness of the U10Mo foil. A challenge particular to this type of critical assembly is that the fuel is constrained to equal the 5.1 x 5.1 cm dimensions for the drawers without an un-fueled edge. Thus the loading cannot be adjusted, as is ordinarily done in other reactors, using several dimensions. Consequently, the thickness would require an extremely high accuracy. This paper presents results of new conversion studies that propose the use of 19.75% enriched U7Mo fuel, dispersed in an aluminum (Al) matrix.

1. Introduction

Feasibility studies on the conversion from HEU to LEU fuel were performed for five “type-A” KUCA cores (named as A3/8"P36EU[1], B2/8"P48EU, B1/8"P80EU, B1/8"P60EUEU and B1/8"P48EUEUEU) characterized by different moderator-to-fuel volume ratios (V_m/V_f) and different H-to-U235 atom ratios (H/U5) for the purpose of analyzing a broad range of neutron spectra that are representative of both fast and thermal systems. Past studies [2] demonstrated the feasibility of converting the KUCA cores with the use of U10Mo fuel consisting of foils of 12 mils thickness. The resulting LEU cores were found to be very sensitive to fabrication tolerances, especially on the thickness of the U10Mo foils since the width and length are highly constrained for KUCA. The present paper discusses the feasibility of converting the same KUCA cores with the use of alternate types of LEU fuels, namely a dispersion of 19.75% enriched U7Mo in an Al matrix. Studies were performed with dispersed U7Mo fuel densities of 8 gU/cc and 6 gU/cc. Additionally, the sensitivity to fuel fabrication tolerances of the LEU loadings was also investigated. It is demonstrated that the use of dispersed U7Mo reduces the dependence of the core reactivity on fabrication tolerances relative to the use of U10Mo fuel.

2. HEU and LEU KUCA Configurations

Figure 1 shows the core layouts of the five HEU KUCA configurations selected for the conversion study, while Figure 2 shows the cross-sectional view of the respective fuel assemblies and unit cells (see Ref. 1 for other details).

[1] In these designators, the letters “A” or “B” refer to two different configurations of gaps between assemblies for flux wire arrangements; the fractional value (e.g., 3/8"P) specifies the thickness of the polyethylene in the unit cell; the following value denotes the number of times the unit cell is repeated in the core region of the assembly; and the number of times “EU” is repeated indicates the number of uranium plates in the unit cell.

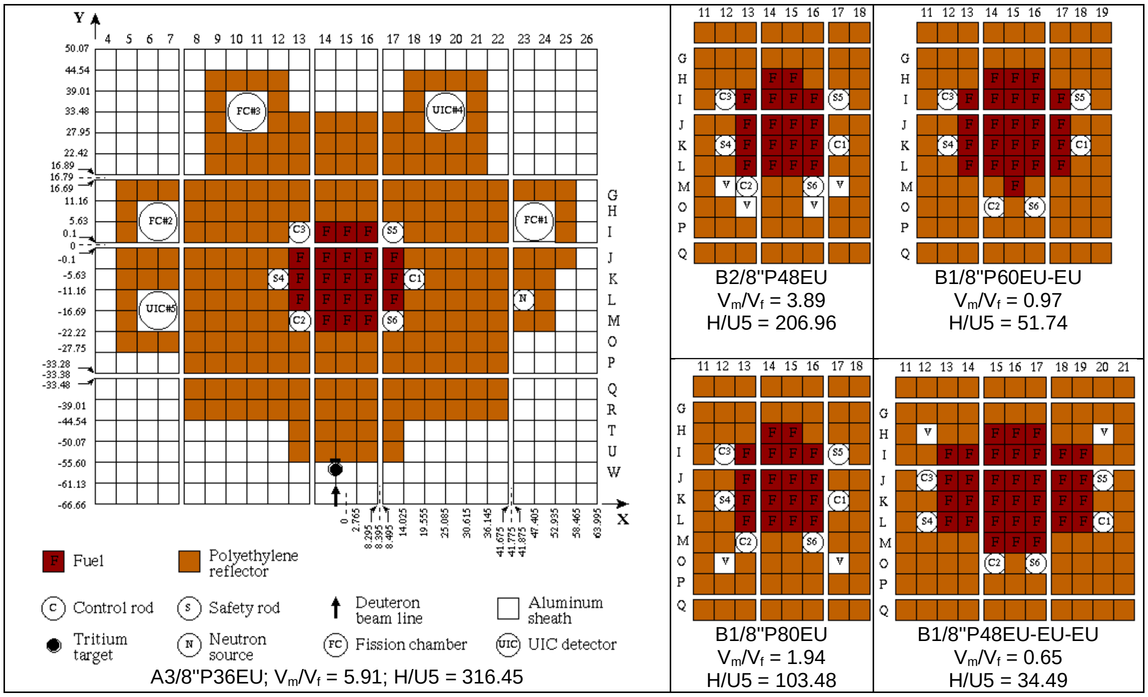


Fig 1. Layouts of the investigated KUCA cores

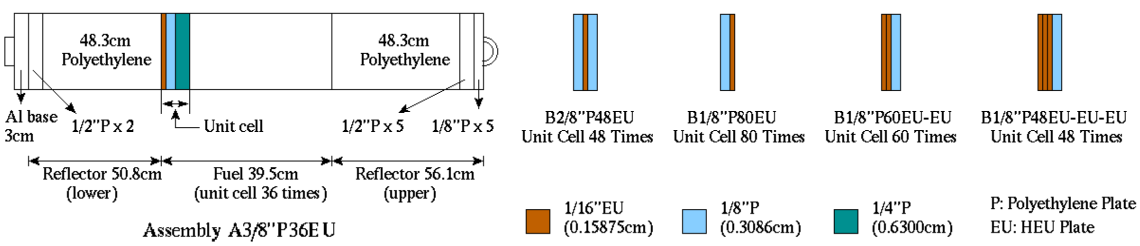


Fig. 2. Cross sectional view of the KUCA fuel assemblies

3. Conversion study approach

The following constraints are applied in this conversion study:

- The defined LEU loadings should preserve approximately the same reactivity and central flux spectra of the corresponding HEU cores.
- The LEU loadings should also preserve approximately the same core size. Particularly, the LEU loadings should keep the same core height of the corresponding HEU cores while only a limited number of fuel assemblies can be added or removed radially.
- The conversion study should identify a single LEU coupon that is suitable for the conversion of all five HEU cores considered.
- In the conversion from HEU to LEU, only the fuel in the unit cell is replaced while the polyethylene plates remain exactly the same and with the same arrangement.

4. Definition of LEU coupons

For the conversion of the KUCA cores, each 1/16-in. (62.5-mils) HEU plate is replaced with LEU fuel clad by Al on both sides, as shown in Figure 3. In the present work, we will always refer to the HEU fuel as a “plate”, as deemed appropriate for the 1/16-in. thickness involved in this case. With LEU fuel the resulting thickness from the conversion study is much smaller than with the use of HEU fuel. Thus, we will refer to the LEU fuel as a “foil” in the case of “monolithic” fuel or simply “LEU fuel” in the case of dispersed fuel. Additionally, we will use the term “LEU coupon” to refer to the sandwich of the LEU fuel plus the two clad sides (see Figure 3). The X and Y dimensions of the LEU fuel are the same of the HEU plate being replaced. The thickness of the LEU fuel, being the key parameter of the study, is determined through iterative calculations. Depending on the thickness adopted for the Al clad, two types of coupons are considered. In one case, for a given thickness of the LEU fuel, the thickness of the Al clad is set so that the total extension of the coupon (LEU fuel plus 2 clad sides) remains the same as the initial HEU plate being replaced (coupon A). In the other case, the thickness of the Al clad is always set at 12 mils (coupon B). In this case, the total thickness of the LEU coupon is smaller than that of the HEU plate being replaced, so that more unit cells can be loaded along the axial extension of the core. As it will be demonstrated later, reducing the clad thickness will also reduce the overall fuel mass needed to attain the critical state. For the coupon type B, the 12-mils value is adopted as the thinnest Al clad that can be fabricated.

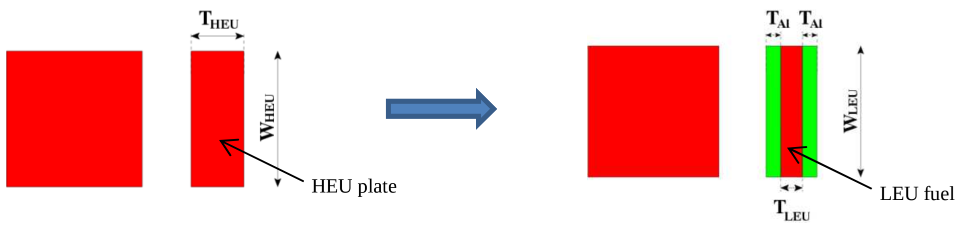


Fig. 3. HEU fuel plate and LEU fuel coupon

5. Conversion study approach

Iterative calculations are first performed to determine the thickness of the LEU fuel that assures preservation of central flux spectra between the HEU and LEU loadings. The first solid guess for such a thickness of the LEU fuel is the value that preserves the same H/U5 atom ratio between the HEU and LEU loadings.

Flux spectra are obtained in a central assembly [assembly (K,15) for the configuration of largest V_m/V_f and assembly (J,15) for all other configurations with both HEU and LEU] and were determined as average values in a specific region of the LEU fuel (or HEU plate) closest to the core midplane. This region is 1 cm × 1 cm with an axial extension that corresponds to the thickness of the LEU fuel (or HEU plate). All flux spectra are obtained in 53 energy groups. The calculations are performed in “homogeneous” mode, i.e. in absence of the external (D-T) neutron source usually present in these configurations.

Once determined the thickness of the LEU fuel that preserves the same central flux spectra of the corresponding HEU cores, the match of the reactivity values between the LEU and HEU cores can be achieved by adding (or removing) peripheral fuel assemblies in the LEU core. With this approach, in fact, it is possible to adjust the reactivity level of the LEU cores without any significant change in the central flux spectra.

All calculations discussed in this study are based on maximum reactivity configurations (i.e., all control and safety rods are fully withdrawn).

6. Issues with the use of high-density fuel for the critical assembly

Studies were performed to address potential issues associated with the use of U10Mo fuel. For a given volume of U10Mo, the U-235 mass is ~5 times higher than in the same volume of the 93% enriched UAl alloy currently in use in the HEU KUCA cores. Consequently, the dimensional tolerances of the U10Mo foils in principle should be ~1/5 that of the UAl plates in order to give the same U235 mass tolerance. Considering the fact that the LEU coupons use very thin U10Mo foils, the associated sensitivity to manufacturing tolerances will be larger than that of the UAl plates. Finally, the LEU loadings of U10Mo are expected to be much more sensitive to fuel fabrication tolerances than the corresponding HEU cores.

To quantify these effects, sensitivity studies were performed for the KUCA cores with both HEU and U10Mo LEU fuel. The sensitivity of the KUCA cores to the dimensional tolerances (or irregularities) of the fuel fabrication was investigated only in terms of reactivity impact. Also, due to the extremely small dimensions that are involved, the fabrication of the LEU coupons with U10Mo foils may also be affected by several types of irregularities, some of which cannot even be easily reproduced by the calculations, such as surfaces not completely flat or parallel, tiny bumps just on the edge of the foil, etc. Additionally, each coupon may have a different type of irregularity with respect to the other coupons in the same fuel assembly. Since the sensitivity studies assume that all coupons/plates in the cores are affected by the same type of irregularity, the results should be taken just as an indication of the effects due to potential variations of the fuel thickness in the most conservative case.

Figures 4 and 5 show the multiplication factor values obtained for the LEU KUCA configurations defined in the conversion study [2] and the HEU core of largest V_m/V_f (i.e., KUCA A3/8”P36EU) by varying the thickness of the U10Mo foil or the HEU plate. Similar sensitivity curves showing the effect of Al clad thickness variations can be found in Ref. 2. The k_{eff} values corresponding to the nominal dimensions are marked by the symbol “◊” for each configuration. The results presented in Figure 4 refer to the case where a 100mil Al edge was placed all around the LEU foil.

From Figure 4, it appears that the reactivity impact of potential fabrication tolerances on the U10Mo thickness can be dramatic. Particularly, even a fabrication tolerance as small as 1 mil could have a reactivity impact as large as ~1500 pcm in the worst case, that for this type of sensitivity corresponds to the configuration with largest V_m/V_f, i.e. KUCA A3/8"P40LEU(12)E+7.

For comparison purposes, Figure 5 shows the reactivity impact in the KUCA HEU configurations due to potential variations in the thickness of the fuel plates. The results are presented only for the configuration with the largest V_m/V_f that represents the worst case for this type of sensitivity. It is observed that with the HEU loadings, a 1-mil variation of the fuel plate thickness would have a reactivity effect of only ~200 pcm in the worst case. Note that the volume associated with 1-mil tolerance is also slightly larger than in the LEU case. Because of the assumed Al edge, 1-mil increase in the thickness of the LEU U10Mo foils corresponds to a volume change that is 23% smaller than the volume change associated with 1-mil increase in the thickness of the HEU plates.

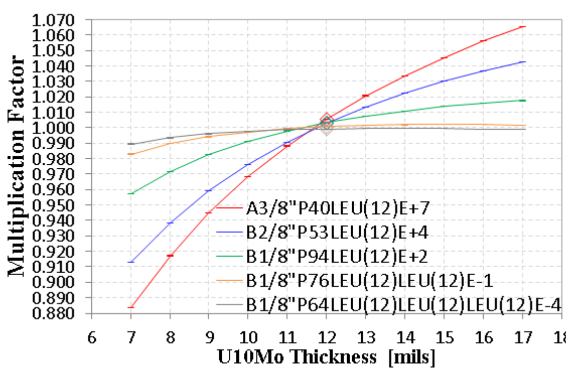


Fig. 4. Sensitivity of KUCA LEU keff values to the tolerances of U10Mo thickness

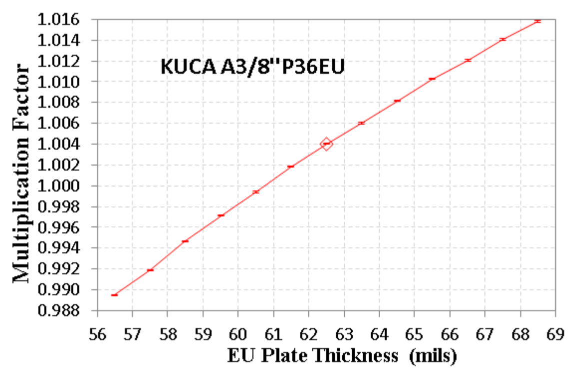


Fig. 5. Sensitivity of KUCA HEU keff values to the tolerances of the fuel plate thickness

The results discussed in this section make it clear that the fabrication of the U10Mo coupons requires extremely high accuracy. A challenge particular to this type of critical assembly is that the fuel foil is constrained to equal the 5.1 x 5.1 cm dimensions for the drawers without an un-fueled edge. Thus the loading cannot be adjusted, as is ordinarily done in other reactors, using several dimensions.

Based on the discussed sensitivity results, alternative LEU fuels were considered for the conversion of the KUCA cores. Particularly, with dispersed U7Mo the uranium density is smaller than that of the U10Mo fuel so that the conversion of the KUCA cores would be more feasible with the use of dispersion fuel where the dispersed fuel particle loading is controlled by addition to the compact material rather than through physical dimensions.

7. Conversion of the KUCA configuration using U7Mo fuel coupons

This section shows the results of the KUCA conversion study with dispersed U7Mo fuel of two different density values, 8 gU/cc and 6 gU/cc. According to the conversion approach described in Section 5, parametric calculations were performed to target first the same central flux spectrum between the LEU and HEU KUCA configurations. As a first attempt, the thickness of the dispersed U7Mo fuel was fixed so that the H/U5 atom ratio between the HEU and LEU configuration is preserved. This results in a fuel thickness of 23.27 mils for the case of dispersed U7Mo at 8 gU/cc. The central flux spectra of the resulting LEU configurations appear slightly harder than that of the HEU cores, as shown, for example, in Figures 6 and 7 for the configuration of largest V_m/V_f. Both coupon types A (KUCA A3/8''P6LEU(19.62_Al;23.27_U7Mo_8gU/cc)) and B (KUCA A3/8''P36LEU(12_Al;23.27_U7Mo _8gU/cc)) were used. New attempts were then made to match the spectra by reducing the thickness of the U7Mo fuel.

Finally, it was found that to preserve the central flux spectra for all selected configurations the thickness of the dispersed U7Mo fuel at 8 gU/cc should be fixed at 21 or 22 mils for both coupon types A and B (as shown in Figures 6 and 7 for the case of the largest V_m/V_f configuration). Further investigations were done with the 22-mils thick fuel, assuming that it is always preferable to have thicker fuel. The results also indicate that the thickness of the Al clad (at the least in the range of values considered in this study) does not have any significant impact on the central flux spectra.

Once determined the thickness of the LEU fuel that preserves the same central flux spectra of the corresponding HEU cores, the next step was to also match approximately the same reactivity between the LEU and HEU cores. As discussed in Section 5, this can be achieved by adding (or removing) peripheral fuel assemblies in the LEU cores identified in the previous step.

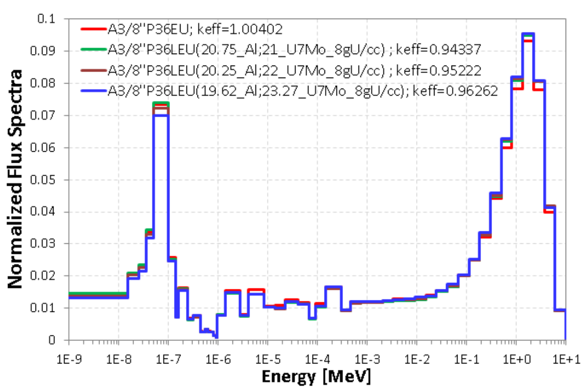


Fig. 6. Central flux spectra in A3/8''P36EU and LEU cores using coupon A: A3/8''P36LEU(20.75_Al;21_U7Mo_8gU/cc), A3/8''P36LEU(20.25_Al;22_U7Mo_8gU/cc) and A3/8''P36LEU(19.62_Al;23.27_U7Mo_8gU/cc)

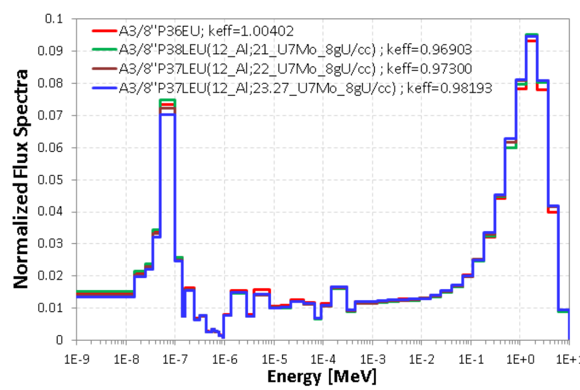


Fig. 7. Central flux spectra in A3/8''P36EU and LEU cores using coupon B: A3/8''P36LEU(12_Al;21_U7Mo_8gU/cc), A3/8''P36LEU(12_Al;22_U7Mo_8gU/cc) and A3/8''P36LEU(12_Al;23.27_U7Mo_8gU/cc)

Figure 8 shows the final layouts of the LEU cores using dispersed U7Mo at 8gU/cc that preserve both reactivity and central flux spectra of the corresponding HEU cores and meet all other constraints imposed in the present conversion study (see Section 3). Similarly to the HEU cores, the names of the LEU configurations consist of designators that are indicated in table 1.

Use of coupon A	Use of coupon B
A3/8"P36LEU(20.25_Al;22_U7Mo_8gU/cc)+4 [(a)]	A3/8"P37LEU(12_Al;22_U7Mo_8gU/cc)+2
B2/8"P48LEU(20.25_Al;22_U7Mo_8gU/cc)+4	B2/8"P51LEU(12_Al;22_U7Mo_8gU/cc)+2
B1/8"P80LEU(20.25_Al;22_U7Mo_8gU/cc)+6	B1/8"P88LEU(12_Al;22_U7Mo_8gU/cc)+2
B1/8"P60LEULEU(20.25_Al;22_U7Mo_8gU/cc) +11	B1/8" P69LEULEU(12_Al;22_U7Mo_8gU/cc)+2
B1/8"P48LEULEULEU(20.25_Al;22_U7Mo_8gU/cc)+18	B1/8"P57LEULEULEU(12_Al;22_U7Mo_8gU/cc)+0

[(a)] Designators in “A3/8"P36LEU” have the same meaning of the HEU configuration names; 20.25_Al indicates the clad thickness; 22_U7Mo indicates the thickness of the U7Mo dispersed fuel; 8gU/cc indicates the density of the fuel dispersion; “+4” indicates the number of peripheral fuel assemblies that need to be added with respect to the corresponding HEU cores to achieve the desired reactivity.

Tab. 1: Names of the LEU cores using dispersed U7Mo at 8gU/cc

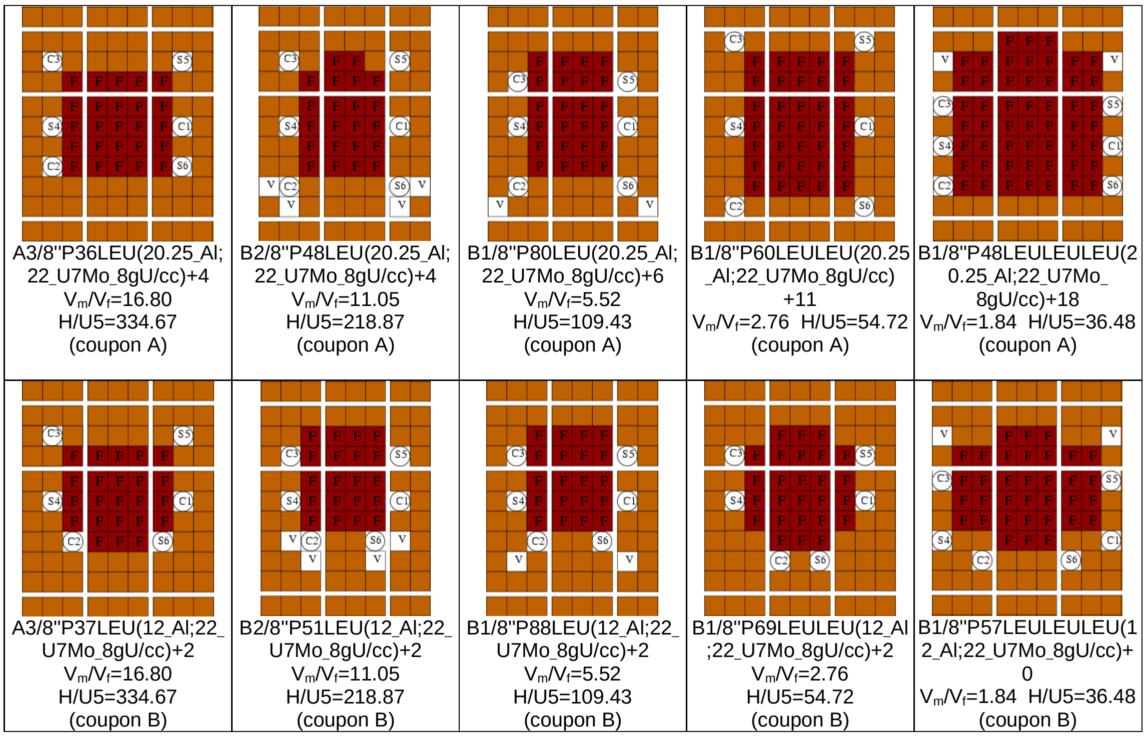


Fig. 8. Layouts of the LEU KUCA cores using dispersed U7Mo at 8 gU/cc obtained from conversion study

As shown in Figure 8, besides the additional fuel assemblies, the reactivity increase was also achieved by moving some control or safety rods farther from the core center with respect to the corresponding HEU configurations. As expected, with the use of coupon B the critical state can be attained by adding less peripheral fuel assemblies with respect to the case of coupon A, especially for the low H/U5 ratio configurations. In these configurations, in fact, reducing the clad thickness to 12 mils increases considerably the number of LEU coupons that can be loaded axially due to the presence of multiple LEU coupons per unit cell. As an example, for the configuration B1/8"P57LEULEULEU(12_Al;22_U7Mo_8gU/cc)+0, with three LEU coupons per unit cell, reducing the clad thickness to 12 mils leaves room along the core height for an additional 9 unit cells (i.e. ~1/5 more than the initial 48) so that the desired reactivity could be achieved without adding any peripheral fuel assembly. Conversely, the use of coupon A in the configuration of lowest V_m/V_f would require the addition of as many as 18 fuel assemblies to attain the critical state (configuration B1/8"P48LEULEULEU(20.25_Al;22_U7Mo_8gU/cc)+18). In this configuration, in fact, the reactivity worth of a fuel assembly added at the core boundary is much smaller because of the harder spectrum and also because the assemblies are added at an increased distance from the center due to the larger core size with respect to the high H/U5 ratio configurations. Figures 9 to 13 show the central flux spectra and reactivity values of the initial HEU and the final LEU cores using dispersed U7Mo at 8 gU/cc.

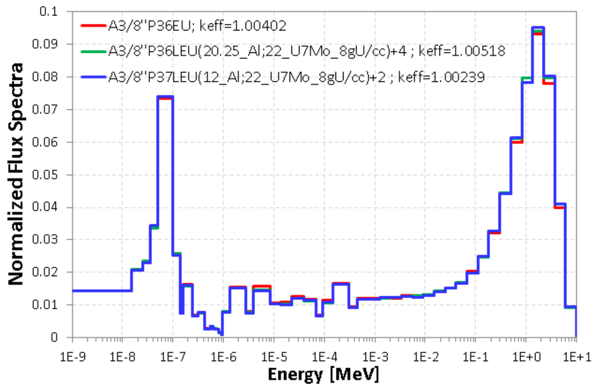


Fig. 9. Central flux spectra in A3/8"P36EU, A3/8"P36LEU(20.25_Al;22_U7Mo_8gU/cc)+4 and A3/8"P37LEU(12_Al;22_U7Mo_8gU/cc)+2

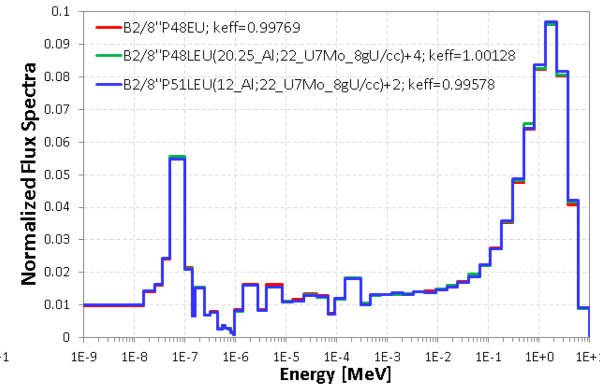


Fig. 10. Central flux spectra in B2/8"P48EU, B2/8"P48LEU(20.25_Al;22_U7Mo_8gU/cc)+4 and B2/8"P51LEU(12_Al;22_U7Mo_8gU/cc)+2

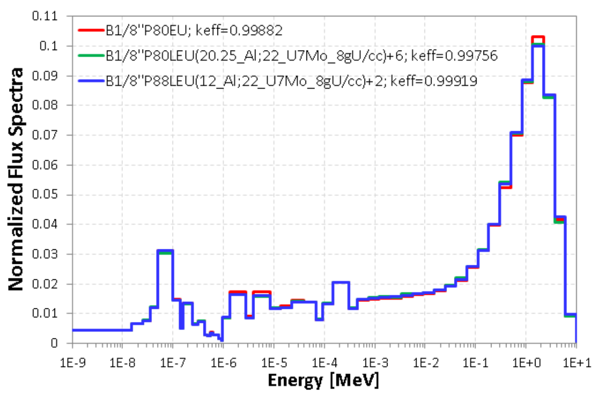


Fig. 11. Central flux spectra in B1/8"P80EU, B1/8"P80LEU(20.25_Al;22_U7Mo_8gU/cc)+6 and B1/8"P88LEU(12_Al;22_U7Mo_8gU/cc)+2

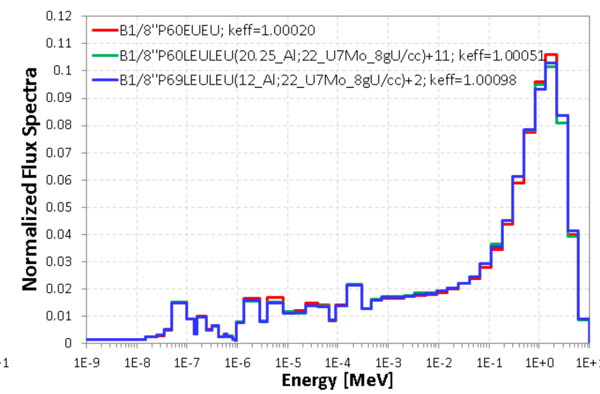


Fig. 12. Central flux spectra in B1/8"P60EUEU, B1/8"P60LEULEU(20.25_Al;22_U7Mo_8gU/cc)+11 and B1/8"P69LEULEU(12_Al;22_U7Mo_8gU/cc)+2

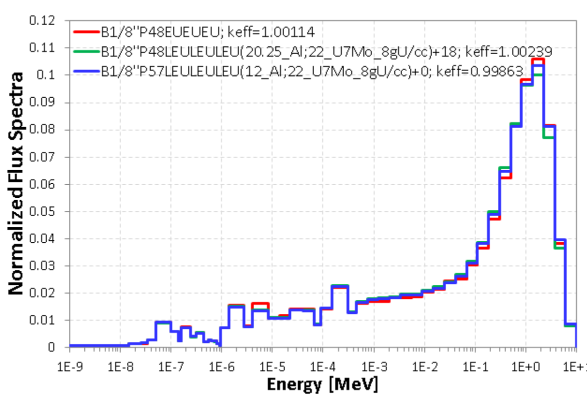


Fig. 13. Central flux spectra in B1/8"P48EUEUEU, B1/8"P48LEULEULEU(20.25_Al;22_U7Mo_8gU/cc)+18 and B1/8"P57LEULEULEU(12_Al;22_U7Mo_8gU/cc)+0

The conversion approach discussed above was repeated with dispersed U7Mo fuel at 6 gU/cc. In the first phase, it was found that the preservation of the central flux spectra of the corresponding HEU cores can be achieved by setting the thickness of the U7Mo dispersed fuel at 29 or 30 mils for both coupon types A and B. The 30-mils thickness was selected for further study, assuming again that it is always preferable to have thicker fuel. Calculations were then made to determine the number of additional fuel assemblies needed for the preservation of the HEU core reactivity as well. Figure 14 shows the layout of the final LEU cores using dispersed U7Mo fuel at 6gU/cc in both coupon configurations A and B. Note that because of the thicker 6 gU/cc U7Mo fuel, fewer unit cells can be placed in the same axial core height than with the thinner 8 gU/cc fuel, and as a result more peripheral elements must be added compared to the 8 gU/cc results. Figures 15 to 19 show the central flux spectra and reactivity values of the initial HEU and the final LEU cores using dispersed U7Mo at 6gU/cc.

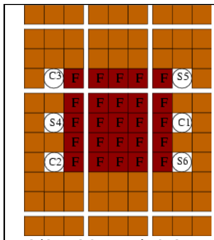
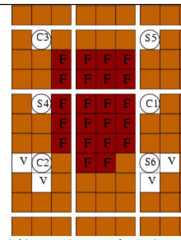
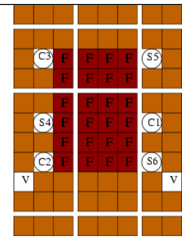
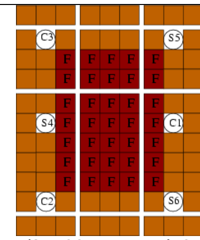
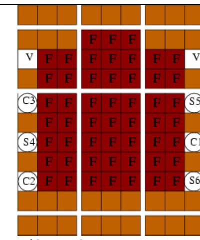
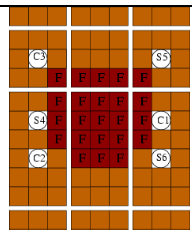
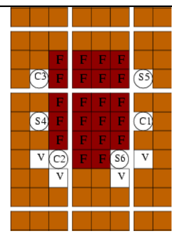
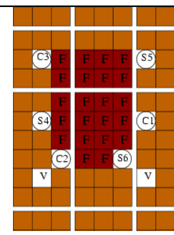
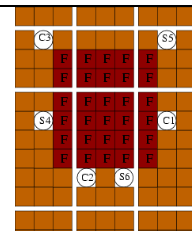
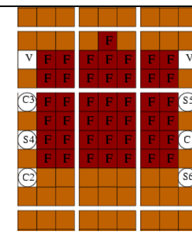
				
A3/8"P36LEU(16.25_Al;30_U7Mo_6gU/cc)+4 V_m/V_f=12.32 H/U5=327.23 (coupon A)	B2/8"P48LEU(16.25_Al;30_U7Mo_6gU/cc)+4 V_m/V_f=8.10 H/U5=214.01 (coupon A)	B1/8"P80LEU(16.25_Al;30_U7Mo_6gU/cc)+6 V_m/V_f=4.05 H/U5=107.00 (coupon A)	B1/8"P60LEULEU(16.25_Al;30_U7Mo_6gU/cc)+11 V_m/V_f=2.02 H/U5=53.50 (coupon A)	B1/8"P48LEULEULEU(16.25_Al;30_U7Mo_6gU/cc)+18 V_m/V_f=1.35 H/U5=35.67 (coupon A)
				
A3/8"P37LEU(12_Al;30_U7Mo_6gU/cc)+2 V_m/V_f=12.32 H/U5=327.23 (coupon B)	B2/8"P49LEU(12_Al;30_U7Mo_6gU/cc)+4 V_m/V_f=8.10 H/U5=214.01 (coupon B)	B1/8"P84LEU(12_Al;30_U7Mo_6gU/cc)+4 V_m/V_f=4.05 H/U5=107.00 (coupon B)	B1/8"P64LEULEU(12_Al;30_U7Mo_6gU/cc)+6 V_m/V_f=2.02 H/U5=53.50 (coupon B)	B1/8"P52LEULEULEU(12_Al;30_U7Mo_6gU/cc)+9 V_m/V_f=1.35 H/U5=35.67 (coupon B)

Fig. 14. Layouts of the LEU KUCA cores using dispersed U7Mo at 6 gU/cc

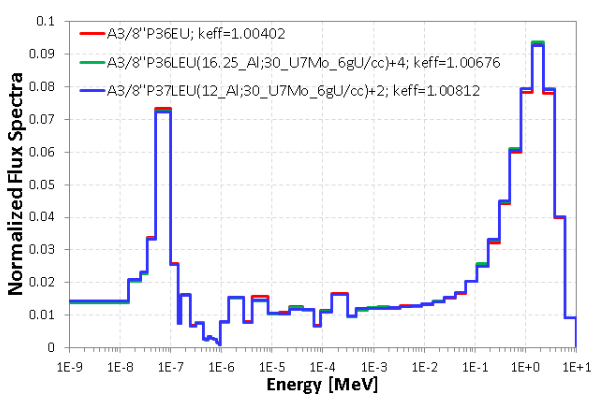


Fig. 15. Central flux spectra in A3/8"P36EU, A3/8"P36LEU(16.25_Al;30_U7Mo_6gU/cc)+4 and A3/8"P37LEU(12_Al;30_U7Mo_6gU/cc)+2

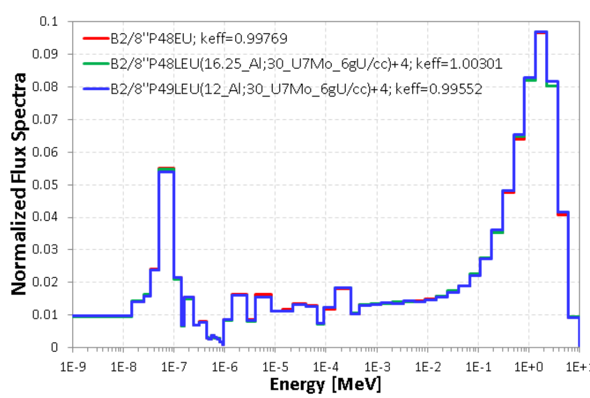


Fig. 16. Central flux spectra in B2/8"P48EU, B2/8"P48LEU(16.25_Al;30_U7Mo_6gU/cc)+4 and B2/8"P49LEU(12_Al;30_U7Mo_6gU/cc)+4

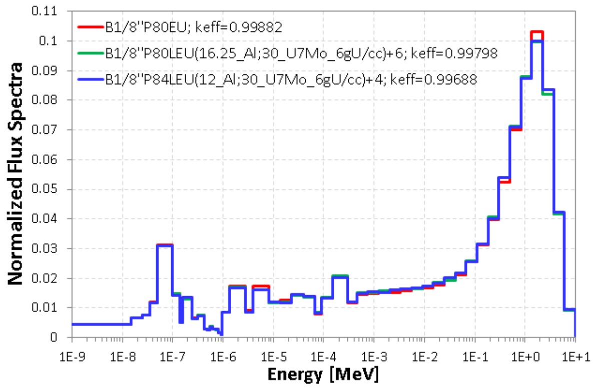


Fig. 17. Central flux spectra in B1/8"P80EU, B1/8"P80LEU(16.25_Al;30_U7Mo_6gU/cc)+6 and B1/8"P84LEU(12_Al;30_U7Mo_6gU/cc)+4

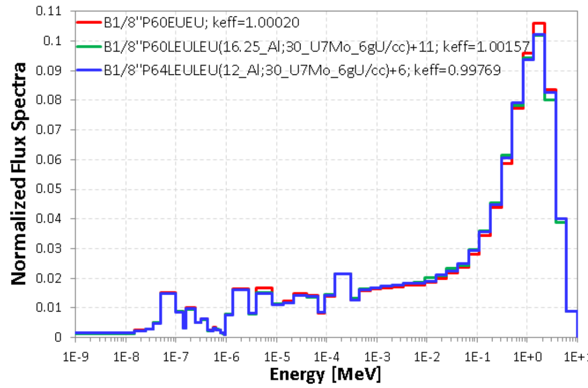


Fig. 18. Central flux spectra in B1/8"P60EUEU, B1/8"P60LEULEU(16.25_Al;30_U7Mo_6gU/cc)+11 and B1/8"P64LEULEU(12_Al;30_U7Mo_6gU/cc)+6

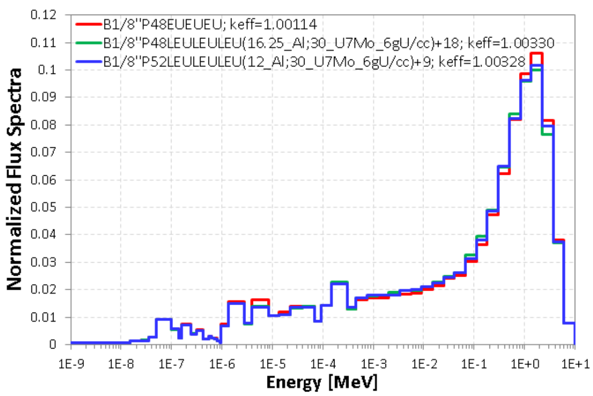


Fig. 19. Central flux spectra in B1/8"P48EUEUEU, B1/8"P48LEULEULEU(16.25_Al;30_U7Mo_6gU/cc)+18 and B1/8"P52LEULEULEU(12_Al;30_U7Mo_6gU/cc)+9

8. Sensitivity of the U7Mo LEU cores to fuel fabrication tolerances

Additional calculations were made to quantify the sensitivity of the KUCA LEU loadings using dispersed U7Mo fuel with both 8 gU/cc and 6 gU/cc to the dimensional tolerances of fuel fabrication. The study was limited to the configuration of largest V_m/V_f, i.e., KUCA A3/8"P36LEU(12_Al;22_U7Mo_8gU/cc)+2 and KUCA A3/8"P36LEU(12_Al;30_U7Mo_6gU/cc) +2. The sensitivity was investigated in terms of reactivity effects due to variations in the thickness of the LEU fuel. Results are presented in Figures 20 and 21.

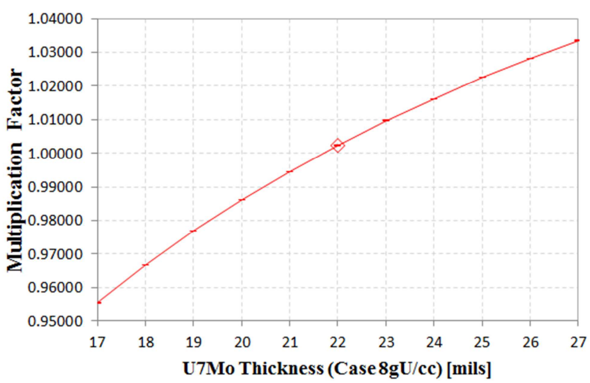


Fig. 20. Sensitivity of KUCA A3/8"P36LEU(12_Al;22_U7Mo_8gU/cc)+2 k_{eff} values to the tolerances of dispersed U7Mo thickness

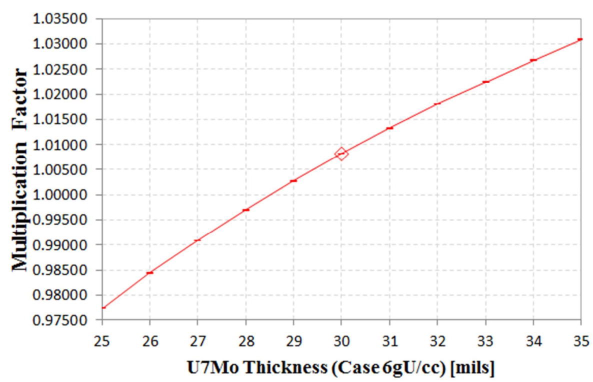


Fig. 21. Sensitivity of KUCA A3/8"P36LEU(12_Al;30_U7Mo_6gU/cc)+2 k_{eff} values to the tolerances of dispersed U7Mo thickness

It can be seen that for the case of 8gU/cc, a 1-mil variation in the thickness of the LEU fuel would cause a reactivity effect of ~800 pcm. Note that the configuration of largest V_m/V_f is the worst case for this type of sensitivity. On the other hand, the effect decreases to ~500 pcm in the case of 6 gU/cc. The results are quite encouraging if we consider that with the use of U10Mo it was found that the LEU loadings were extremely sensitive to potential fuel fabrication tolerances (effects of ~1500 pcm for 1-mil variation of the LEU foil thickness in the worst case) since for this critical assembly configuration the dimensions of the fuel are not adjustable other than through thickness.

9. Conclusions

Past studies demonstrated the feasibility of converting the KUCA cores to LEU with the use of U10Mo foils of 12 mils thickness. The resulting LEU cores were found to be very sensitive to the precision of the fuel fabrication. Specifically, the reactivity change for a 1-mil variation in the thickness of the U10Mo foils was estimated to be ~1500 pcm in the most conservative case since for this critical assembly configuration the dimensions of the fuel are not adjustable other than through thickness. The present paper discusses the feasibility of converting the same KUCA cores with the use of 19.75% enriched U7Mo dispersion fuel in an Al matrix.

Studies were performed for five KUCA cores characterized by different moderator-to-fuel volume ratios for the purpose of analyzing a broad range of neutron spectra that are representative of both fast and thermal systems. Two types of coupons are considered. In both cases the dispersed U7Mo fuel is clad by aluminum on both sides. In one case, for any thickness of the U7Mo fuel, the thickness of the Al clad is adjusted so that the total extension of the coupon (fuel plus 2 clad sides) remains the same as the initial HEU plate being replaced. In the other case, the thickness of the Al clad remains fixed at 12 mils. In this last case, the total thickness of the LEU coupon is smaller than that of the HEU plate being replaced, so that more unit cells can be loaded along the axial extension of the core.

Studies were performed with two values of dispersed U7Mo fuel density, namely 8 gU/cc and 6 gU/cc. Results indicate that the conversion of the KUCA dry cores is feasible with both fuel densities and with both types of coupons. However, the total number of coupons needed for the conversion of the same HEU core is smaller with coupon type B than with type A. Additionally, the use of 6 gU/cc dispersed U7Mo requires thicker fuel, thereby reducing the dependence of the core reactivity on eventual fabrication tolerances. On the other hand, the use of 6 gU/cc dispersed U7Mo increases the required fuel inventory. Particularly, for the configuration of lowest V_m/V_f it is estimated that the total number of LEU coupons type B needed to attain the critical state would increase by ~15% when the U7Mo dispersion is set at 6 gU/cc compared to 8 gU/cc.

7. Acknowledgements

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8. References

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