# Effects of different nuclear evaluation data on the RMC $k_{eff}$ calculation

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**Abstract.** Neutron cross section data is the basis of nuclear reactor physical calculation and has a decisive influence on the accuracy of calculation results. AFA3Gassemble is widely used in nuclear power plants. CENACE is an ACE format multiple-temperature continuous energy cross section library that developed by China Nuclear Data Centre. In this paper, we calculated the AFA3G assemble by RMC.We respectively used ENDF6.8/, ENDF/7 and CENACE data for calculation. The impact of nuclear data on RMC calculation is studied by comparing the results of different nuclear data.

## 1 Introduction

Neutron cross section library plays a key role in the core calculation. The ace format temperature dependent neutron cross section library for continuous energy Monte Carlo transport programs such as RMC and MCNP, which is processed by NJOY. The machining process includes resonance reconstruction, Doppler broadening, neutron thermalization. CENACE cross section library was obtained from the ENDF/B7.1 evaluation database processed by the 401 using NJOY. In this paper, RMC is used for the modelling and calculation of AFA3G assemble. Then we analysis three groups data of $k_{eff}$ varies with time to sections the formatting shown in Table 2 should be used.

## 2 Introduction of AFA3G assemble

The AFA3G assemble is the third generation of advanced PWR fuel assemble designed by Framatome Each assemble contains 264 fuel rods and 25 guide tubes. AFA3G assemble does not use a combination of discrete burnable poison and integrated burnable poison, but uses an integrated burnable poison design with Gadolinium. This paper calculates two assemblies, one is that the assemble contains 16 poison rods, and the other is the assemble without poison rod. Both fuel assemblies do not take into account the grid, the structure of the assemble is shown in the figure 1 and figure 2. The assemble has an enrichment of 3.1%, with 264 fuel rods and 25 guide tubes.

**Table 1.**Parameters of AFA3G assemble

| Parameter | Vlaue |
|---|---|
| Assemble type | 17X17 |
| Fuel pellet radius | 0.4096 cm |
| Fuel cladding external diameter | 0.475 cm |
| Guide tube inside diameter | 0.5605 cm |
| Guide tube external diameter | 0.6225 cm |
| Lattice interval | 1.26 cm |

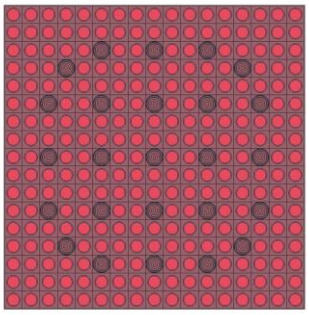

**Fig. 1.** AFA3G31000 assemble

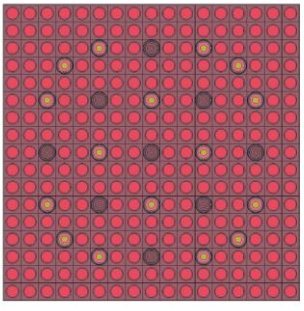

**Fig. 2**. AFA3G31016 assemble

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## 3 Introduction of RMC and cross section library

We use RMC to model and calculate the assemble, and calculate the fuel burnup with a constant power of 40 MW. The fuel burnup of the assemble is 90000 MWD /TU, and burnup calculation is divided into 120 steps.

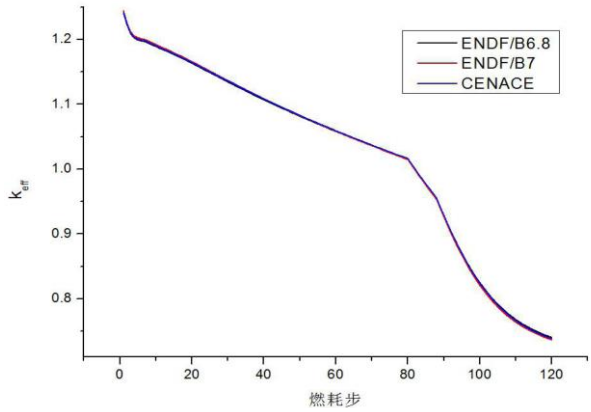


Fig. 3. Results of AFA3G31000 Assemble

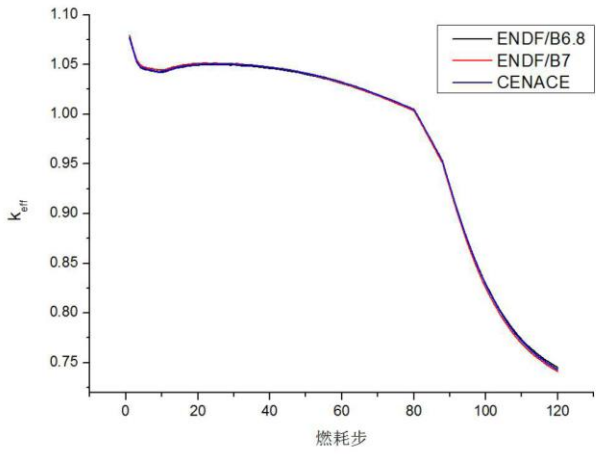


Fig. 4. Results of AFA3G31016 Assemble

As we can see from Figure 3 and figure 4, the results of two assemblies are not much different.

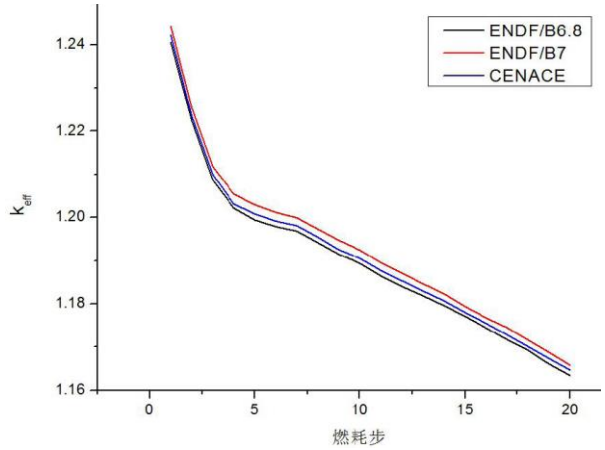


Fig. 5. Results of AFA3G31000 assemble in first 20 steps

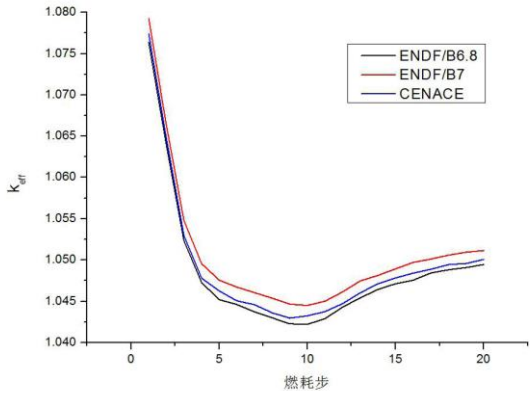


Fig.6. Results of AFA3G31016 assemble in first 20 steps

Figure5 and Figure 6 show the calculation results of the first 20 steps, it can be seen that the $k_{eff}$ of ENDF/B7 library is slightly higher than the other two libraries at the beginning of the burnup, and the $k_{eff}$ of ENDF/B6.8 library is the smallest.

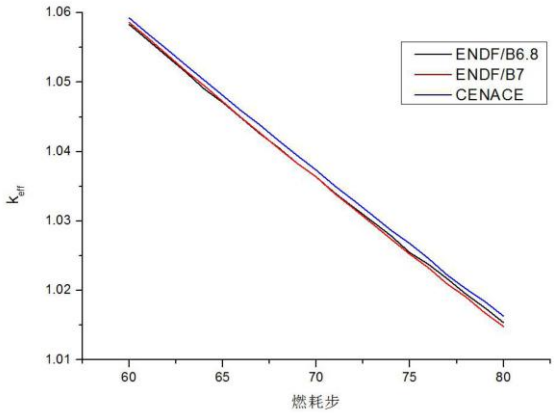


Fig.7. The results of AFA3G31000 assemble from steps 60 to 80

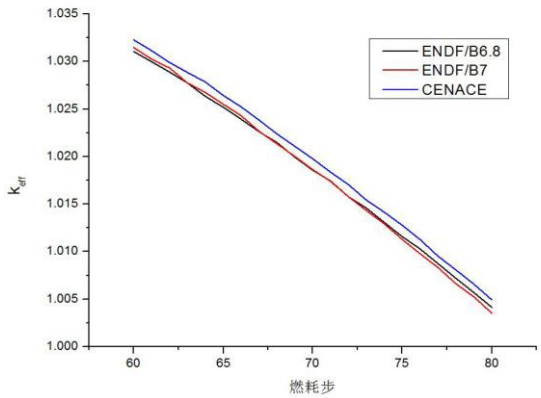


Fig.8. The results of AFA3G31016 assemble from steps 60 to 80

With the burnup, from steps 60 to 80, results of ENDF/B7 and ENDF/6.8 library is basically same, results of CENACE library is slightly higher than the ENDF/B7 and ENDF/6.8 library.

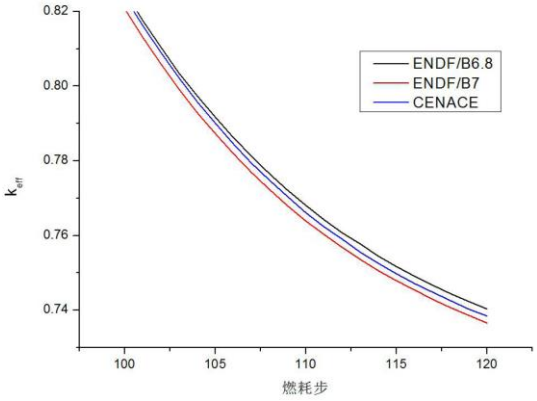


Fig.9. The results of AFA3G31000 assemble from steps 80 to 120

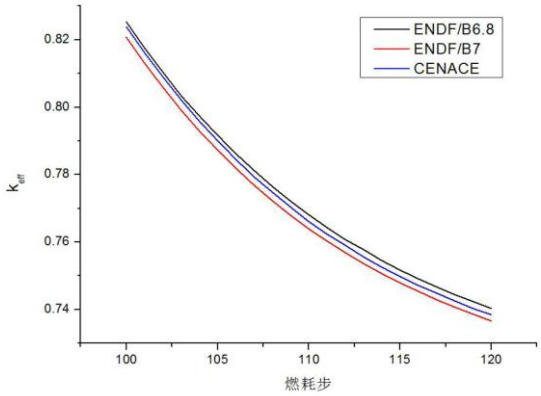


Fig.10. The results of AFA3G31016 assemble from steps 80 to 120

As can be seen from the above figure,at the end of period, ENDF/B68 has the largest $k_{eff}$ and the ENDF/B7 library has the smallest calculation results. with the burnup, compared with the CENACE, the k calculated by the ENDF/B7 library gradually decreases. The difference between the calculation results of the ENDF/B68 and the ENDF/B7 library is about -0.004 to 0.005. The $k_{eff}$ calculated by ENDF/B7 is relatively small when in the deep burnup.

## 4 Conclusion

We used three cross section libraries to calculate AFA3G assemble. By comparing the calculation results, it is found that the calculation results of $k_{eff}$ under different library are very close. The $k_{eff}$ calculated by ENDF/B7 is relatively small when in the deep burnup, and $k_{eff}$ of CENACE library is in between.

## References

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