PRELIMINARY STUDY ON CHARACTERISTICS OF EQUILIBRIUM THORIUM FUEL CYCLE OF BWR

Abdul Waris[1,3], Rizal Kurniadi[1], Zaki Su'ud[1], and Sidik Permana[2]

[1]Department of Physics, Bandung Institute of Technology
Jl. Ganesa 10 Bandung, 40132, Indonesia
[2]Research Laboratory for Nuclear Reactors, Tokyo Institute of Technology
2-12-1 O-okayama, Meguro-ku, Tokyo 152-8550, Japan
[3]*E-mail: awaris@fi.itb.ac.id*

ABSTRACT

One of the main objectives behind the transuranium recycling ideas is not merely to utilize natural resource that is uranium much more efficiently, but to reduce the environmental impact of the radio-toxicity of the nuclear spent fuel. Beside uranium resource, there is thorium which has three times abundance compared to that of uranium which can be utilized as nuclear fuel. On top of that thorium is believed to have less radio-toxicity of spent fuel since its produce smaller amount of higher actinides compared to that of uranium. However, the studies on the thorium utilization in nuclear reactor in particular in light water reactors (LWR) are not performed intensively yet. Therefore, the aim of the present study is to evaluate the characteristics of thorium fuel cycle in LWR, especially boiling water reactor (BWR). To conduct the comprehensive investigations we have employed the equilibrium burnup model[1-3)]. The equilibrium burnup model is an alternative powerful method since its can handle all possible generated nuclides in any nuclear system. Moreover, this method is a simple time independent method. Hence the equilibrium burnup method could be very useful for evaluating and forecasting the characteristics of any nuclear fuel cycle, even the strange one, e.g. all nuclides are confined in the reactor[1)]. We have employed 1368 nuclides in the equilibrium burnup calculation where 129 of them are heavy metals (HMs). This burnup code then is coupled with SRAC cell calculation code by using PIJ module to compose an equilibrium-cell burnup code. For cell calculation, 26 HMs, 66 fission products (FPs) and one pseudo FP have been utilized. The JENDL 3.2 library has been used in this study. The design parameters of the studied BWR are presented in **Table 1**, which is the design parameter of the BWR/6 of the General Electric's BWR.

Keywords: *thorium fuel cycle, equilibrium burnup, BWR*

Table 1 Design parameters of studied BWR

Power Output (Thermal)	3000 MW
Average power density	50 Wcm^{-3}
Radius of fuel pellet	0.529 cm
Radius of Fuel rod	0.615 cm
Pin Pitch	1.444 cm
Void coefficient	42 %
Fuel type	Oxide
Cladding	Zircaloy-2
Coolant	H_2O

References

1. A. Waris and H. Sekimoto, "Characteristics of several equilibrium fuel cycles of PWR", *J. Nucl. Sci. Technol.*, **38**, p.517-526, 2001
2. A. Waris, H. Sekimoto, and G. Kastchiev, *Influence of Moderator-to-Fuel Volume Ratio on Pu and MA Recycling in Equilibrium Fuel Cycles of PWR,* Int. Conf. On the New Frontiers of Nuclear Technology, PHYSOR 2002, Seoul, Korea, 2002
3. A. Waris, et. al., *Influence of void coefficient change on Plutonium and Minor Actinides Recycling in BWR with Equilibrium Burnup,* Proc. Int. Conf. Innovative Nuclear Energy Systems, INES2 2006, November 26 – 30, 2006, Yokohama, Japan, 2006.