Preliminary Calibration Curves for the ACP Nuclear Material Accounting during the Early Stage of ACPF Hot Operation

Tae-hoon Lee, Ho-dong Kim, and Ji-Sup Yoon
Korea Atomic Energy Research Institute, 150 Dukjin-dong Yuseong-gu, Daejon, 305-353
typhoon@kaeri.re.kr

The construction of a hot cell facility for the Advanced Spent Fuel Conditioning Process (ACP) was completed and the process equipment and NDA system were installed in the ACP Facility (ACPF) in 2005 [1]. The ACP Safeguards Neutron Counter (ASNC) is a kind of neutron coincidence counter for the Non-Destructive Assay (NDA) of ACP's nuclear materials [2]. It was developed for the nuclear material accounting in the ACPF hot cell of ACP's process materials such as spent fuel rod cuts, UO_2 pellet, U_3O_8 powder, uranium metal ingot, and waste materials including hulls and salt waste. The performance test of the ASNC was done by using a ^{252}Cf neutron source which was cross-checked by the safeguards group of the Los Alamos National Lab. (LANL). The measured values of ASNC's main parameters such as neutron detection efficiency, neutron die-away time, and deadtime coefficient are satisfactory to get doubles rate for the spontaneous fission neutrons of ^{244}Cm element. Especially, the ASNC's cavity was designed to have a flat efficiency profile in the cylindrical space of the cavity. According to the present schedule, the PWR spent fuel will not be brought into the ACPF until 2008. Instead, the simulated fuel will be used to fulfil ACP experiments during the cold test period. The calibration of the ASNC system can be performed preliminarily by using the well-calibrated ^{252}Cf source and MCNPX code [3]. A preliminary calibration curve for non-multiplying samples of ACP is generated to perform the nuclear materialaccounting of prototype ACP nuclear materials during the first ACPF hot operation. We can measure the mass of ^{244}Cm of ACP nuclear materials through this calibration curve. And then the plutonium mass of them can be obtained by using Cm ratio [4]. Preliminary calibration curves for main ACP nuclear materials such as metal ingot, UO2 powder and salt waste are also generated by using MCNPX and ORIGEN codes. We can see the obvious neutron multiplication influence on the increase of doubles rate for metal ingot and UO2 powder. However, there is almost no multiplication for salt waste there because there is not much enough of plutonium content in it. These calibration curves will be modified and complemented when hot calibration samples are prepared. To verify this calibration curve, DUPIC SFS measurement and DA will also be conducted.

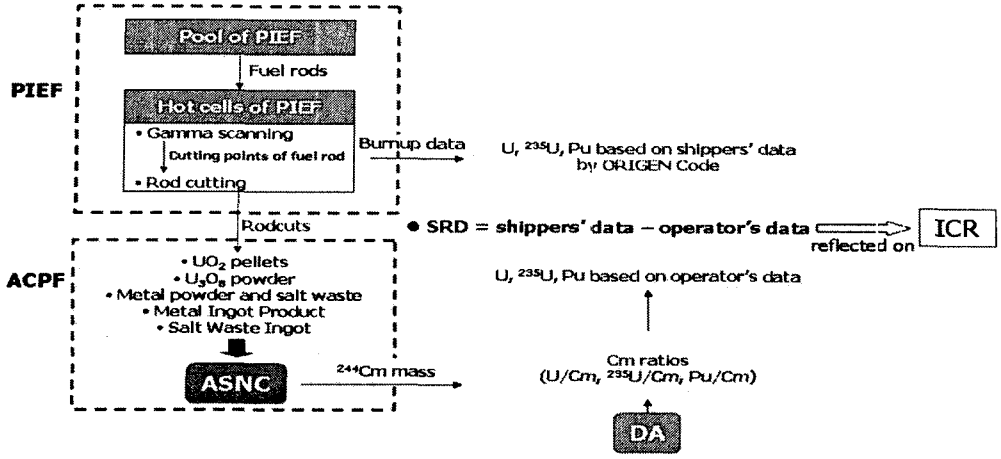

Figure 1. Nuclear material accouting procedure of the ACPF

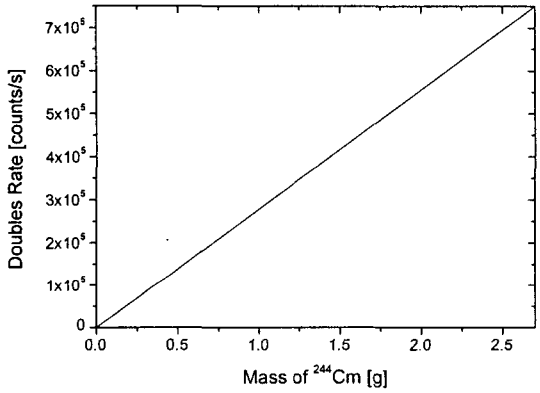

Figure 2. Preliminary calibration curve for non-multiplying sample of ACP nuclear materials

References

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