Summary of OECD/NEA/NSC Expert Group on Integral Experiments for Minor Actinide Managerment

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Abstract

To establish a reliable fuel cycle together with managing safely the radioactive wastes is inevitable in pursuing a sustainable utilisation of nuclear fission energy. One of the key subjects to realize it is the appropriate management of minor actinides (MA), such as neptunium, americium and curium in the spent fuel. In particular, the necessity to manage MA becomes more obvious when plutonium is used as MOX fuel on a large scale in power reactors, both light-water reactors and fast reactors, since more accumulation of americium and curium will be predicted in the spent fuel. One effective way to manage MA is to transmute them in nuclear systems; fast reactors and accelerator-driven subcritical systems. The transmutation of MA, however, is not easy. From a viewpoint of the reactor neutronics, the loading of MA generally affects the reactor characteristics, such as the coolant void reactivity, the Doppler coefficient, and the burn-up effect.

The detailed design of transmutation systems with reliable accuracy and the precise prediction of the composition of the spent fuel are difficult since the accuracy of MA nuclear data is not sufficient yet. This is because there is a lack of experimental data for MA. It should be remembered that nuclear data of the major actinides, such as U-235, U-238 and Pu-239, have been improved for more than 50 years, based on a huge number of differential and integral experiments, using accelerators, critical facilities and experimental reactors.

The results of the integral experiments have been used to validate the nuclear data. Recently the covariance data in the nuclear data libraries have been introduced to estimate the uncertainty in design study of the nuclear system. The integral experimental data together with the sensitivity analysis have become more effective to improve the design accuracy. The integral experiments on MA, however, are much more difficult than those on the major actinides because of restrictions at the facilities, the difficulty of sample preparation, the necessity to improve measurement techniques to reduce the influence of background radiation, and so on.

Considering these situations, it is requested that a critical review of integral experiments for validating MA nuclear data should be undertaken with appropriate quality assurance for MA transmutation in the nuclear systems. The Nuclear Science Committee in OECD/NEA accepted the establishment of the Expert Group (EG) on Integral Experiments for Minor Actinide Management in 2008.

The EG consisted of 19 members from 10 countries and OECD. The meetings were held 7 times between Sept. 2009 and Sept. 2012. The members discussed about the following subjects; (1) Requirement of nuclear data for MA management (including evaluation of target accuracy, comparison of uncertainty analysis results among nuclear data libraries and identification of important nuclear data), (2) Reviewing existing integral data (including review of MA sample amount used/required in experiment), (3) Specification of missing experimental work to be required, (4) Identifying and considering possible solutions to the bottlenecks, such as availability of MA sample and experimental facilities, and (5) Proposal of action program for international cooperation.

The summary of these activities and the results will be shown.