

14-1 Evaluation of Radioactive Inventory in Nuclear Facility for Its Decommissioning

-The Applicability of a Radioactive Inventory Evaluation Technique for "FUGEN" Verified-

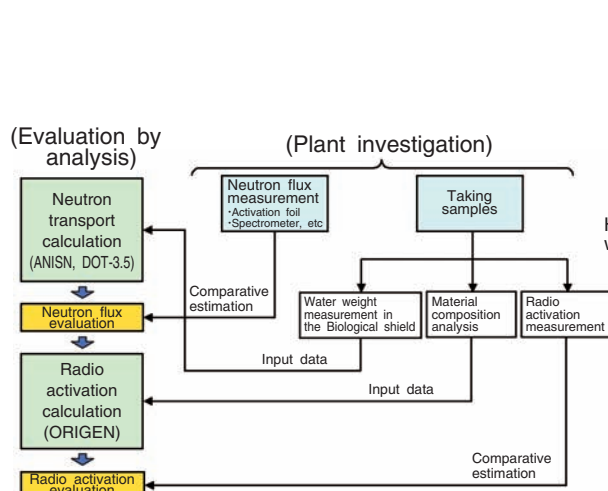
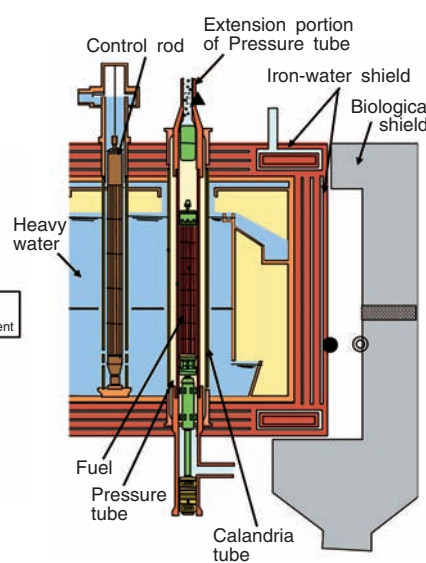


Fig.14-1 The estimation technique of radio-activation in "FUGEN"

The neutron flux is estimated from measurements and calculations, and then, the radio-activation is calculated with the ORIGEN code using it. We had been acquiring data on neutron flux, material composition, and water content in concrete during the reactor operation period in order to calculate the radio-activation. We also had been measuring radio-activation. We verified the validity of our technique by comparing those data with calculation data.



Cross-section of reactor core of "FUGEN"
Note: ▲●○ indicate the measurement positions of activation foil, and ■ indicates the sampling point of concrete specimens.

Fig.14-2 Comparison between calculated and measured radio-activation values

(a) Measurement data of Activation foil

Evaluation at the Extension portion of Pressure tube (▲ position) (Bq/g)

	Co-60	Au-198
measurement data	8E+02	3E+04
calculation data	1E+03	4E+04

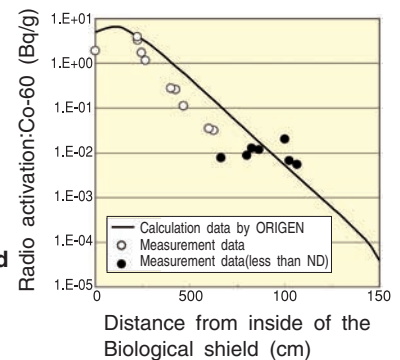
Evaluation at the Iron-water shield's surface (● position) (Bq/g)

	Co-58	Co-60	Au-198
measurement data	6E+01	1E+04	3E+05
calculation data	2E+02	1E+04	7E+05

Evaluation at the biological shield's surface (○ position) (Bq/g)

	Co-58	Co-60	Au-198
measurement data	8E+01	1E+04	3E+05
calculation data	2E+02	1E+04	7E+05

(b) Measurement data of concrete specimen in the Biological shield



When we carry out the decommissioning of the "FUGEN" reactor, it is important that the safety assessment of the public exposure dose, the evaluation of radioactive waste amount and the planning of an appropriate method and procedure for dismantlement are based on an accurate radioactive inventory.

The radioactive inventory evaluation consists of (1) evaluation of the radio-activation on the structural materials such as reactor cores, caused by the neutron irradiation during reactor operation and (2) evaluation of the corrosion layer adhering to the equipment and piping, etc. in which there are substances which were in the coolant water and were radio-activated in the reactor core.

The radio-activation of many parts can be evaluated by analysis following the flow of "Evaluation by analysis" in Fig.14-1. However, "FUGEN" is a complicated pressure tube type reactor different from a light water reactor, and its neutron behavior near the reactor can be complicated. Thus, it is necessary to understand the neutron flux distribution accurately before analyzing the radio-activation, and to evaluate the appropriateness of the result. We acquired as much data as possible of the element composition, neutron flux, and the radio activation in investigation of "FUGEN", and we compared those with the evaluations made by analysis (Fig.14-1).

In "FUGEN", the radio-activation calculation was analyzed by dividing the reactor into the core structure area and the shielding area surrounding reactor core.

The radio-activation measurement was carried out as follows. A high pressure tube test piece irradiated for a certain period in the core structure area during the reactor operation was measured. Also, many Activation foils set around the reactor core in the shielding area and irradiated for a certain period during the reactor operation were gathered and measured. Moreover, after reactor shutdown, pieces of concrete were taken from the Biological shield and were measured.

The analytical data values were almost equal or more conservative than the measurement data in all cases. Thus, the validity of our evaluation method was confirmed (Fig.14-2). This technique was applied to the radioactive inventory evaluation in the "Decommissioning plan of FUGEN" (authorized on February 12, 2008), and the public exposure and the amount of generation of waste were evaluated appropriately from these results. Moreover, this technique will also be applicable to the safety clearance evaluation of the waste surrounding the nuclear reactor after dismantling which had been exposed to neutrons.

Reference

Kitamura, K. et al., Evaluation of Radioactive Inventory for Fugen's Decommissioning, Hoshasen, vol.34, no.1, 2008, p.53-63 (in Japanese).