Lessons-learned from ongoing decommissioning project of Fugen NPS

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Abstract

Advanced Thermal Reactor (ATR) Fugen is a 557MWt, 165 MWe, heavy water moderated, light-water cooled, pressure-tube type reactor. In 2003, Fugen was shut down after ca 25yaers operation, and started decommissioning activity from 2008. In the initial period of decommissioning, we have been dismantling from turbine systems because of their little contamination. In general, most difficult process of dismantling of nuclear power plant is the dismantlement of the reactor core because the radiation rate of the reactor core is very high, e.g., it is over 200 Sv/hr in the Fugen's case. Our plan of dismantlement of the core is from about 2022.

The core area has some features that the structure is narrow and complicated by tube-cluster structure that contains 224 fuel channels with both the pressure and the calandria tubes coaxially in each channel. The radiation shielding area is laminated structure composed of up to 150 mm thickness of carbon steel. And the structure of the reactor, which is made of various materials such as stainless steel, carbon steel, zirconium alloy and aluminum. In particular, the core area is planning to be dismantled under water by remote controlled machines in order to shield the radiation around the core and prevent airborne dust generated by the cutting considering the usage of Zr alloy which is likely to be oxidized.

In consideration of above, the cutting methods were selected for dismantling the reactor core in order to shorten the dismantling term and reduce the secondary waste [1]. The candidate cutting method options were decreased based on the results of the researches on achievement of the cutting methods domestically and internationally. Finally, the laser cutting method was selected for dismantling the core area and shielding area, and diamond wire saw was also selected for dismantling the shielding area applicable to concrete with metal liner, based on the results of some cutting tests.

The laser cutting method has many advantages, e.g., narrow calf width leading to reduction of secondary waste and remote-handleability by using fiber laser[2]. But this method has not yet been applied to reactor facilities throughout the world. Therefor for the safe and reliable dismantlement, laser cutting system in air will be organized and demonstration examinations to some equipment except core area will be carried out. Moreover, laser cutting system underwater should be also organized, taking a safety assessment data such as behavior of cutting dust. In the final stage, after inspection of dismantling procedure using mock-up device, after the core area is planning to be dismantled.

This indicates an example of lessons-learned for the process of how the decommissioning program is planned and R&D for suitable technologies are implemented and they are applied to the final dismantlement process.

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[2] TEZUKA, M., et al., The development of thermal and mechanical cutting technology for dismantlement of the internal core of Fukushima Daiichi NPS, Integration of Knowledge Management System for the Decommissioning of Nuclear Facilities, Journal of Nuclear Science and Technology, Vol.51(2014), pp1054–1058.