Design of J-PARC Transmutation Experimental Facility

Toshinobu Sasa, Kazufumi Tsujimoto, Hayanori Takei, Shigeru Saito, Hironari Obayashi, Kenji Nishihara, Takanori Sugawara, Hiroki Iwamoto, and Hiroyuki Oigawa
Japan Atomic Energy Agency, Japan

Abstract

After the Fukushima accident, management of spent fuel got many attentions and then, reduction of the radioactive wastes becomes increasingly important. Partitioning-Transmutation technology using fast reactors or accelerator-driven systems (ADS) is noted at re-evaluation of the national fuel cycle policy discussed by Atomic Energy Commission of Japan. To realize the transmutation of minor actinides and long-lived fission products, basic studies for various research fields are needed and therefore, equipments to obtain the experimental data using spallation target and minor actinides are required. In the framework of the J-PARC project, Japan Atomic Energy Agency (JAEA) has been promoted to construct the experimental facility for transmutation systems and performed design of Transmutation Experimental Facility (TEF). The facility consists of two buildings, Transmutation Physics Experimental Facility (TEF-P) to perform critical experiments using minor actinide bearing fuels and ADS Target Test Facility (TEF-T) for irradiation of various structural material candidates in flowing lead-bismuth environment. According to the latest time schedule, TEF-T will be constructed rather faster than licensing of TEF-P to facilitate the construction. TEF-T will be operated within 5 years and TEF-P needs another 5 years to finish construction, after the budget approbation by government. Based on this time schedule and facility layout, concepts of the facility, namely the TEF-T should be revised to accept proton beam up to 400MeV-133kW. Sealed-annular tube type spallation target filled by lead-bismuth eutectic alloy is considered for both low-power proton irradiation target and full stop length target for proton/neutron simultaneous irradiation. Both targets were designed to simulate the operating condition of actual lead-bismuth cooled ADS transmutor (800MWt). The temperature range of the lead-bismuth can be set around 300 – 500 degree centigrade and systematic data accumulation is planned for various structural materials and irradiation damage rate indicated by DPA (displacement per atom) at various operation temperatures under the structural stressed environment. Even the sample is limited in very small size, the annual irradiation rates can be set to several tens DPA. TEF-P is designed reflecting the structure of existing critical assembly FCA located in JAEA/Tokai site to take over many experimental data and experiences at FCA. Required amount of minor actinides to perform the significant critical/subcritical experiments are specified and is reflected to the design of critical assembly itself. Remote devices and related facility layout are also designed to handle the minor actinide bearing fuels safely. In the presentation, latest status for TEF construction and experimental needs discussed by atomic energy society of Japan will be introduced.