Criticality calculations of fuel debris in various conditions during falling down

*Anton Smirnov[1], Ekaterina Bogdanova[1], Georgy Tikhomirov[1], Hiroki Takezawa[2], Jun Nishiyama[3] and Toru Obara[3]

[1]Institute of Nuclear Physics and Engineering, National Research Nuclear University MEPhI, Moscow, Russia, [2]Department of Nuclear Safety Engineering, Tokyo City University, Tokyo, Japan, [3]Laboratory for Advanced Nuclear Energy, Institute of Innovative Research, Tokyo Institute of Technology, Tokyo, Japan

Tokyo Tech, TCU and MEPhI work together to develop advanced criticality analysis method for securing safety in removal work of Fukushima Daiichi fuel debris. Criticality calculations of fuel debris in various conditions during falling down were performed by universities. The Russian Monte Carlo code MCU was used and improved to perform debris modeling. Positions of fuel debris particles falling in water are calculated by Particleworks.

Keywords: fuel debris, Monte Carlo, criticality analysis

1. Introduction

An important part of the decommissioning of the Fukushima-1 NPP is the procedure for extracting radioactive corium. Corium is a lava-like material created in the core of a nuclear reactor during a meltdown accident. It is very important that when removing the corium, safety is ensured to prevent the formation of repeated criticality. Russian and Japanese scientists jointly develop advanced criticality analysis method for securing safety in removal work.

At the first stage, a joint benchmark was developed. It includes three tasks. This paper presents the results of solving the first benchmark task.

2. Methodology

The system consists of several cylindrical areas: concrete, water and empty space, from where the corium falls. Corium is represented by 1000 debris cubes. Number of fuel debris distributions in water is five (see fig. 1). Water surface boundary condition used in Monte Carlo calculations is flat approximation. Composition of fuel debris and concrete bed were taken from [1] and [2], respectively. Positions of fuel debris particles calculated by Particleworks have been confirmed [3].

3. Results and conclusion

Neutron multiplication factors k_{eff} derived from the 5 distributions were obtained. Preliminary results showed good agreement between the solutions obtained using the MVP, MCU and Serpent codes. The detail results will be presented at the meeting.

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