

Nuclear Multiscale Systems Analysis for Safety and Security

The importance of safety, security, and risk management has been recognized in nuclear multiscale systems modeling, simulation, and analysis applications. Since 2011, earthquake and tsunami led to the nuclear accident at Fukushima Daiichi-Japan; nuclear energy facilities have been under massive pressures to enhance the safety and security. Enormous number of researches was conducted on the area of nuclear safety and security including cybersecurity, stress testing, resilience analysis along with risk management.

The researches were both in nondeterministic and deterministic approaches to analyze the system from safety point of view. ASME International Conference on Nuclear Engineering (ASME ICONE24, June 22–28, 2016, Charlotte Convention Center, Charlotte, NC) was an example of a recent assembly of the researchers from around the world to discuss the safety, risk, security, and associated uncertainty issues among other interested topics in nuclear engineering. This Special Section issue with the title of “Nuclear Multiscale Systems Analysis for Safety and Security” intends to focus on the state-of-the-art of methods on the area of nuclear safety, security, and risk management. The submission was open for all quality research papers in this area. The goal is to better understand both nondeterministic and deterministic approaches to assess and improve the confidence of simulation-based predictions supported with the experimental data. After careful evaluation of ten submissions to the special section, three papers were finally accepted for the publication.

The paper “Safest Roadmap for Corium Experimental Research in Europe” by Journeau et al. discusses European roadmap on corium experimental research. It has been written to define the research challenges to contribute to further reinforcement of Gen II and III NPP safety. It is based on the research priorities determined by SARNET SARP group as well as those from the recently formulated in the NUGENIA Roadmap for severe accidents and the recently published NUGENIA Global Vision report. It also takes into account issues identified in the analysis of the European stress tests and from the interpretation of the Fukushima accident. The coherence between European infrastructures and R&D needs has been assessed, and a table linking issues and infrastructures have been derived.

The paper “Development of Probabilistic Risk Assessment Methodology against Volcanic Eruption for Sodium-Cooled Fast

Reactors” by Yamano et al. develops a probabilistic risk assessment methodology against volcanic eruption for decay heat removal function of sodium-cooled fast reactors. This study evaluated a volcanic hazard using a combination of tephra fragment size, layer thickness, and duration. In this paper, functional failure probability of each component is defined as a failure probability of filter replacement obtained by using a grace period to filter failure. Finally, based on an event tree, a core damage frequency has been estimated about $3 \times 10^{-6}/\text{yr}$ in total by multiplying discrete hazard probabilities by conditional decay heat removal failure probabilities.

The paper “Assessment of RELAP5/MOD3.3 based against single rod reflooding experiments” by Nikoglou et al. presents the assessment of the RELAP5/MOD3.3 code using the experimental work upon the rewetting mechanism of bottom flooding of a vertical annular channel enclosing concentrically a heated rod. The experiments have been carried out in the experimental rig 1 of the Nuclear Engineering Department of National Technical University of Athens (NTUA-NED-ER1) inside which the dry out and the rewetting process of a hot vertical rod can be simulated. The results show that the RELAP5/MOD3.3 code provides temperature estimations of the reflow mechanism within acceptable error margin.

We would like to thank all of the authors who considered to submit their research papers to this Special Section issue. The guest editors appreciate the timely efforts of the journal staff to follow up the required actions and make this Special Section issue happen.

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