PURDUE UNIVERSITY | Nuclear Engineering COLLEGE OF ENGINEERING

Nuclear Engineering Seminar

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Sustainable Spent Nuclear Fuel Management: Overview, Challenges, and Recent Research Developments

Abstract

Despite the Fukushima accident, projections by the International Atomic Energy Agency (IAEA) suggest that nuclear energy will grow globally in all scenarios. More than 60 reactors are under construction in 15 different countries, and more than 20 countries have informed the IAEA that they have an interest in launching nuclear energy programs. However, expansion of nuclear energy will unavoidably create increased pressure to ensure that spent nuclear fuel remains safe and secure. For instance, although spent fuel accounts for less than 1% of the volume of all radioactive waste generated, it contains 95% of the radioactivity including plutonium-239. Further, the amount of spent fuel is growing rapidly with over 2,500 spent fuel canisters currently being used for dry storage of commercial spent nuclear fuel in the U. S. and 150–200 new canisters loaded each year.

In order to ensure the development of a sustainable nuclear fuel cycle and provide nuclear energy access to tens or more countries without compromising spent fuel safety or spreading the threat of nuclear weapons, there is a need to develop a sound technical basis to better understand, assess, and communicate the risks, and uncertainty associated with the safe and secure management of spent nuclear fuel. This presentation will cover challenges associated with safety and security during storage, transportation and disposal of spent nuclear fuel. Current research on spent fuel characterization and new technologies including remediation techniques, cosmic ray muon tomography and ultrasound and AI-based monitoring and their application to the management of spent nuclear fuel will be presented and recommendations for future research will be discussed.

Stylianos Chatzidakis is currently R&D Staff and Weinberg Distinguished Fellow within the Reactor and Nuclear Systems Division at Oak Ridge National Laboratory where he contributes to several research projects and provides R&D support to DOE spent fuel management programs. Stylianos received his Ph.D. in Nuclear Engineering from Purdue University, his M.Sc. in Energy Physics from the Institut National Polytechnique de Grenoble in France and his Diploma in Mechanical Engineering (5-year program) from the National Technical University of Athens. Stylianos is currently leading research in the fields of spent fuel management, muon tomography, particle transport and, nuclear fuel simulations using GEANT4 and COBRA-SFS. His research also includes instrumentation and monitoring using advanced statistical pattern recognition and machine learning methodologies, and the development of a Mobile Examination and Remediation Fixture (for remote inspection and remediation of spent fuel welded stainless steel canisters. It is worth noting the development of a "Muon Event Generator" that has received attention by researchers.