EXECUTIVE SUMMARY

Development of Educational Undergraduate Course Modules for Interactive Reactor Physics

Objectives. To motivate and assure the undergraduate students' broad understanding and competence in the important area of reactor physics and to achieve high educational standard in teaching reactor physics the undergraduate course curriculum would benefit from the innovations in teaching styles and teaching materials. The reactor physics course is usually tiresome for undergraduate students due to its abstractive nature and numerous mathematical derivations. Interactive visualization of the reactor physics phenomena is one of the experiential and inspirational ways to teach reactor physics more effectively. To some extent we may categorize our sequence of three courses pertaining to reactor physics as the spiral in the undergraduate curriculum in that the concepts are revisited with increasing complexity from the sophomore NUCL200 (Introduction to Nuclear Engineering), to junior NUCL310 (Introduction to Neutron Transport) to senior/graduate NUCL510 (Reactor Physics) course. In order to increase the students' technical proficiency, their analytical skills and motivation to study, I developed a framework for the web-based course modules and completed ~ 20% of the interactive reactor physics learning tools. The objective of this proposal is to develop the remaining interactive course modules for teaching reactor physics at the undergraduate level. Specifically, the NUCL310 course will be fully supported by this modern web-based interactive tools emphasizing learning of: neutron physics (neutron interactions, concept of neutron cross section, neutron attenuation and fission), neutron transport including the statics and kinetics (neutron diffusion theory, neutron slowing-down process, neutron multiplication, effect of boundary conditions and reactor heterogeneity on neutron economy, point kinetics, role of delayed neutrons, reactor period), and reactor control (difference between the thermal and fast reactors, control rod effect, fission products poisoning). By the end of the grant the students will interactively use all of these modules to learn the reactor principles through the tasks inclusive of the fundamental reactor physics theory and its direct application to nuclear industry (how the theory applies in analyzing the real world designs, including the GenIV reactor neutronics). These course interactive modules will provide a good base for building the competent reactor physics knowledge.

Benefits. The web-based interactive tools are experiential for the students, and are helping modernize the course content. Most importantly they help the students to visualize the reactor physics phenomena and understand the reasons for certain trends using the graphical interpretations. In addition, by exposing students to various computational tools that are directly or indirectly related to the course material traditionally presented in the undergraduate class help them understand how to apply what they learn.