Advanced Fuel Cycle Simulator Description

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Abstract

This paper describes the major functions and use cases of the Advanced Fuel Cycle Simulator (FCS). The FCS is the next generation fuel cycle analysis tool that is in initial stages of development as the Grand Challenge for the Systems Analysis Campaign of the United States Department of Energy's (DOE) nuclear fuel cycle technologies program (FCT). The FCS will dynamically simulate the commercial nuclear fuel cycle at the discrete facility level with isotopic resolution. It seeks to be a versatile, open-platform effort, supporting users and developers at levels of detail appropriate for a broad and varied stakeholder base interested in a range of analysis types. Intended users include government laboratories, universities, and industry groups. The paper identifies analysis missions and summarizes the functional requirements of a comprehensive, top-level fuel cycle simulation code more fully described in the FCT report "Draft Next Generation Fuel Cycle Simulator Functions and Requirements Document". The report also proposes a design approach to complement currently available fuel cycle simulation capabilities. The FCS is intended to provide a supportive framework for research across national, institutional, and disciplinary boundaries. One of the primary missions of the FCS will be to improve understanding of advanced fuel cycle performance and the interactions of fuel cycle technologies existing and under development. This includes modeling of the impacts of advanced reactors, separations and recycling options on resource sustainability, economics, safety, security, proliferation risk, waste streams, waste form options and disposal system performance. As of the writing of this abstract, DOE has initiated a three-year effort to develop the FCS via a Nuclear Energy University Program (NEUP) grant to a consortium of four universities, led by the University of Wisconsin. The grant includes development of the core FCS functions by modifying and maturing the object-oriented CYCLUS code in an open source environment, reconfiguring the code for cloud computing so that it can be delivered on anything from an engineering workstation to a tablet computer, developing interface capabilities for different levels of users and screen sizes, and performing and implementing research for display and comparison of different fuel cycles and transition scenarios. The overall objective is to establish a powerful and flexible open source fuel cycle simulator that significantly improves communication and understanding of fuel cycle issues for both analysts and stakeholders.