# Integration of high-fidelity Monte Carlo and deterministic transport codes into Workbench

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**Program**: NEAMS

**ABSTRACT:**
In recent years, many advanced tools have been developed within DOE NEAMS program, such as PROTEUS, Nek5000, and BISON. They provide powerful nuclear reactor simulation capabilities, but they often require large computational resources, can be difficult to install, and require expert knowledge to operate. To mitigate the learning curve of using these tools and accommodate users' expectations for practical design and analysis work, a new NEAMS initiative just started. The central idea of the initiative is to employ a unified model and workflow interface called the NEAMS Workbench and integrate the utilization of NEAMS tools within the Workbench framework. The Workbench will serve as the only operation environment that users need to interact with. Users only provide the problem definitions to Workbench, which will automatically handle the operations of different tools to run simulations, report outputs and visualize results. Thus, end users only need to focus on defining the problems to be solved, rather than learning to run a tool to solve a problem.

In this project, we propose to integrate two high-fidelity neutron transport calculation tools MCNP6 and PROTEUS into Workbench. MCNP6 is a Monte Carlo method-based code for multi-purpose applications. It has been successfully deployed for nuclear reactor analysis in the past, with its high-fidelity geometry modeling and continuous energy neutron transport calculation capabilities. It is mostly used to provide reference solutions to verify other deterministic codes. PROTEUS is a deterministic method-based neutron transport code and provides multiple high-fidelity solution methods (SN2ND, MOCFE, and MOCEX) based on finite element techniques. Both MCNP6 and PROTEUS are transport theory-based high fidelity codes. They provide indispensable capabilities in experiment simulations for the designs of new reactor experiments and advanced nuclear reactors. They can also provide simulations that produce accurate group constants data. These data can be used in coarse node-based analysis codes, such as DIF3D, for better accuracy in the routine analysis of full core reactors.

The objectives of the project are to provide end users with an ability to run both MCNP6 and PROTEUS codes from a common user input by (1) templating user-provided engineering scale specifications to code-specific input requirements, (2) enabling multi-fidelity analysis of a system from a common input using MCNP6 and PROTEUS, as well as DIF3D, which is an ongoing effort by ORNL and ANL, and (3) allowing the easy use of high-fidelity simulations to inform lower-order models for the design, analysis, and licensing of advanced nuclear systems and experiments.