Neutronics Related Safety Analysis and Code Development

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The University of Wisconsin-Madison's Fusion Technology Insitutte began a collaboration with the Chinese Academy of Science's Institute of Plasma Physics (ASIPP) to collaborate on the neutronics-based safety analysis of fusion energy systems, and specifically to share expertise and software tools for the development of components for the Chinese Fusion Engineering Test Reactor (CFETR).

Neutronics analysis experts from the UW-Madison (Sawan, El-Guebaly) visited ASIPP to initiate the UW-ASIPP collaborative program and review the neutronics and activation analyses and experimental R&D program for the Water Cooled Ceramic Breeder blanket design developed by the team at ASIPP (Liu). Comments provided on the 3-D model, radiation limits, mockup of blanket and experimental measurements. The activation model and material constituents were discussed at length, mentioning the missing impurities for some alloys and the need for more accurate definition for the alloying elements – both tend to affect the end results of the activation analysis.

A second visit to ASIPP (Wilson, Biondo) focused on the transfer of advanced modeling and simulation tools, and training on the use of those tools for complex 3-D nuclear analysis. Training was provided in the Direct Accelerated Geometry Monte Carlo (DAGMC) extension for Monte Carlo radiation transport, the ALARA activation code, and the PyNE rigorous-2-step (R2S) module. These tools provide the basis for performing a variety of nuclear analyses on CAD-based geometry including basic radiation transport and its responses (radiation heating, material damage, and tritium breeding ratios), as well as more advanced analysis such as shutdown dose rate analysis.

Results of analysis preformed by ASIPP will be presented, demonstrating the incorporation of guidance and feedback from the first visit and the use of new tools from the second visit.