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Coupled Radiation Transport and Thermomechanics using the AMP and Denovo Codes

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The ability to accurately model the behavior of nuclear fuels during irradiation in a nuclear reactor remains one of the most significant impediments to the development of improved reactor designs. Modeling the coupled effects of heat transfer and structural mechanics on nuclear fuels in a reactor environment is vital to the development of predictive fuel performance capabilities. Existing methodologies utilize 'reference pin' approximations in which a single fuel pin is selected to be representative of a much larger set of pins. This approach, however, is unable to account for assembly-level effects due to interactions between pins. In this study we demonstrate the use of a heat generation source produced by solving the Boltzmann neutron transport equation on a full light water reactor (LWR) assembly with thermomechanics calculations performed on every pin, capturing effects that are generally ignored. The transport equation is solved using the Denovo 3D discrete ordinates code and the thermomechanics solutions use the AMP multiphysics package. Results from computations performed on the Jaguar supercomputer on more than 40,000 processors will be presented.