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**Reacting Plasma-Neutral Fluid Simulations using the NIMROD Finite Element Code** PETER NORGAARD, URI SHUMLAK, University of Washington, PLASMA SCIENCE AND INNOVATION CENTER, UNIVERSITY OF WASHINGTON, SEATTLE, USA TEAM — NIMROD is being modified to solve fully-coupled neutral particle dynamics with MHD for 3D fusion configurations. Our approach is based on a generalized fluid model derived from the Boltzmann equation that captures the effects of plasma interacting with a gasdynamic neutral fluid. Three implementations are presented, in order of increasing complexity. In the "static" model, the neutral fluid properties are fixed and only the plasma dynamics are modified by the contribution of ionization, recombination, and charge exchange reactions to the MHD source terms. In the "stationary" model, a fully coupled neutral fluid density equation is evolved simultaneous with the plasma dynamics. The "isothermal" model solves the neutral density and momentum equations, but maintains a fixed neutral fluid temperature. Development of an implict leapfrog algorithm for these physical models is based on previous work by C.R. Sovinec and J.R. King. The equations are implemented in the NIMROD psuedospectral / finite element code, which has been used extensively for simulating MHD and two-fluid plasma physics. In this work, we present verification simulations for the static, stationary, and isothermal models, which confirm the collision operator coefficients and plasma-neutral couplings. Initial validation work is also presented for the isothermal model.

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