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Numerical modeling and simulation of a magnetohydrodynamic(MHD) generators HYOUNGKEUN KIM, National Energy Technology Laboratory (ORISE), E. DAVID HUCKABY, RIGEL WOODSIDE, THOMAS OCHS, National Energy Technology Laboratory — A MHD generator is a device that extracts electricity directly from thermal energy and kinetic energy. In a MHD generator, a supersonic fluid flow under applied magnetic field is used to produce electricity without any moving mechanical parts. Two numerical solvers have been developed to predict the dynamics of the fluid and the electricity generation efficiency: a 1D MHD code for quick assessment and design calculations and a customized OpenFOAM solver for multidimensional analysis under the low magnetic Reynolds number approximation. The 1D MHD code uses a space marching approach and includes non-equilibrium chemical reactions. The resulting differential algebraic system is integrated using the Sundials library via Assimulo package. Cantera(chemical reaction library) is used for non-equilibrium chemistry, thermodynamic properties and transport properties. The multidimensional code discretizes the equations via the standard finite-volume schemes available OpenFOAM. The compressible codes in OpenFOAM are modified to include the additional physical processes to model an MHD channel. Verification and validation work for both in progress. This testing includes consistency tests, comparison with previously published numerical solutions and with published experimental measurements.

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