HYDRODYNAMIC EVOLUTION OF IFE CHAMBERS WITH DIFFERENT PROTECTIVE GASES AND PRE-IGNITION CONDITIONS

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Design and operation of rep rated fusion facilities are strongly determined by the long time scale evolution of the IFE chambers past the target ignition. This evolution is dependent on a variety of factors, such as chamber geometry, chamber constituents (e.g., gases, aerosol) and their properties and the chamber pre-ignition conditions.

SPARTAN simulation code has been utilized to investigate the IFE chamber evolution. SPARTAN solves Navier-Stokes equations in 2D Cartesian and cylindrical coordinate system and handles arbitrary-shape boundaries, while preserving the uniform accuracy across the domain by adaptive mesh refinement. We have simulated the dynamic evolution of a 6.5-m-radius chamber filled with either Xe, D, or He at different initial pressures. Xenon has been proposed previously as a protective gas. Following the target explosion D, T, and He ions from the target will be implanted in the wall and will eventually diffuse back into the chamber. Initial conditions for SPARTAN are taken from solutions of BUCKY 1-D rad-hydro code. The gas properties are dependent on local density and temperature. Ideal gas law is used as the equation of state. Chamber wall is assumed to have a constant temperature of 700^{o}C.

The results indicate that radiation of background plasma has a major impact on the evolution of the chamber environment. The background plasma exists due to compressive heating from the initial shockwave generated from the target blast. This shockwave reflects from the chamber wall and converges back to the center of the chamber, generating a hot core which in case of Xenon reaches up to 40 eV. The radiation removes the heat from this region. Other modes of the cooling mechanism of the chamber are the heat conduction from gas into the wall and turbulent mixing combined with thermal diffusion. The full impact of the plasma and other constituents on the evolution of the chamber is currently under study.