An Overview of the Fluid Dynamics Aspects of Liquid Protection Schemes for Fusion Reactors

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This paper provides an overview of experimental and numerical studies conducted at Georgia Tech to assess the fluid dynamics aspects of liquid protection schemes for fusion energy reactors. Problems to be addressed include:

1. Dynamics of slab jets or liquid sheets for thick liquid protection, including the effect of nozzle design, flow conditioning, and boundary layer cutting on jet surface smoothness;
2. Primary turbulent breakup of turbulent liquid sheets and forced thin liquid films, and quantification of the associated hydrodynamic source term;
3. Dynamics of forced thin liquid films on downward-facing flat and curved surfaces, including film detachment and flow around beam ports;
4. Free surface topology and droplet detachment from downward-facing porous wetted walls;
5. Thermocapillary effects and associated design constraints for thin-liquid film protected divertors and first walls; and
6. Inertial fusion energy chamber clearing phenomena, including interactions between liquid drops and an expanding plasma.