Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Turbulent swirling layer with free surface PHILIPPE BARDET, PER PETERSON, OMER SAVAS, UC Berkeley — A turbulent annular liquid wall jet, or vortex tube, generated by helical injection inside a tube was characterized experimentally. The resulting hollow confined swirling layer is proposed for use in a thick liquid first-wall chamber concept for inertial fusion power plants. The velocity fields were measured with a single camera split-screen stereoscopic particle image velocimetry scheme. The flow was studied at 5 stations between 1.5 and 4.5 "vortex tube" diameters downstream of the injection nozzle in a horizontal plane that coincides with the tube axis. Up to 1024 independent realizations were recorded and analyzed for Reynolds numbers ranging from 3,200 to 14,000 at each station. The turbulent structures are non-isotropic and non-homogeneous. Gradients in average velocity and Reynolds stress result in turbulent kinetic energy production. Between 1.5 and 3.5 diameters, the average azimuthal velocity profile alone is non uniform away from the wall. Persistent large vortical structures are observed. The turbulent kinetic energy decreases slowly with distance while the dissipation decreases rapidly. At 4.5 diameters, the wall effect influences strongly the average velocity profiles. The vortical structures disappear and the turbulent kinetic energy increases.

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Date submitted: 06 Aug 2007 Electronic form version 1.4