Overview Summary - CQ1

Liquid Walls for MFE and IFE:

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What Happened in the Liquid Wall Discussions at Snowmass?

About 60 participants from MFE/IFE, Technology/Physics discussed the potential attractiveness, key issues, and current research related to liquid walls. Many configurations and concepts utilizing the liquid wall idea were presented. The area is very concept-rich. The following themes emerged from the discussion:

- Possibility of an improved vision of a fusion product
- Reduced development costs,
- Enabled attractive physics regimes, and
- Considerable physics/technology, MFE/IFE synergy

Liquid walls have the potential to lead to an improved fusion energy reactor product with competitive economics and attractive safety & environmental features. Examples of this potential included high power density, impulse loading, and disruption handling capability without failures in highly-stressed FW/D components, enabling high β, stable physics regimes that lead to smaller devices, reduction in volume and hazard of radioactive waste, *etc*. In addition liquid walls have the potential to reduce MFE/IFE development costs and affect the technology and physics programs in positive ways by making the material development and testing issues more tractable, allowing FW/D proof-of-principle demonstration without neutrons, providing near-term HHF technology for long-pulse physics experiments.

What are the Opportunities for Liquid Wall Development?

Liquid Walls are just now entering into serious concept exploration – it is clearly too early to identify the most promising configuration or working liquid. Significant design, analysis, modeling, and experiments are needed to quantify the potential benefits and identify attractiveness trade-offs, explore the many concept variations that utilize the LW idea, and explore generic critical issues in (magneto-) hydrodynamics, heat transfer, plasma edge transport, surface composition and sputtering, *etc*.

Facility to address generic R&D needs have been identified and include:

- LM-MHD/Free Surface Flow in Tokamak-like Magnetic Fields
- Thermal-Fluid/Free Surface Flibe Simulant Flow and Flibe Handling
- Laser and Heavy Ion Beam Propagation in Vapor and Droplet Mists
- HHF, Sputtering, and Plasma Interaction Experiments

It was generally concluded that testing in tokamaks should initially focus on divertor, but may need a dedicated all-liquid wall experiment to fully test the physics potential.