DRAFT – 10/11/01

Proposed Task II Work Plan For FY02

1. **Numerical Tool Development for Free Surface Liquid Flow** – Develop and validate numerical capability for analysis of LM-MHD free surface flows with no axi-symmetry requirement and multiple, space varying components of magnetic field. The capability is needed in order to simulate free jets and film flows with toroidal breaks – both of which are crucial problems for LM first walls and divertors. This task will be approached via several promising avenues.

   ? 3D Parabolized Navier-Stokes solver with height function free surface – This builds off of our past 2 years of work using boundary layer and parabolized Navier-Stokes approximations in 2 and 2.5D with the height function free surface tracking method. It is limited to flows where surface and/or flow does not change extremely rapidly. It has a high probability of successful implementation in the next 6 months and will be used as a test bed for 3D MHD formulations, including potential, induced field and induced current formulations, that may be applied in more complex codes (see below).

   ? Flow3D-MHD – Continuing to build off of our past years work on modifying Flow3D for certain MHD conditions including 3D magnetic field models. Testing of formulations will be done here, but Flow3D is limited in the amount of change and integration possible for MHD terms due to lack of full source code. We will continue to upgrade, test and use these modifications whenever possible, including comparing results with Parabolized NS code above and new experimental data. Results will be continuously generated as the capabilities are expanded and tested.

   ? Cooperation with Hypercomp and Telluride Developers – We will also develop subroutines for various MHD models to be used with the Hypercomp and Telluride unstructured mesh free surface flow codes, both of which we will have source access to. These codes will utilize the formulations developed and tested above, and if successful, have a high degree of flexibility in 3D problem geometry and surface shapes. First results with full MHD are expected by the end of next year. (This work is funded under SBIR and doesn't explicitly appear in the APEX budget).

2. **Experimental Testing of Characteristic Problems for Free Surface Liquid Flow** – Experimental tests need to be performed in order to generate data for assessing feasibility of near-term concepts for plasma experiments (task I) and more long-term concepts for future reactors (task III), as well as data for validation of various numerical models still under development (task II).

   (NOTE that the MTOR operating budget is explicitly included under Task I, but some

MTOR related tasks are included here as well since all experiments can be classified under MHD exploration).

The work for next year will have several components.

- ? Continuation of first experiments in MTOR with inclined plane module to look at surface stability issues for MHD film flows with and without (1) wall conductivity , (2) geometric complexities and obstacles, (3) magnetic propulsion currents, (4) multiple component fields built from permanent magnets, and (5) plasma wind mass fluxes. This data will be useful all goals of experimental program (i.e. near and long term concept feasibility and model validation).

- ? Continuation of experiments in the FLIHY facility to investigate surface heat transfer and surface stability for molten salt film flows with geometric complexity from penetrations, curved walls, and heat transfer enhancers. This data will be useful all goals of experimental program (i.e. near and long term concept feasibility and model validation).

- ? Other small-scale experiments on MTOR as proposed by task I team (see Task I writeup)

- ? Continual extension of experimental capabilities including (1) new test sections for soaker hose and curved walls, (2) increase in field strength and field directional control in MTOR facility by higher magnet current and addition of localized flux concentrators and/or magnet pairs, (2) assessment of the use of Na in MTOR for higher interaction parameter experiments, (3) shakedown and testing of lithium stream in LIMITS (see Task I writeup)

3. **Plasma Bulk Liquid Interactions** – Has been provided in a separate writeup for Task B.