Work plan for Task-III

It is expected that the work on the Sn-CLIFF will be completed by the end of this fiscal year. However, many issues, especially the LMMHD issues, will need to be resolved together with Task-II. Also, the issues associated with the interaction of the plasma need to continue. Therefore, the work plan for Task-III will include two parts:

1. Develop new concepts with a non-conducting CLIFF, probably based on flinabe. The following are the sub-tasks for this part of work:

    a. Establish phase diagram: We need at least to confirm the melting temperature for the few attractive compositions. The melting temperature for the 1-1-1 composition was reported to be 240C, but the accuracy of this melting temperature is questioned. However, there are a few other compositions with melting temperatures about 300C. Therefore, there is high confidence a low melting temperature salt melt can be found. Kathy indicated that INEEL maybe able to do this measurement. Before, this information is available, I will select the 1-1-1 composition with a melting temperature of 240C. Sze will provide the best estimate of the material properties, including the vapor pressure, to start this process.
    b. Heat transfer: It is important to assess the heat transfer capability as a function of all the parameters. It is also important to assess the impact of MHD to heat transfer. A very important process will be to develop methods to improve heat transfer by any means. Due to the poor thermal conductivity and limited temperature window, high turbulence will be essential. It is expectd that Task Group-II will provide support in this work.
    c. Material selection: We will need input from material community for the material properties and the temperature window for the structural material we select. This structural material maybe an advance FS.
    d. Plasma interaction: We need to establish the temperature limit on the coolant from the plasma edge group. Since the vapor pressure will be similar to flibe, and dominated by BeF2, it is expected that the temperature limit will be similar to that of flibe. The flibe temperature limit will be used until new value is available.

e. Breeding: Tritium breeding is a necessary function of a fusion power plant. Some initial calculations have showed that tritium breeding is acceptable, we will need to confirm that.
f. Activation and safety: Na activation will be a severe issue. The activation, and its impact to safety, needs to be addressed. What will be the advantage from safety point of view if we use flinabe for the CLIFF, and flibe for the blanket? (I prefer to use the same material for both CLIFF and the blanket.)
g. Divertor design: Can free flowing flibe handle the divertor heat flux? What is the temperature limit for the flibe in the divertor regime?
h. Plasma stability: What will be the impact on the plasma stability with a non-conducting CLIFF face the plasma? Can we use the first wall behind the CLIFF to provide the conducting shell function? How thick a wall will we need?
i. Configuration: What will be the configuration of the nozzle and the blanket if we have a flinabe blanket instead of a LiPb blanket:
j. Tritium control: We need to address the issue of tritium control. Flinabe will have a very small, similar to flibe, tritium solubility.
k. Power conversion: We will need to get a converting efficiency ~> than 45%.
l. Interface with IFE and JUPITER-II. It will be important if we can get both IFE and JUPITER-II interested on the flinabe based system. I believe they will. we need to define a R/D program. The support from IFE and JUPITER-II will be essential for this future development.

2. Other activities:

We need to continue some of the activities in progress.

a. We will need to work with Task Group-II to define the MHD problems, for both conducting and non-conducting fluid. The answers to the MHD problems will be a very important outcome to the APEX project. This process has started already, with a joint conference call between the Task-II and Task-III.
b. We need to work together with Task Group-V on the issues with plasma interaction, for both conducting and non-conducting fluid. Since the CLIFF is facing the plasma, the interaction between the coolant flow and the plasma causes some unique issues.

c. We need to assess the issues and advantages of a Li-CLIFF. Li-CLIFF has some special advantages from plasma point of view. We need to assess the pay back to the attractiveness of the power plant.