October 10, 2002

Conference call-11 am IFE-AIES Ralph Moir

Structural materials selection for HYLIFE-II

For that discussion, I would like to refer people to the materials section of the HYLIFE-II report on p 18 and 19 of Moir et al., "HYLIFE-II: a molten-salt inertial fusion energy power plant design—final report," Fusion Technology vol 25 (1994) 5-25. Also P. A. House, "HYLIFE-II Reactor chamber design refinements," Fusion Technology Vol 26 (1994) 1178-1195.

Design criteria:

1-30 year life from corrosion-300 series (nickel) SS for corrosion resistance to residual TF before it gets reduced to its chemical equilibrium state of T_2.

2-30-year structures due to radiation damage

100 dpa (0.5 m flibe at r= 3 m) based on prediction about 1990 of PCA alloy. Mike Billone says 30 vol% or 9% linear swellling

3-304 or 305 for its low activation (extra cost needed to get feed stock extra low in Nb and Mo).

> **swelling-3-mm thick flow guiding structure made of corrugated or wavy sheets and tubing designed to be highly swelling tolerant. An allowed swelling percentage needs to be determined by the HYLIFE-II mechanical design team. Mike has pointed out his criterion up till now has been based on pressure vessel application or something much more restrictive than out flimsy flow guiding structure. Failure will occur when "chunks" fall off the flow structure. Leaks, even fairly large leaks are quite tolerable.**

4-Good economics--->high efficiency. Temperature-650 C. The stress was reduced due to the high temperature to under 50 MPa and to accommodate the cyclic stress.

Other materials than 304 SS could be considered for HYLIFE-II but they would have to meet the design criteria. There is a design and performance consequence for choices away from the design choice. For example, thicken the flibe layer and reduce the dpa dose but increase the cost of flibe and pumping power. Lower the temperature and decrease the thermal efficiency (more pumping power, lower carnot efficiency).

The 3-mm thick flow guiding structure is dominating this discussion, however, by far most of the material is in the thick chamber walls and piping where neutron damage is not an issue.

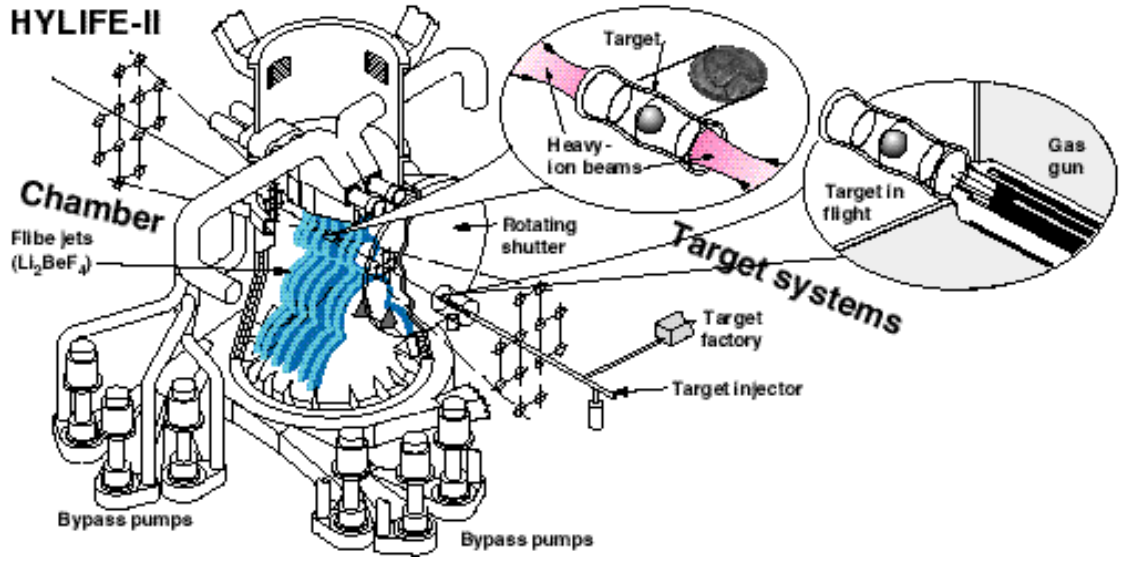

Fig. 1 HYLIFE-II chamber 7 m dia 208 tons

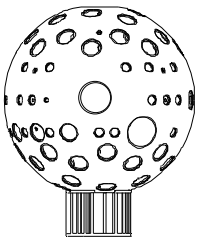

Fig. 2 NIF chamber 10 m dia 150 tons.

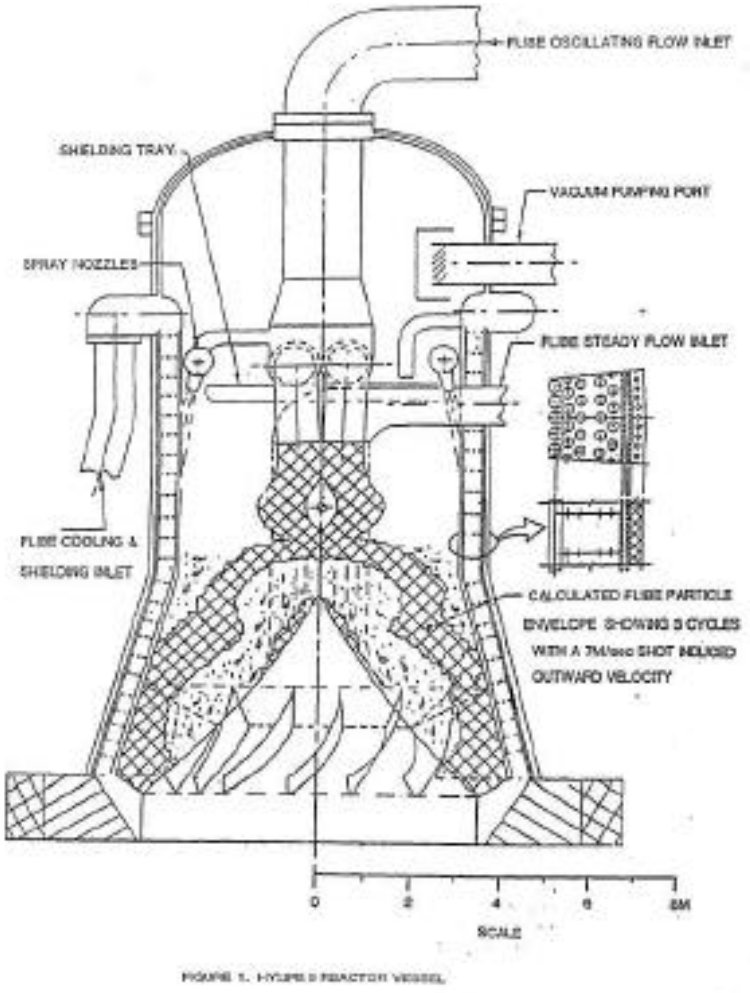

Fig. 3 HYLIFE-II reactor vessel