APEX Task Group III Progress Report

Dai-Kai Sze, Argonne National Laboratory
Brad Nelson, Oak Ridge National Laboratory
Richard Nygren, Sandia National Laboratory

Presented at the APEX E-meeting

March 24, 2000

Work to be done

- Upon received information on the tritium stream throughput and composition, LANL will calculate the tritium inventory, ISS size, ISS cost and refrigeration power for the APEX tritium system.
- The time to deliver this result will be discussed between Sze and Willms.
- With a large hydrogen isotopes flow rate, possible safety concerns will be discussed with INEEL.

Flibe Chemistry

- Four different flibe chemistry control processes have been identified.

  a. Using the MFn + F$\rightarrow$MFn+1 redox process.
  b. To convert T to (OT)- to increase tritium solubility in flibe, and adjust F2/TF ratio for corrosion control.
  c. Use Be effect to reduce both TF and F2 to BeF2.
  d. To use the transmutation of F to control the free F activities.

Work to be Done

- Detailed assessment will be made to determine the key issues for each process.
- Further results will be available in the May meeting.

Cliff Temperature Window

- The temperature window between the allowable CLIFF surface temperature and the coolant melting temperature needs to be large enough for operation flexibility.
- Usual engineering considerations requires the minimum coolant temperature to be 50C above the melting temperature of the coolant.
- The coolant temperature rise for heat transport (Tout-Tin) needs to be between 30 to 50C.
- The coolant heat transfer temperature difference needs to be 70C.
- Therefore, the allowable surface temperature has to be higher than T melting + 150C.
- The melting temperature of flibe is between 364 and 459C.
- The CLIFF temperature limit has to be above 514 (for Li2BeF3) or 609C (for Li2BeF4).

Assumptions and Parameters

- For this calculation, a lithium CLIFF and Li divertor are assumed.
- The plasma burn fraction is assumed to be between 1 to 30%.
- The divertor absorption fraction is assumed to be between 100% to 10%.
- A tritium recovery system will be designed to handle this tritium throughput.

Questions

- In order to have acceptable temperature window, the flibe composition with high viscosity has to be used. Can we circulate this flibe in a heat transport system?
- Even using Li2BeF3, only low recycling mode cases provide acceptable design window. Can flibe blanket/divertor operate in a low recycling mode?
- With a high recycling mode, the allowable surface temperature is only 400°C. This temperature limit is not high enough to provide acceptable temperature window.

Tritium System

- For a reactor system with a liquid wall and a liquid divertor, tritium may be absorbed by the liquid.
- This results a low recycling divertor, with all tritium being carried away by the coolant.
- Questions have been asked both in Snowmass, as well as within the APEX meeting, can the tritium be recovered with a reasonable tritium recovery system.

Work to be Done

- Before the end of April, the following information will be delivered:

  - A tritium recovery system will be developed with the above mentioned parameters.

  - The system cost, tritium inventory, and the power requirement will be assessed.

  - The throughput of the tritium system, as well as its composition, will be calculated.

  - The throughput and composition of the tritium system will be the input for LANL to do the ISS design.

  - During the same period, LANL will work on the ISS code to be ready for calculation.