EVOLVE
Status and Evolution
(We are continuing to evaluate critical issues)

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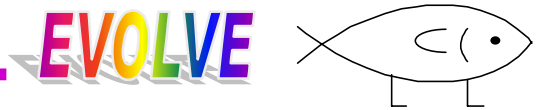
ORNL: B. Nelson, S. Zinkle, P. Fogarty

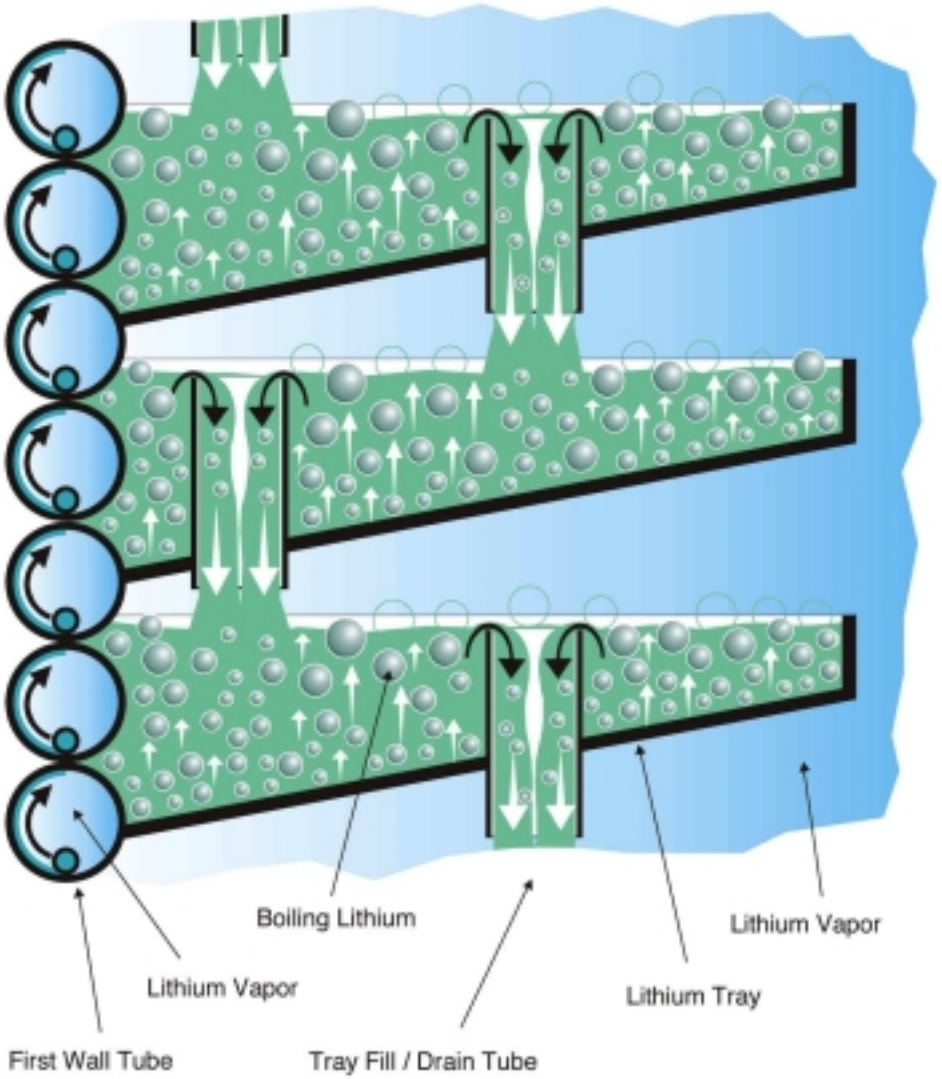
INEEL: K. McCarthy, B. Merrill,

UCLA: M. Abdou, N. Ghoniem, S. Sharafat, M. Youssef,

APEX Project Meeting, May 10-12, 2000, ANL



Schematic of EVOLVE First Wall Tubes and Blanket Trays

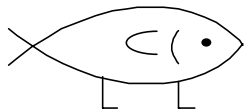


EVOLVE PRESENTATIONS

Introduction	C. Wong	5 min
Some aspects of the EVOLVE trays' configuration	I. Sviatoslavsky	15 min
Evolution of the transpiration FW/blanket concept	L. Barleon	25 min
EVOLVE Li trays boiling analysis	J. Murphy	25 min
Impact of vapor fraction on nuclear parameters of EVOLVE	M. Sawan	15 min
Review of MHD effects on Liquid Metal Boiling	R. Mattas	15 min
Initial testing of W-mockups	R. Nygren	10 min
Summary and further evolution	C. Wong	10 min

A set of questions for different tasks

1. Does the concept work? If not why?
2. What design changes/fixes could make it work or make it work better?
3. As a design concept what design principle we could recommend?
4. What are the design limits for this concept? e.g. heat flux, neutron wall loading, temperature, design stresses…etc.
5. What are the critical issues of this concept?
6. What are the advantages and disadvantages of this concept?
7. What analysis or fundamental data will be needed to address the identified critical issues?
8. What fundamental experiments will be needed to resolve these issues or obtain necessary data?



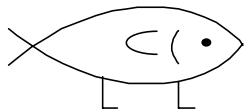
EVOLVE SUMMARY AND EVOLUTION

- **FW/blanket Configuration:**

  For the Transpiration FW and boiling trays design, to reduce the number of welds in front, the separate FW/tray structure is preferred. Vibration caused by boiling needs to be assessed. For the Transpiration FW/blanket concept, detailed module configuration and construction approach to be assessed. In general, construction with W-alloy has to be assessed and new approaches may be needed. The general approach of the start-up of liquid blanket will be assessed.

- **Blanket Lithium Boiling Analysis:**

  The drift flux model and considering the churn-turbulent boiling regime, the generation of Li-vapor was determined as a function of location in the lithium tray. Results show a large void fraction of up to 65%, but this has minimum impact on neutronics performance. Assessment will continue on the MHD effect on the boiling trays, possibly through vapor channel modeling, the vibrational characteristics of the boiling trays and the potential phenomena of dry-out.



EVOLVE SUMMARY AND EVOLUTION

- **First Wall/Blanket Li Transpiration cooling analysis:**

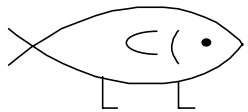
  Basic issues outlined and assessed. The transpiration cooled first wall could be credible if the superheating of lithium and W-surface is verified. Bubble nucleation due to the generation of helium in the liquid Li needs to be studied also. The basic design logic of capillary wall transpiration cooling could be extended to the blanket design. Construction of the thin Li-slabs test module should be prepared.

- **Neutronics:**

  Assessment on nuclear/shielding/afterheat and radioactivity continues. No critical issues identified, but will evaluate both boiling tray and transpiration cooling options.

- **Materials Evaluation:**

  W-5Re continues to be the reference material. Assessment of more radiation resistant and low activation W-alloy will continue.



EVOLVE SUMMARY AND EVOLUTION

- **W-alloy fabrication and joining:**

  Components received from SBIR companies continued to show difficulties in working with W-alloy. Different designs and manufacturing approaches need to be assessed.

- **Safety**

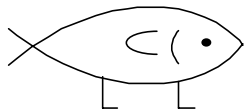
  High afterheat continues to be a safety concern, various passive afterheat removal options are being assessed.

- **POP MHD Experiments**

  Literature review completed, MHD effects on boiling may not be significant. Liquid metal POP experiments to address critical issues will be identified.

- **Structural Analysis**

  Stress concentrations of the boiling trays and the thin capillary wall transpiration FW/Blanket concepts will be assessed.



EVOLVE SUMMARY AND EVOLUTION

- **Tritium**

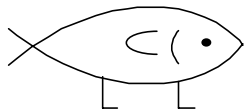
  Cold trap process of tritium separation from Li is the base line approach, we will be open to other innovative approaches.

- **Configuration CAD**

  This task can be initiated for the boiling trays and transpiration cooled blanket options.

- **Power conversion**

  The low pressure high temperature Li-vapor condenser power conversion system needs to be assessed.



Observations and Recommendatons

- The transpiration cooled first wall seems to be a credible concept to receive continuous evaluation. This is a critical concept for both boiling trays and transpiration cooled blanket concepts.
- If the transpiration cooled first wall works, the corresponding blanket design should be acceptable in principle.
- Recommendations for the next phase:

1. Refinement of analysis for the identification of critical and feasibility issues.
2. Perform detailed listing of advantages and disadvantages for various design options.
3. Identification of critical data and corresponding experiments.
4. Initiation of experimental planning
5. Recommend a reference design for EVOLVE