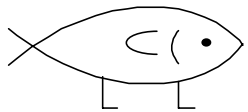
APEX-TASK IV

EVOLVE

(A W-alloy structure, vaporized Li blanket concept)

- **W-5%Re, is the primary candidate structural material (Tmax<1400 C)**
- **High operating temperature implies high CCGT power conversion efficiency (~58%) is possible.**
- **Vaporizing lithium allows very low operating pressure (< 0.2 MPa).**
- **The temperature variation throughout the first wall and blanket is minimized. (Tin=900 C, Tout=1200 C)**
- **Slow lithium flow rate implies MHD insulator coating is not required.**

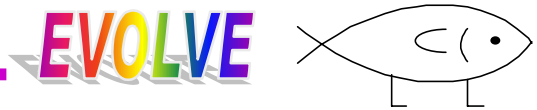
Task summary presented at the
July 2000 VLT monthly Conference Call



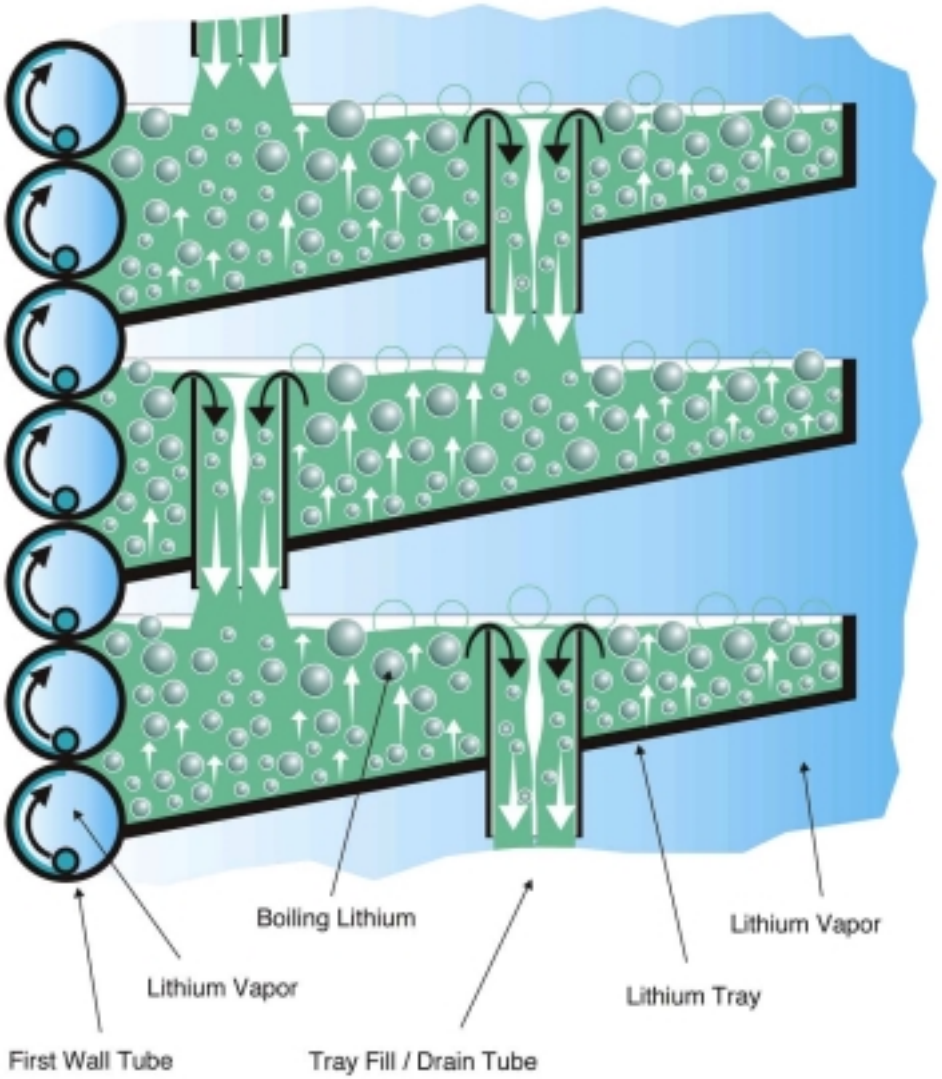
EVOLVE TASKS

(FOCUSED ON ADDRESSING CRITICAL ISSUES)

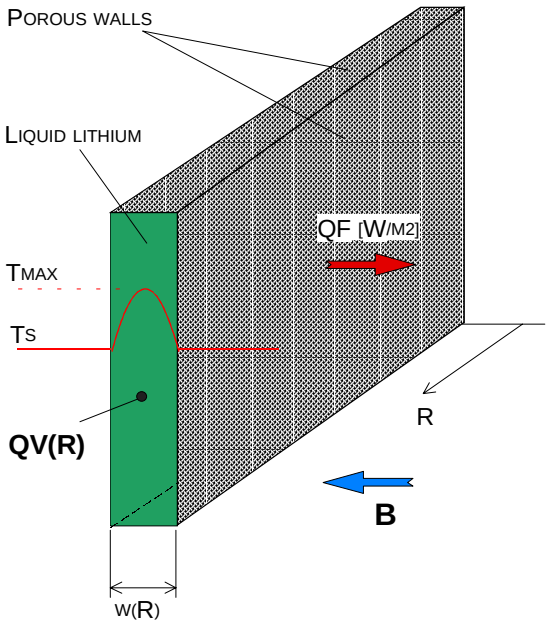
- FW/blanket configuration
- Blanket lithium boiling analysis
- First Wall/Blanket Li transpiration cooling analysis
- Neutronics
- Materials evaluation
- W-alloy fabrication and joining
- Safety: afterheat removal and leak propagation
- POP MHD experiments
- Structural analysis
- Tritium
- Configuration CAD
- Power conversion



Schematic of EVOLVE First Wall Tubes and Blanket Trays

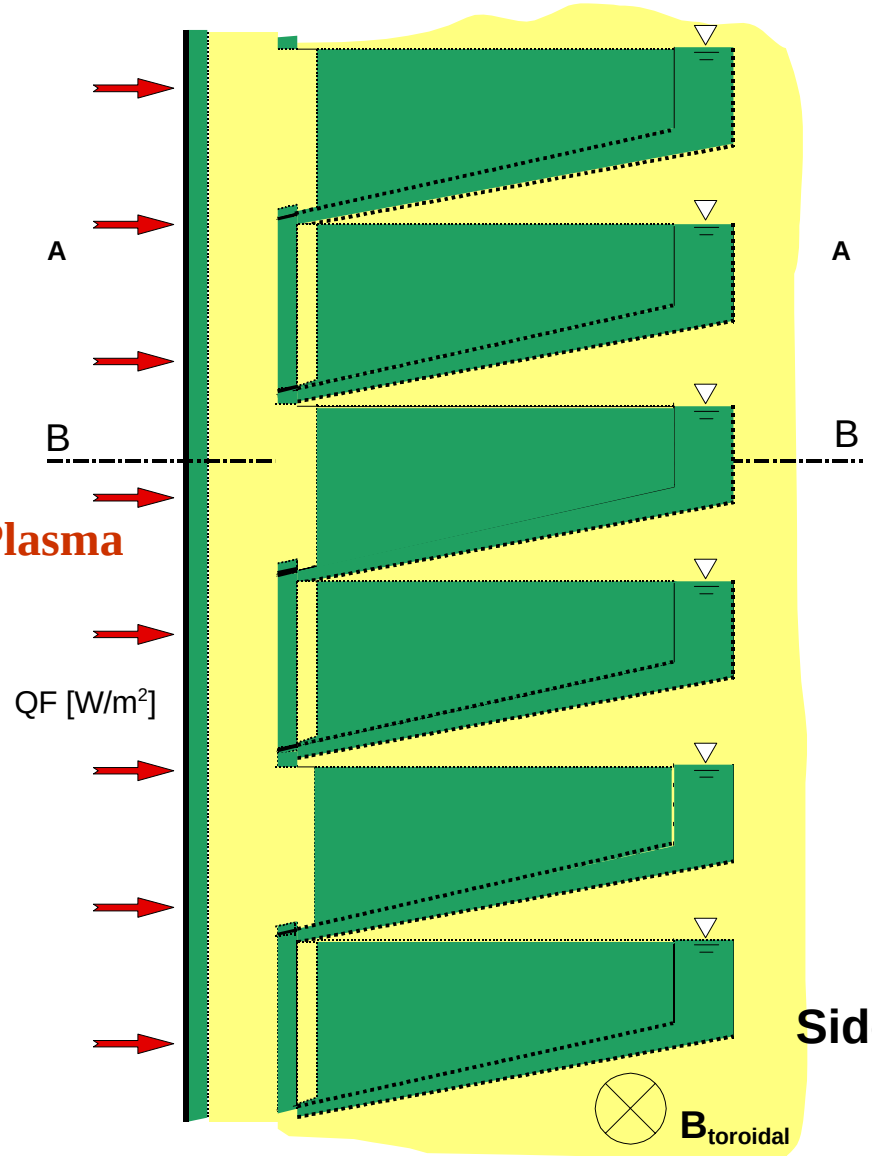


Transpiration Cooled First Wall and Blanket Concept (Poloidal flow FW)



Blanket plate

(A)



Side view

(B)

EVOLVE

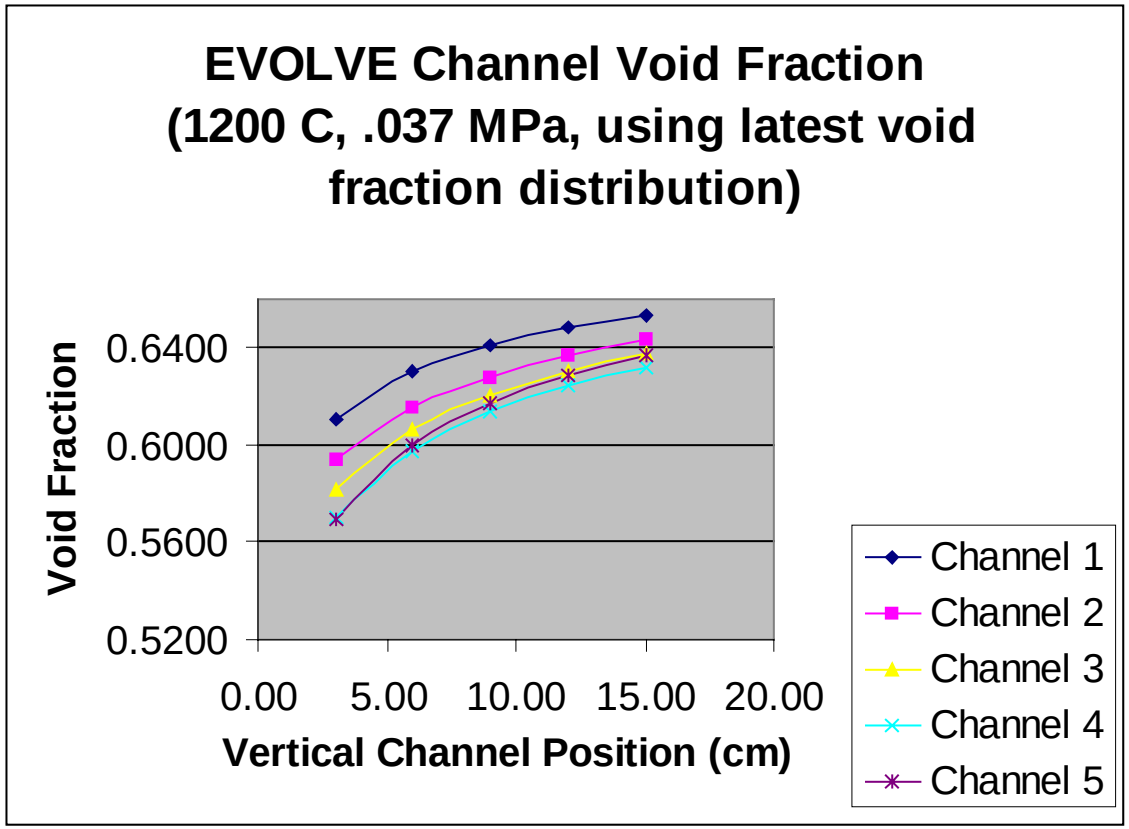
- New nuclear heating values are calculated based on the previous void fractions

Nuclear Heating (W/cm^3) Distribution in OB Tray Using Second Iteration Vapor Fraction Distribution

104.4						
104.5	13.5	11.9	10.4	9.3	8.4	56.7
105.5	13.7	12.1	10.6	9.5	8.5	55.8
106.4	14.1	12.3	10.9	9.8	8.8	54.8
107.2	14.6	12.6	11.5	10.3	9.3	53.8
109.0	27.0	23.1	20.0	17.7	16.0	52.7
109.0	98.0	84.2	72.9	64.1	56.8	50.5
110.0						

Final Iterated Void Fraction Distribution

- Essentially no change from previous void distribution (convergence)



Iteration Comparison

University of Wisconsin-Madison

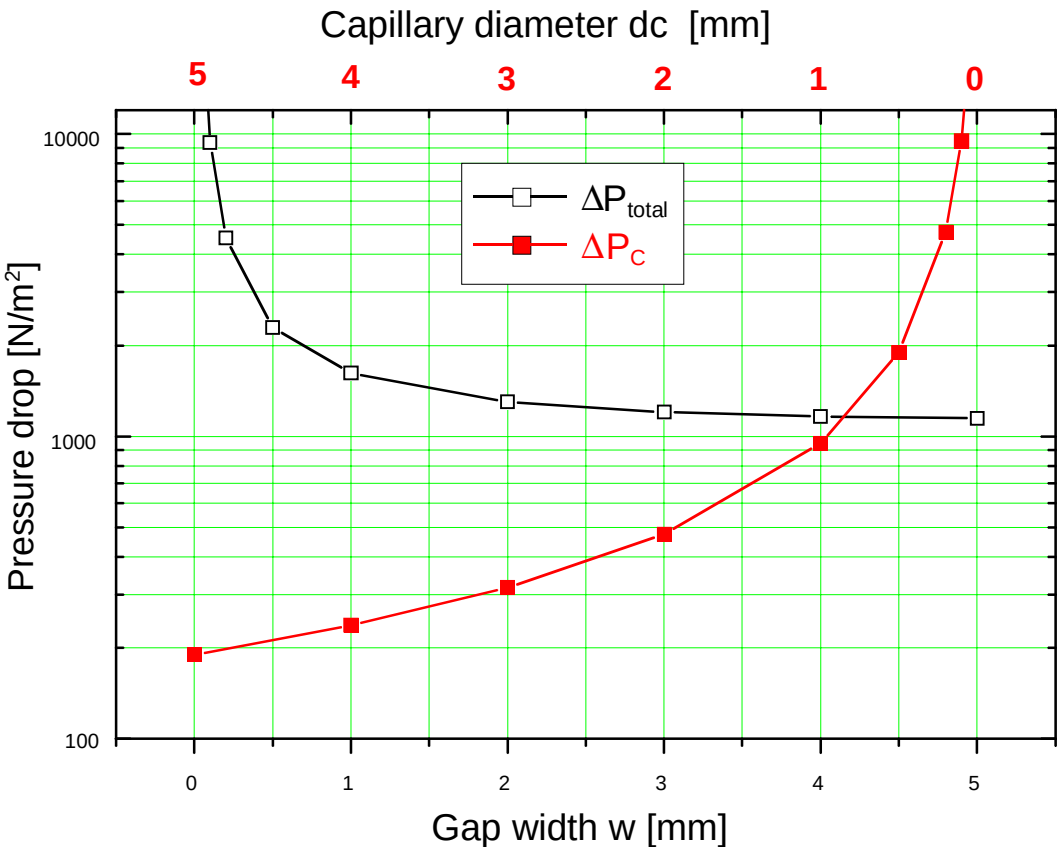


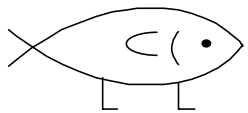
Fig. 5 Capillary pressure head and the total pressure drop in dependence of the capillary diameter $\mathbf{d_C}$ and of the first wall feeding gap width w respectively.

Observations and Recommendatons

- **The transpiration cooled first wall seems to be a credible concept. This is a critical concept for both boiling trays and transpiration cooled blanket options.**

Continuing work to November 2000:

1. **Refine analyses and design to identify critical and feasibility issues.**
2. **Recommend a reference design for EVOLVE.**
3. **Perform detailed listing of advantages and disadvantages.**
4. **Identify experiments to address critical data and issues.**
5. **Initiate planning of experiments.**



APEX Task-IV
The EVOLVE team
(We are continuing to evaluate critical issues)

- **GA:** C. Wong, C. Baxi, E. Reis, R. Schleicher
- **UW:** M. Corradini, J. Murphy, M. Sawan, I. Sviatoslavsky, H, Khater, E. Mogahed
- **ANL:** R. Mattas, S. Majumdar, D. K. Sze
- **SNL:** R. Nygren
- **FZK:** L. Barleon, S. Malang "initiated the concept"
- **ORNL:** B. Nelson, S. Zinkle, P. Fogarty
- **INEEL:** K. McCarthy, B. Merrill
- **UCLA:** M. Abdou, N. Ghoniem, S. Sharafat, M. Youssef

VLT monthly conference call, July 12, 2000