ARIES-AT Liquid Divertor

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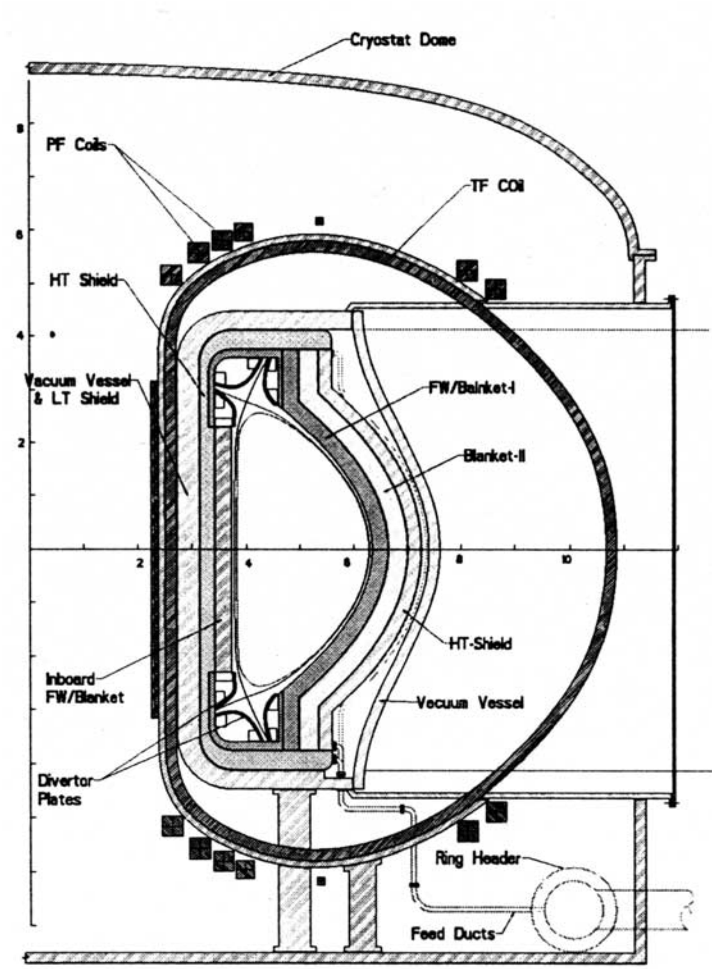
Design Objectives

- Address design issues within context of ARIES-AT advanced power system.
- Compare performance with solid surface divertor system.
- Identify key technical issues to be addressed in future.

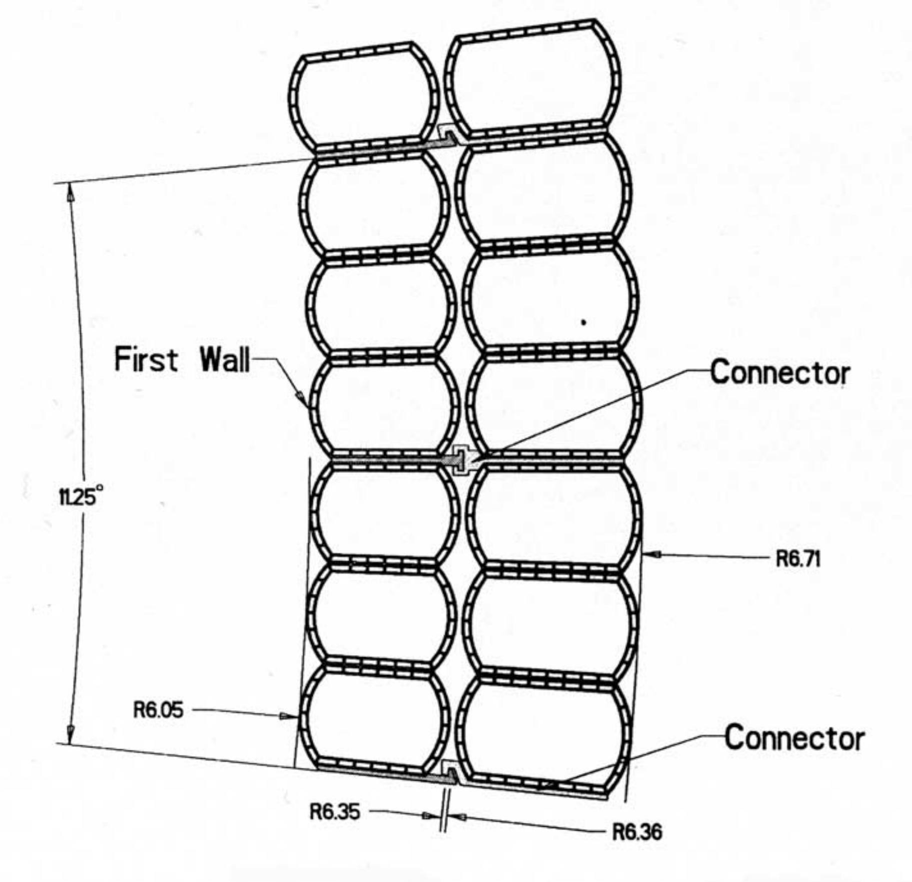
ARIES-AT Background*

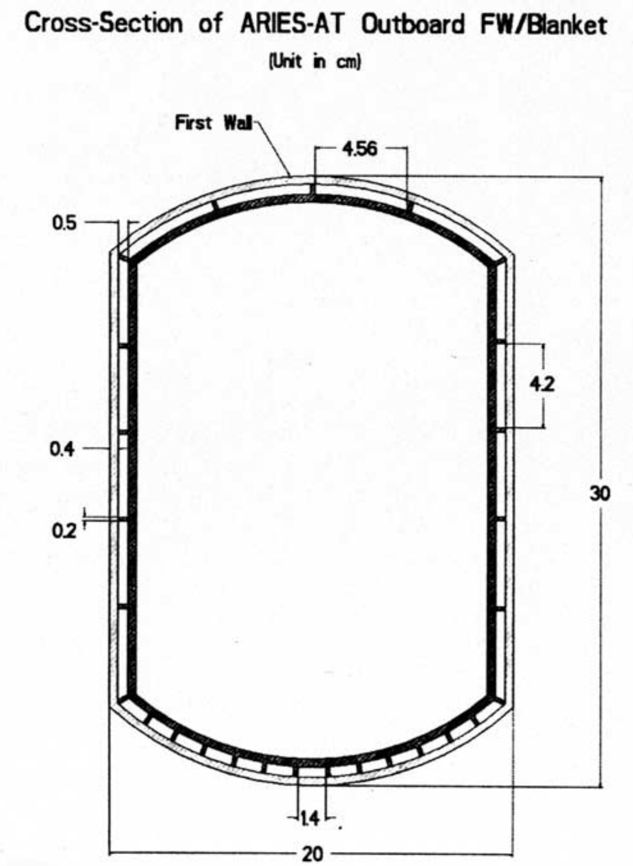


- Fusion Power - 1737 MW
- Neutron Power - 1390 MW
- Alpha Power - 347 MW
- Current Drive - 47 MW
- Av. Wall Load - 4.3 MW/m2
- Max. OB Wall Load - 6.1 MW/2
- Av. FW Heat Flux - 0.5 MW/m2
- Max. Divertor Heat Flux - 5 MW/m2
- Major Radius - 4.8 M
- Minor Radius - 1.2 M
- An-axis Field - 7.5 T

*A.R. Raffray, ARIES Project Meeting 3/20-21/00

ARIES-AT FW/Blanket





- Blanket Coolant/breeder - PbLi
- Structure - SiC/SiC

Operating Conditions

- Maximum SiC/SiC temperature - ~1000 C
- PbLi Inlet/outlet temperatures - 653/1100 C
- FW PbLi velocity - 5.8 m/s
- FW MHD pressure drop - 0.49 MPa

Liquid Surface Divertor

- Liquid candidates - SnLi, pure Sn
  - Low vapor pressure - high operating temperature
  - High recycle mode operation - standard pumping methods apply
  - Low cost

Liquid Surface Divertor

- Address bottom divertor operation now. If successful then address upper divertor.
- Use free surface jets/shower flow with multiple layers.
- First step is to get self-consistent calculations of plasma edge
  - Free-boundary equilibrium calculations needed for UEDGE calculations, were just completed.
- Initial results to be presented at June ARIES meeting at UW.

Liquid Metal Divertor Design Activity

Input

- ARIES reactor geometry - *ARIES Team*
- ARIES divertor heat load distribution (Radiation and charged particles) for low edge temperature and high recycle operation - *J. Brooks*
- Helium pumping requirement - *J. Brooks*
- Maximum and average operating surface temperature of the liquid metals (Tin-lithium and Flibe) - *J. Brooks*

Design and Analyses

- Divertor concept(s) development - *Y. Gohar*
- Nuclear heating analyses - *Y. Gohar*
- Hydraulic analyses - *Y. Gohar, S. Molokov*
- Jet thermal analyses - *A. Hassanein*
- Evaporation depletion, and sputtering erosion - *J. Brooks*
- Helium pumping analyses - *A. Hassanein*
- Hydrogen (Deuterium and tritium) pumping and inventory - *A. Hassanein*
- Liquid metal processing for hydrogen and impurity control - *D. Sze*
- Material requirements (Coating, structural material, jet nozzle) - *R. Mattas*
- MHD analyses (Jet stability, jet cross section changes, pressure drop in supplying and draining the liquid metal, pressure drop in the nozzle, liquid metal splash at the end of the divertor geometry) - *S. Molokov, C. Reed, Y.Gohar*
- Activation and decay heat analyses - *Y.Gohar*
- Abnormal hydraulics events analyses - *Y.Gohar, S. Molokov*
- Plasma disruptions events - *A. Hassanein*