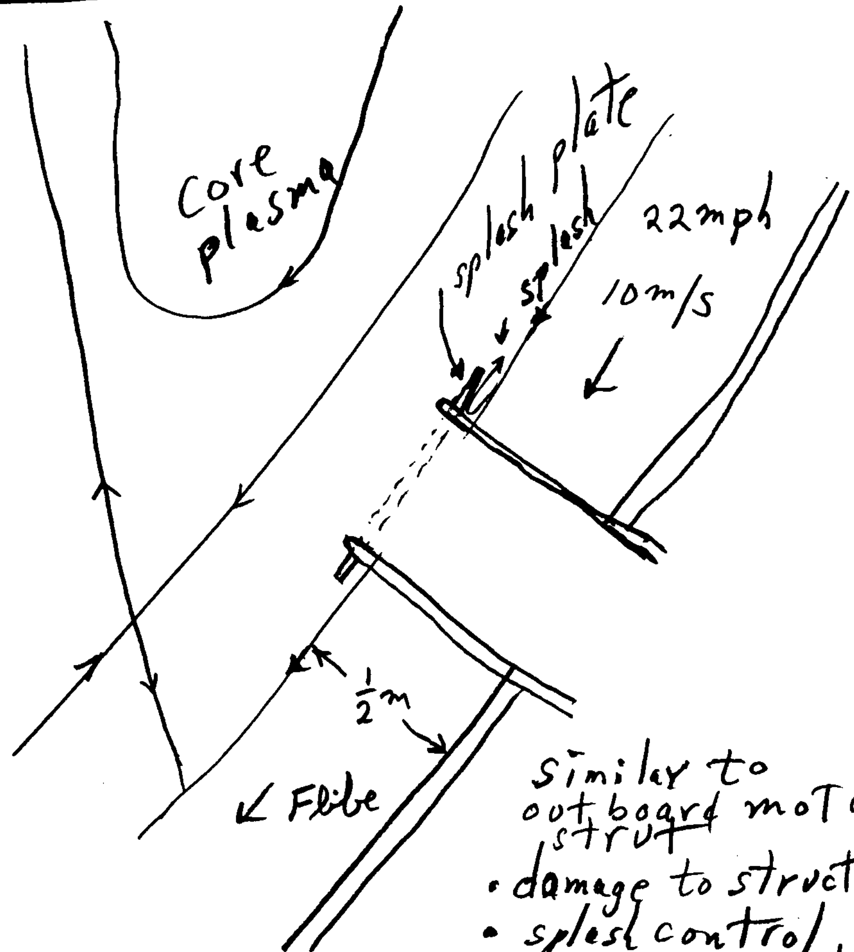
Penetration design

R.W. MOIR
10-27-99



Similar to outboard motor strut
- damage to structures
- splash control
- flow control

K. Gulec et al. Rome, APEX

See R.W. MOIR Fusion Eng. & Design 5 (1987) 267-272).
R.W. MOIR Fusion Tech 15 (1989) 674-679.

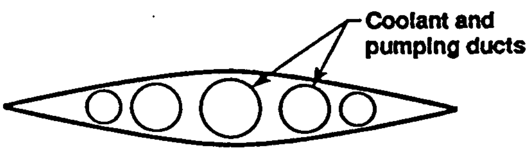
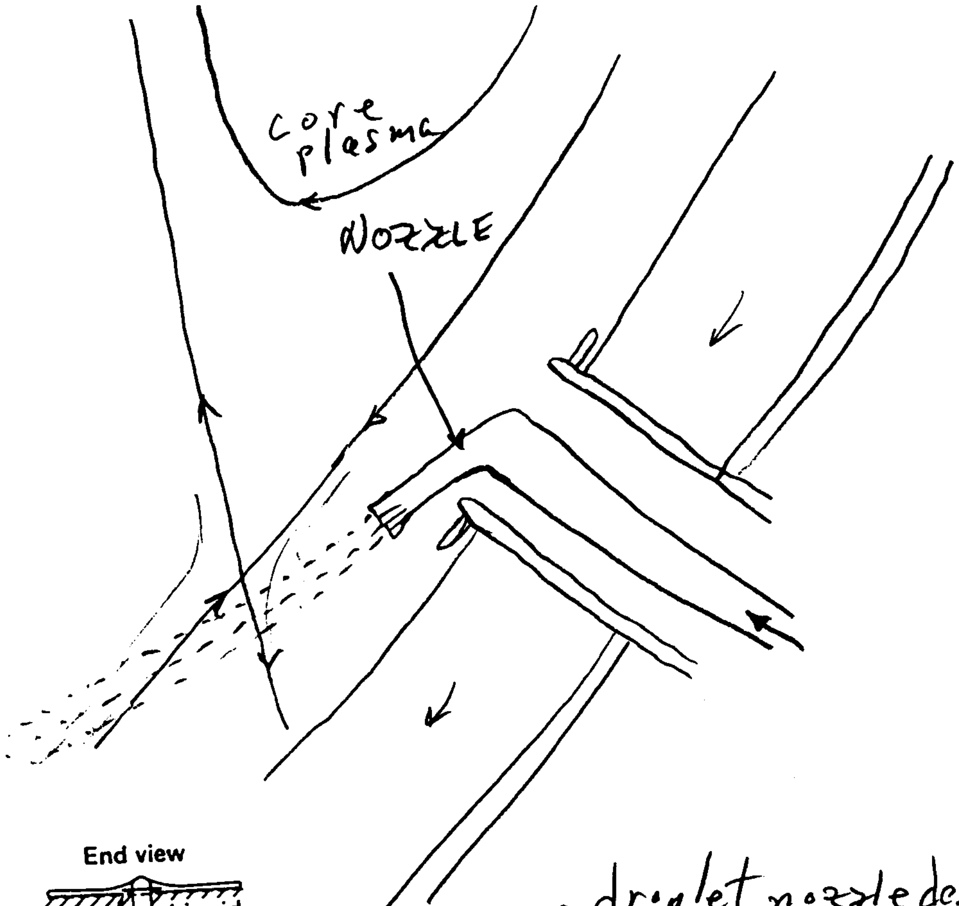


Fig. 4. Cross section of a hydrodynamically designed tube that penetrates the moving liquid. Ducts in the tube can carry coolant and pump gas.

Droplet divertor design



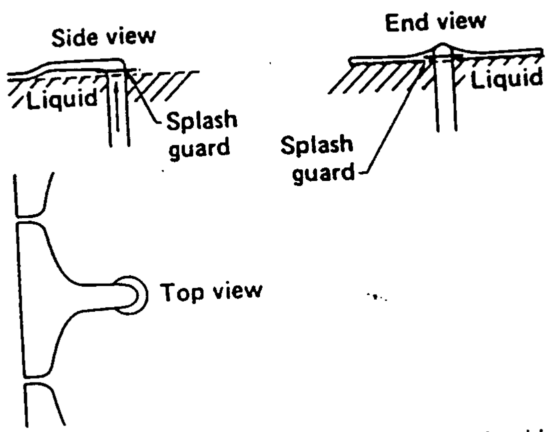
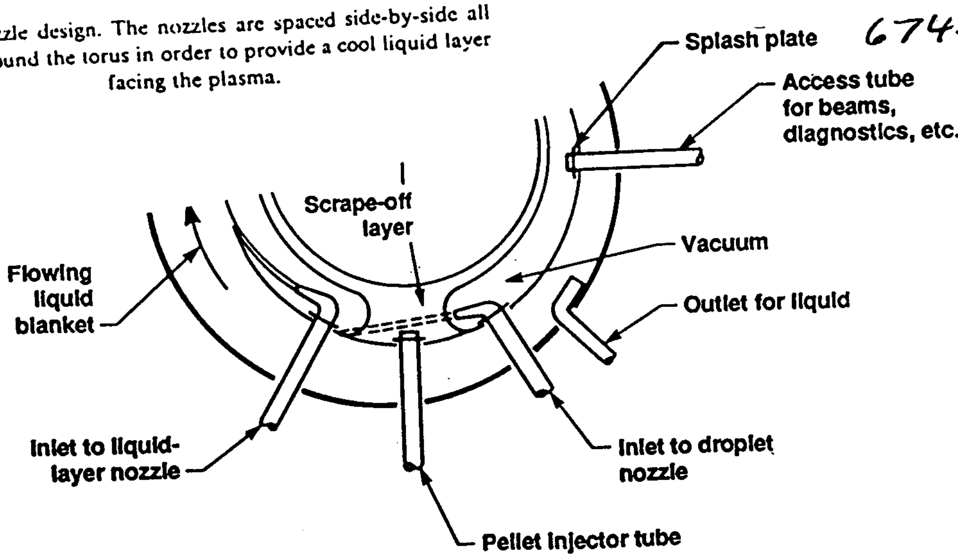


Fig. 2. Nozzle design. The nozzles are spaced side-by-side all the way around the torus in order to provide a cool liquid layer facing the plasma.

- droplet nozzle design
- nozzle damage
- droplet heat transfer 90 MW/m²
- droplet evaporation and condensation

see R. W. Moir, Fusion Tech 15 (1989) 674-679.



10/26/99
RWM

Moir APEX work plan for FY 00

1-Interface with plasma edge work on application to tokamak (close coupled divertor) and FRC (isolated divertor).

This means interpreting the edge plasma work as applied to the actual design. Making consistent heat transfer, temperature rise, and evaporation rates which are then used by the edge plasma/divertor people in making plasma contamination estimates.

2-Develop the corrections to evaporation when the rates become large.

Collisions build up pressure near the surface and cause condensation to cancel some of the evaporation resulting in reduced net evaporation rates. There are other corrections such as evaporative cooling.

3-Flibe droplet heat removal.

Work with ANL and others on analyses of the droplet divertor. Critique the X. Zhou and M. S. Tillack paper.

4-Effect on power cycle due to low ΔT, low liquid temperature and high pumping power.

Work with Alice, Dai-Kai and others on quantifying the above effects. For Flibe the temperature set by staying above freezing keeps the temperature in the 500 °C range and shouldn't much effect conversion efficiency, however, the pumping power can become large and diminish net electricity production.

5-Work with others or stimulate them on the design work on the exit "nozzle," penetration and liquid droplet design.

K. Gulec may take a lead role here in design of penetrations and the exit nozzle. So far he has restricted his work to fluid simulation but he could take up a stronger design role.

6-Liquid wall FRC evolution.

Besides the edge plasma work in item #1 above continue at a low level working some issues of the FRC with others interested such as M. Ohnishi, J. Santarius and U Washington people. Job unspecified at present.