Findings and Recommendations from Wetted-Wall IFE Designs

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Wetted-walls offer an alternative to gas- and thick-liquid-protected walls

- Thin liquid layer, fed from nozzles or introduced through porous wall, protects the solid surface from x-ray ablation and target debris

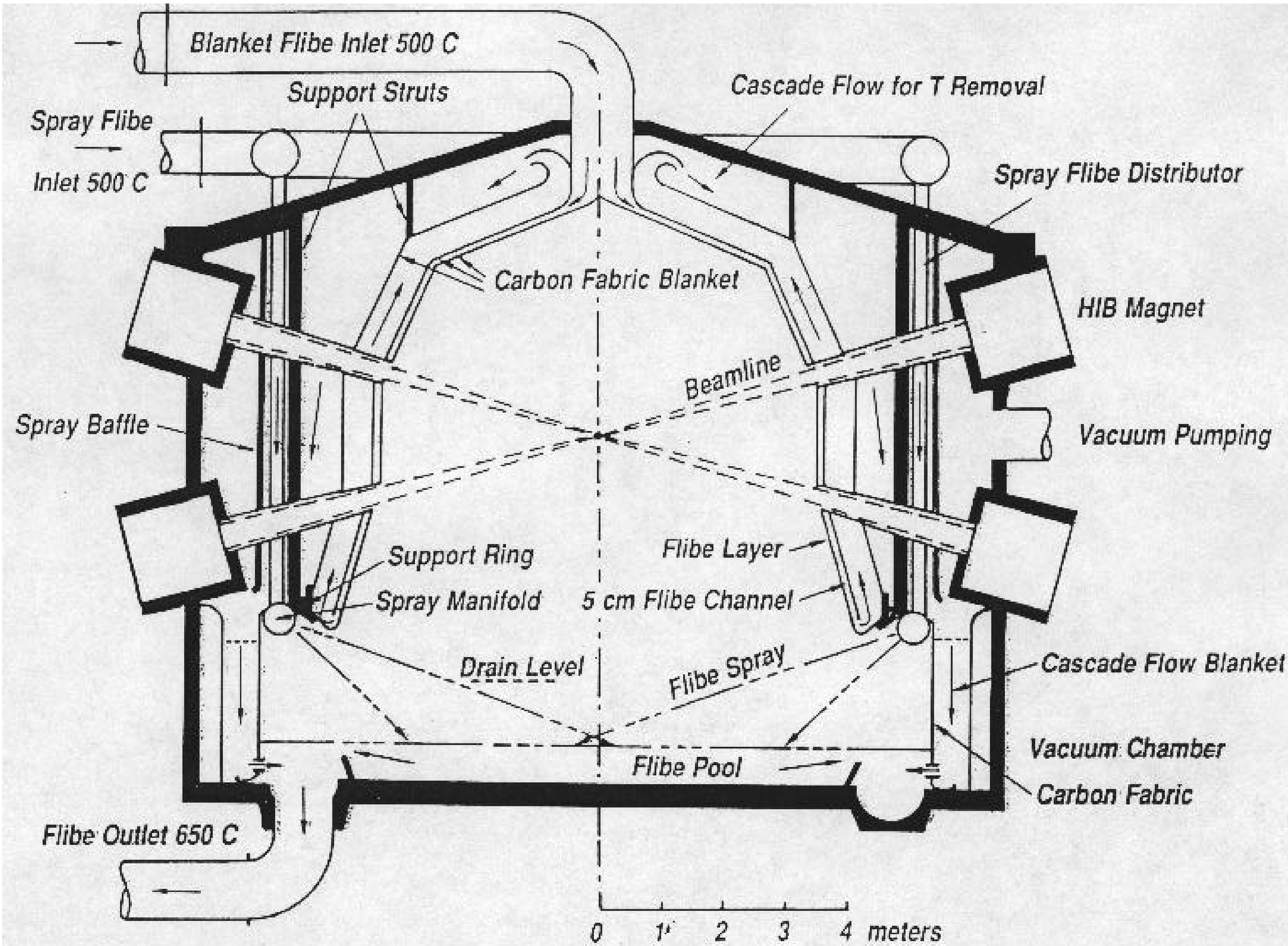
- Wetted-wall designs have many attractive features

- Considerable R&D is needed to address key issues

Wetted-walls have attractive features

- Liquid coolant at surface absorbs high heat load from x-rays and debris
- Pumping power is significantly lower compared to thick-liquid walls
- May be adaptable to laser drivers (including direct-drive) if liquid can be kept off final optics or tolerated (e.g., GILMMs)

Osiris uses a porous C/C composite cloth with oozing flibe coolant



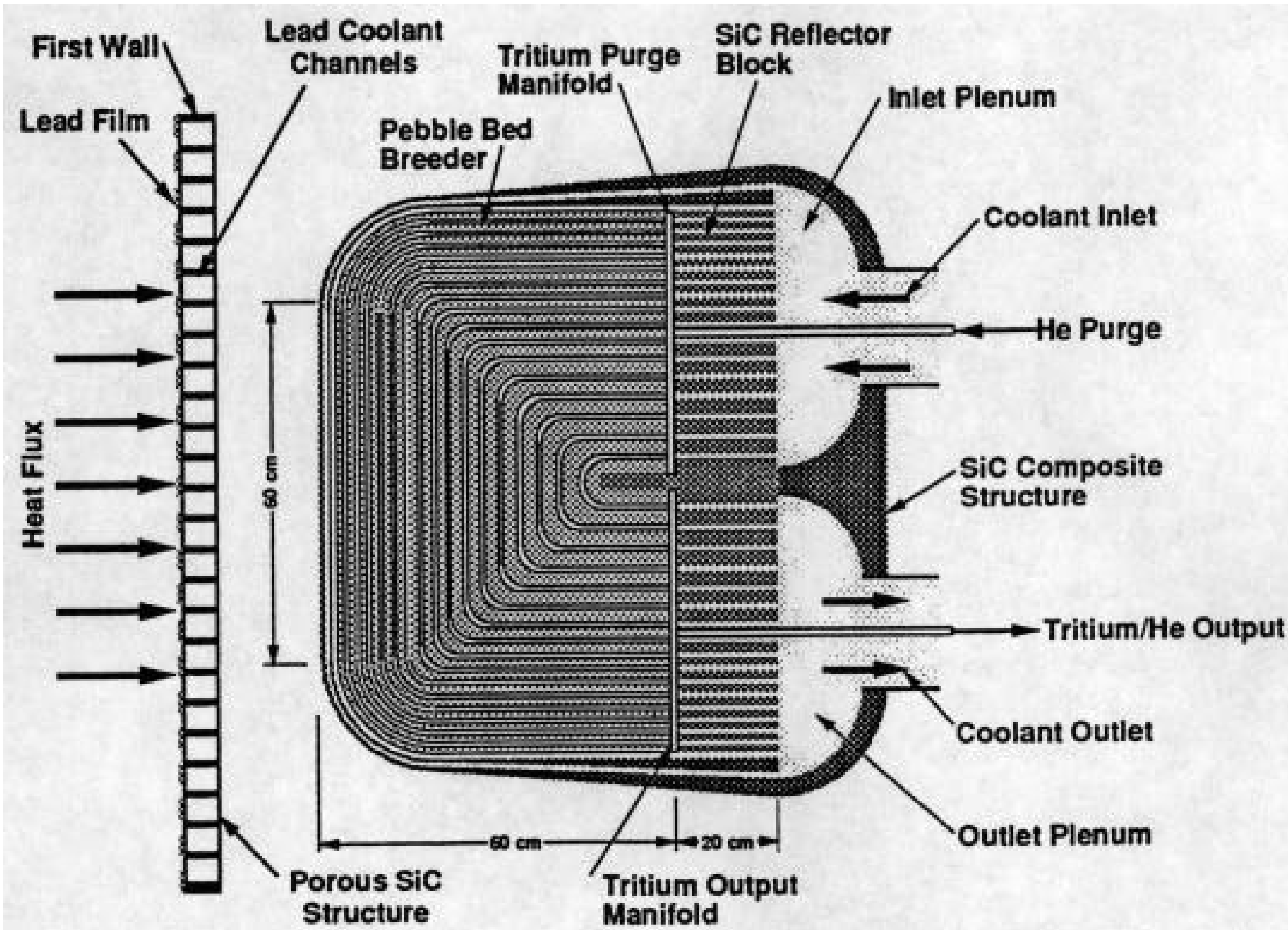
Osiris, (Cont'd.)

- By using a renewable flibe surface, Osiris is able to cope with the intense x-rays emitted by the target:

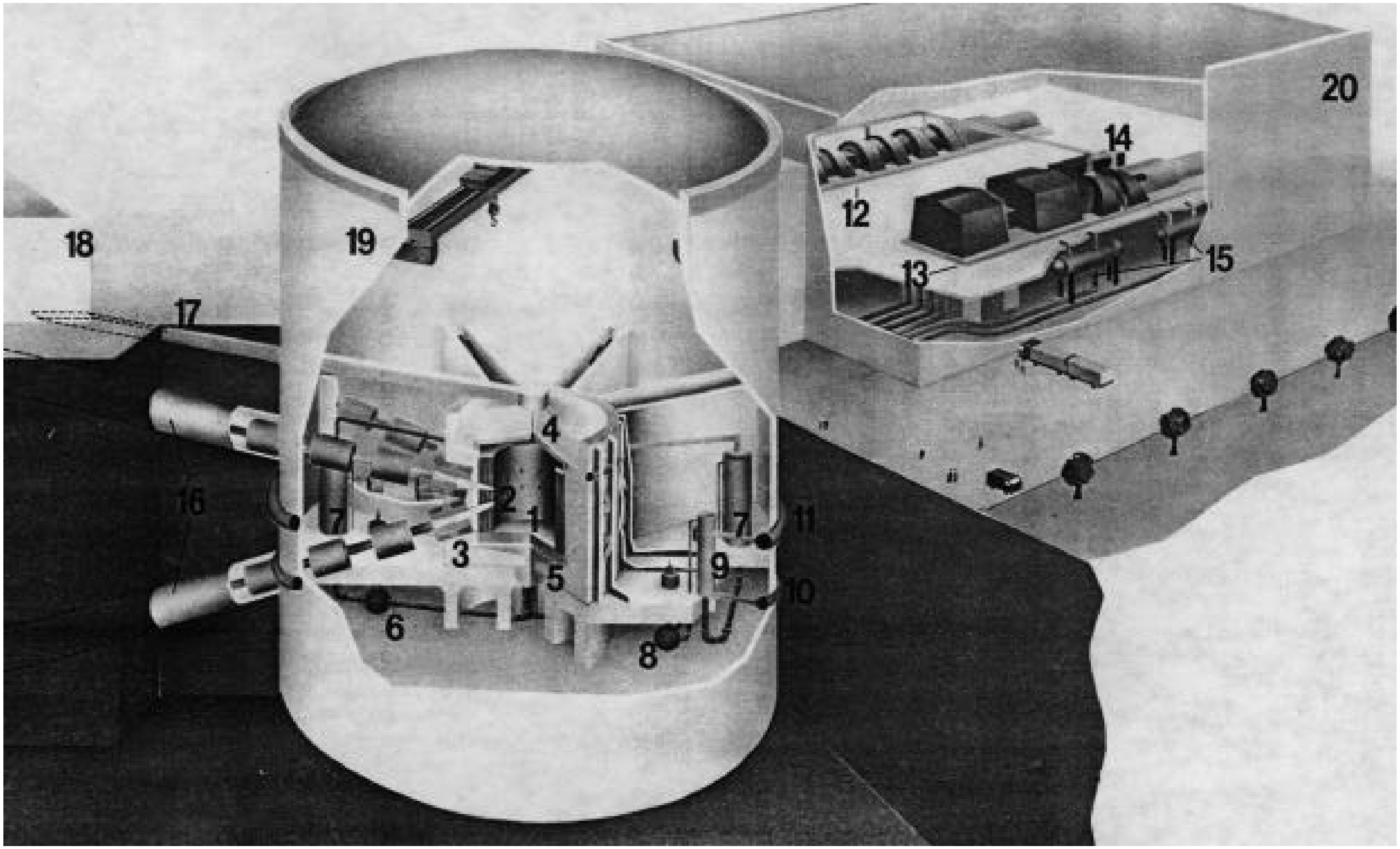
Parameter	Target Emission
Target Gain	87
Target Yield	430 MJ
Neutron Yield	300 MJ
X-ray and Debris Yield	130 MJ

- Wall distance from target = 3.5 m
- x-ray fluence = 55 J/cm^2
- Vaporized thickness = 14 μm
- Vaporized mass = 4.3 kg flibe
- Impulse on wall = 90 Pa-s
- Peak pressure = 37 GPa

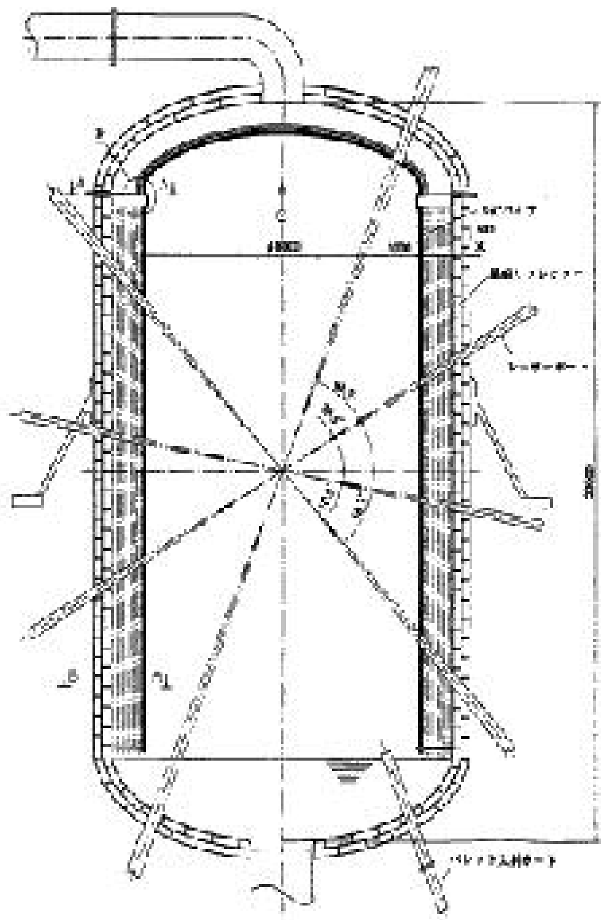
Prometheus uses Pb flowing through a porous SiC structure

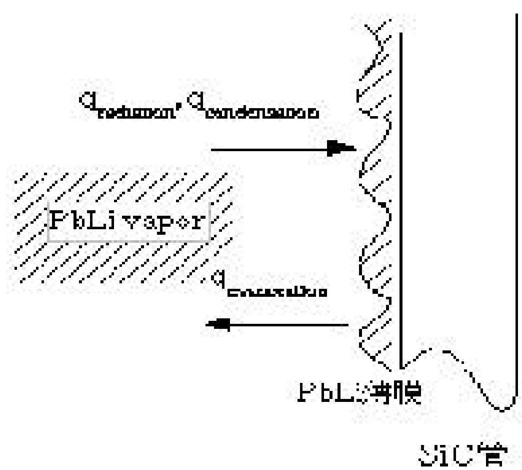


HIBALL-II uses a PbLi coolant in porous SiC tubes



KOYO uses a porous SiC structure with an oozing PbLi coolant





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Parameter	HIBALL-II	Prometheus-H	Osiris
Year Published	1984	1992	1992
First Surface, radius	PbLi, 5 m	Pb, 4.5 m	flibe, 3.5 m
Breeding Blanket	PbLi in porous SiC tubes	Li_2O in SiC structure	flibe in porous C cloth
Primary Coolant	PbLi	Pb & He	flibe
Vacuum Vessel	Ferritic steel	Ferritic Steel	C/C composite
Driver Energy, MJ	5	7	5
Illumination	Cylindrically symmetric	2-sided	2-sided
Target Gain	80	103	87
Yield, MJ	400	720	430
Rep-Rate, Hz	5/chamber	3.5	4.6
Gross Th. Eff., %	42	43	45
Driver Eff., %	27	20	28
Net Power, MWe	946 x 4	1000	1000

Many issues need to be addressed for wetted-walls

- Unique to wetted-wall concepts:
  - Fabrication of porous first wall components
  - Uniform flow on porous surfaces; will liquid wet the surface?
  - Flow around beamports and on inverted surfaces
  - Response of thin film to x-rays and debris
  - Re-establishment of thin film before next shot
- Shared with thick-liquid- and/or dry-wall concepts:
  - Response to isochoric heating by neutrons (both)
  - Flow of vapor up beamports (thick-liquid)
  - Condensation and/or recombination of coolant between shots (thick-liquid)
  - Radiation damage lifetime of first wall & blanket (dry wall)
  - Rapid replacement of first wall & blanket (dry wall)