Protected Wall Chamber Trade Study Definition

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Protected Wall Chamber Requirements

Requirement	Design Constraint
•Extract high quality heat	- Coolant (not necessarily Protectant) to operate above 900°C or higher
•TBR ≥ 1.10	- Achievable with enriched lithium, not necessarily the coolant or protectant
•Coolant or protectant is safe	- Acceptable chemical or radioactive hazard - Minimal inventory of protectant (and contained products)
• Sacrificial surface provide FW and blanket life ≥ 4FPY	- No appreciable long term erosion or damage to FW - Excellent wetting or coverage characteristics (no dry spots) - Predictable film thickness - Extremely fatigue resistant
• Provide atmosphere suitable for target transport and delivery (condition, placement)	- Chamber vapor density and temperature sufficiently low to minimize target heating - Keep wall temperature sufficiently low to minimize target heating - Chamber atmosphere quiescent or predictable

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Protected Wall Chamber Requirements

Requirement	Design Constraint
• Provide atmosphere suitable for beam propagation and accurate placement	- Re-condense vapor or pump time << 1/RR - Chamber atmosphere quiescent or predictable - Chamber vapor pressure suitable for beam propagation
• Accommodates beam ports	- Protection of port area (no hot or dry spots) - No degradation of beam quality - No beam breakdown at beam/chamber interface
• Wall protectant is efficient	- Wall protectant collects or attenuates a majority of prompt incident energy (excluding neutrons and maybe X rays) - Helps protect first wall - Collected energy is efficiently transferred to power cycle - Pumping power is minimal - Protectant removes target debris
• Quick maintenance of replaceable elements	- Use large (few) modular elements - Element configuration tailored for replacement (cylinder?)

Trade Study Approach

Assess the problem in stages:

- Selection of the Protection Concept
- Selection of the Wall Protectant
- Selection of the Design Approach

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Selection of Protection Concept

Requirement	Option A	Option B	Option C	Option D
Accommodates beam ports				
Provides suitable beam atmosphere				
Provides suitable target atmosphere				
Quick replacement of power core				
Removes target debris (or debris does not affect wall operation)				
Simplicity				
Sum of Option values				

Selection of Wall Protectant

Requirement	Option A	Option B	Option C	Option D
Operates at high temperature				
Allows high TBR				
Compatible with beams				
Compatible with targets and has a quiescent or predictable atmosphere				
Protectant approach is efficient				
Is chemically and radiologically safe				
Protects wall surface to full power life				
Sum of Option values				

Selection of Design Approach

Requirement	Option A	Option B	Option C	Option D
Extremely fatigue resistant				
No long term erosion				
Compatible with blanket TBR				
Excellent wetting or coverage				
Viable beam port design				
Predictable film thickness				
Protects wall surface to full power life				
Quick maintenance approach				
Protectant is compatible with structure				
Protectant will allow production of high temperature coolant				
Sum of Option values				

Summary of Protectant Requirements and Trade Study Suggestions

- The ideas presented are only suggestions of criteria to consider in selecting and evaluating various protected wall designs
- Perhaps these ideas will help highlight difficult or advantageous attributes and illuminate productive areas for research