Blanket and Shield Design Considerations for Magnetic Intervention

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Outline

• Chamber Layout
• Shield and Vacuum Vessel (VV) Design
• Blanket Design
• Flibe Blanket Concept
Chamber General Layout

- Bio-shield
- Beam Ducts
- Vacuum Vessel & Shield
- magnets
- Support structure for VV and magnets
Chamber Cut-away

- Polar Cusp
- Armored Dump Module
- Pole Blanket module
- Mid Blanket modules (16 upper & 16 lower)
- Ring Cusp
- Armored Dump
- Shield/VV
- Magnets

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Shield/VV Design Overview

- 50 cm thick
- Water cooled
- 75% steel and 25% water
- Maintenance access via removable modules at each pole
- Chamber access minimizes impact on plant systems (i.e., magnets & beam ducts)
- Minimizes remote handling requirements of plant systems (i.e., those outside Shield)
- Outer 20 cm is re-weldable
Shield and VV Design Details
(beam lines not shown for clarity)

Magnet support integrated into shield & VV support structure
Shield and VV Design Details
(beam lines and support structure not shown)

- Removable dump and blanket modules
- Magnets with supports
  - 4.3m R x 6.65m Z
  - 6.9m R x 3.5m Z
- Shield (50 cm thick)
- Support I-beams
Nested polar modules allow VV access without disturbing beam ducts or magnets.

- VV Module Housing
- Polar Cusp
- Armored Dump

- VV Module housing Polar Blanket
Blanket Design Overview

• PbLi or Flibe Coolant
• Silicon Carbide Blanket structure
• Maximum FW temperature of 1000°C
• Maximum allowable PbLi/SiC Temp. 1000°C
• Concentric channel approach similar to earlier HAPL blanket designs
• Self-draining
• Modular design facilitates remote maintenance
Curved Sub-Module Design Required for Strength Reasons

Cross-Sections

- Concentric variable section channels
- SiC cooled by high velocity flow in gap
- Low velocity return flow in center channel
Alternating Blanket Modules have differing end sub-module profiles
Alternating Blanket Modules have differing end sub-module profiles

- Simplifies Installation
- Maintains pressure balance between modules
Blanket Maintenance Scheme

Self-contained remote handling system attaches vessel at pole
Blanket Maintenance Scheme
Requiring Further Consideration

• Coolant plumbing connection/disconnection
  – Modules include integrated manifold with a single supply and return line
  – Mechanical connection inside VV
  – Or cut/re-weld lines inside or outside VV

• Module attachment/removal
  – Modules have integrated frame with VV connection mechanisms capable of remote engagement and disengagement
Sub-module for Flibe blanket concept

- 10 mm thick Be insert
- Blanket consists of 10% SiC 90% Flibe
Flibe Sub-module Assembly

1. Be inserted at wide end of sub-module
   Shape of Be inserts allows fit between channel walls

2. Be insert secured to inner channel wall once in place
Conclusions

• General magnet intervention chamber design concept

• Chamber maintenance has little/no impact on magnets or lasers

• VV design minimizes remote handling requirements of plant systems (i.e., magnets and other components outside the shield)

• Blanket module profile redesigned to facilitate installation/removal

• Remote handling concept for blanket maintenance

• Be incorporated using multiple shaped inserts