Updates of the ARIES-CS Power Core Configuration and Maintenance

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ARIES Meeting

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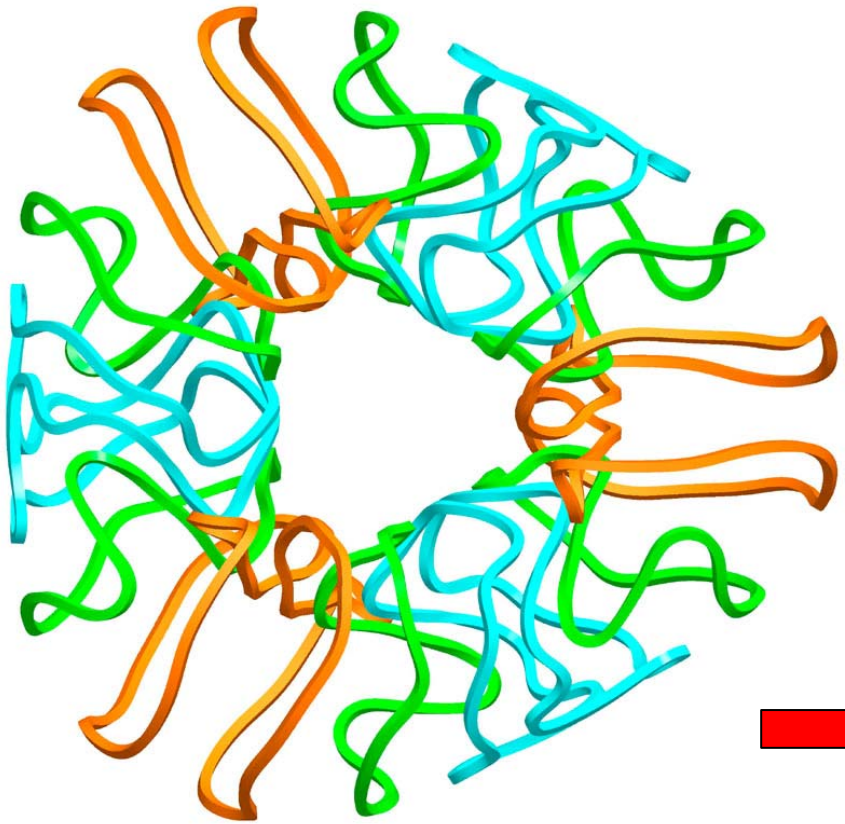
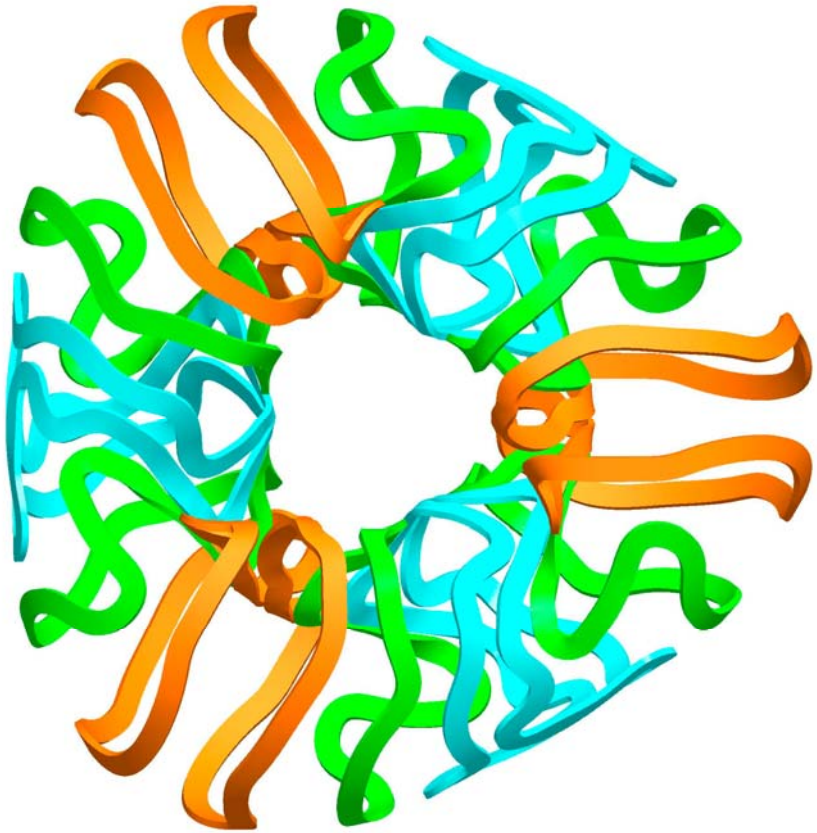
Outline

- Update the ARIES-CS configuration to the ARE coils and new coil cross section
  - ✓ ARE coils, R=6.93 m
  - ✓ Maintenance ports
  - ✓ Power core components, such as VV, blanket/shield module, transition and shield only zone modules have not been updated, yet
- Update the conceptual design of the transition and shield-only zone module based on the old design (R=8.25 m)

Update the Coil Configuration to the ARE Coils





Cross-section of winding: 33 cm x 33 cm

R=8.25 m

Cross-section of winding: 18.4 cm x 67.1cm

R=6.93 m

Pro/E Engineering Analysis Detects Touching Between Coils

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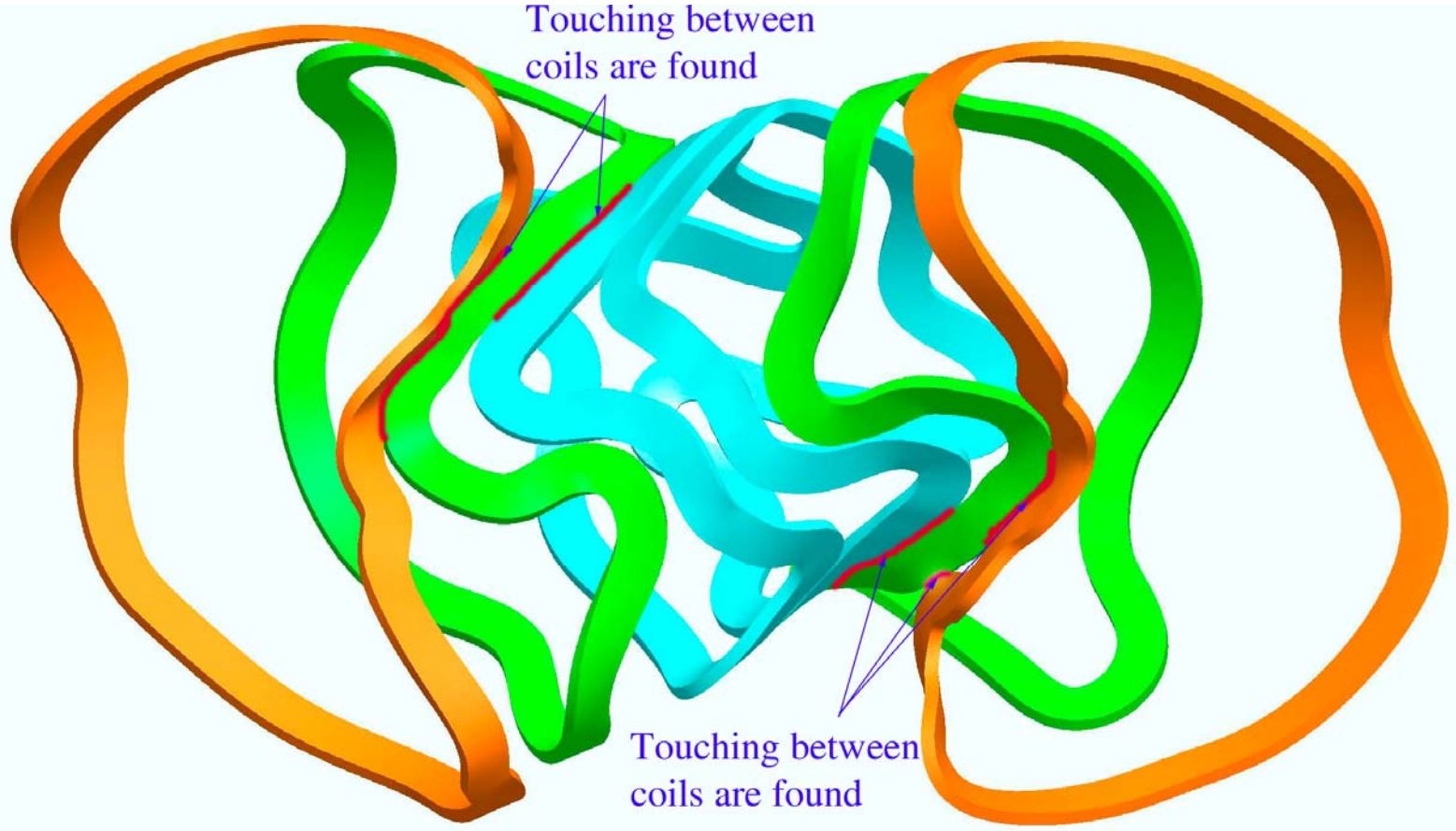

✓We need to allow some space around the winding pack for electric insulation.

✓Question is do we need side coil cases? ***The NCSX coils do not have side coil cases.***

Maintenance Ports Have to Be Shaved to Accommodate to the Available Space Between Coils (ARE Case)

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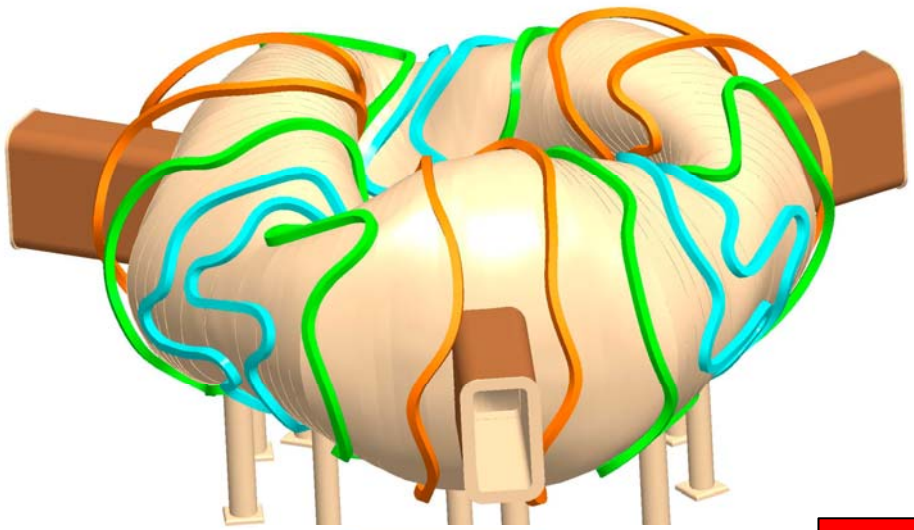
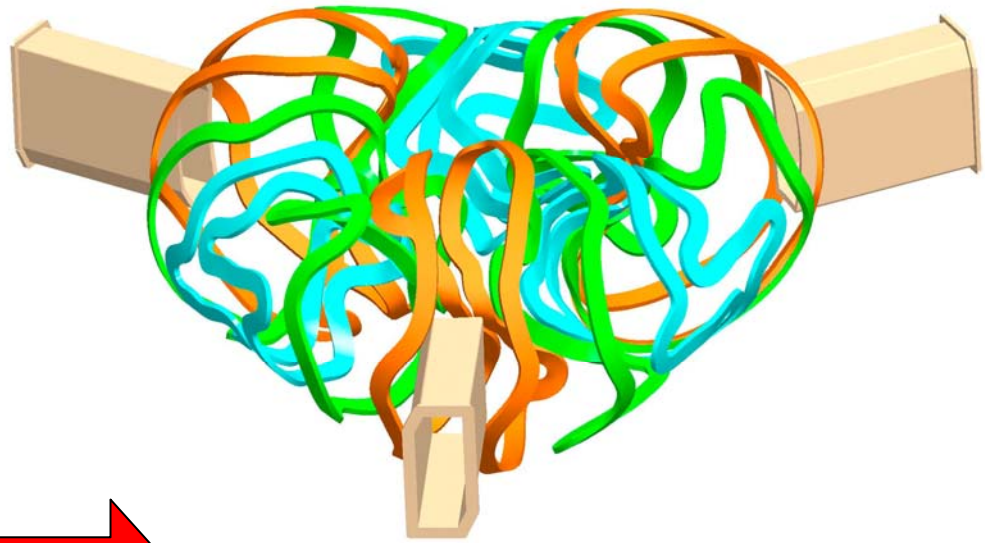
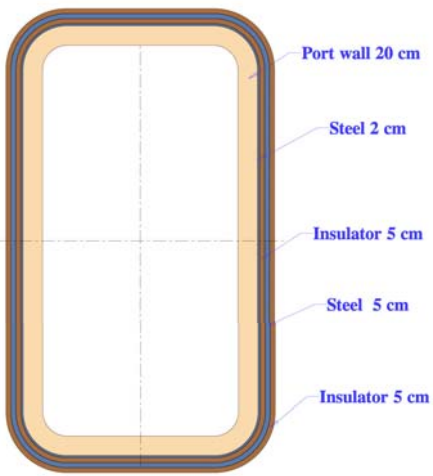
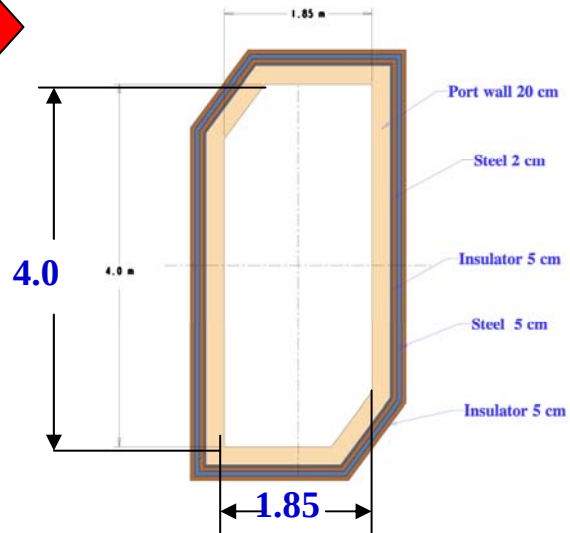
R=8.25 m



R=6.93 m







Rectangular port shape: 2m x 4m

The Old Shield-only Module Design Assuming to Attach Coolant Manifold To the HT Shield

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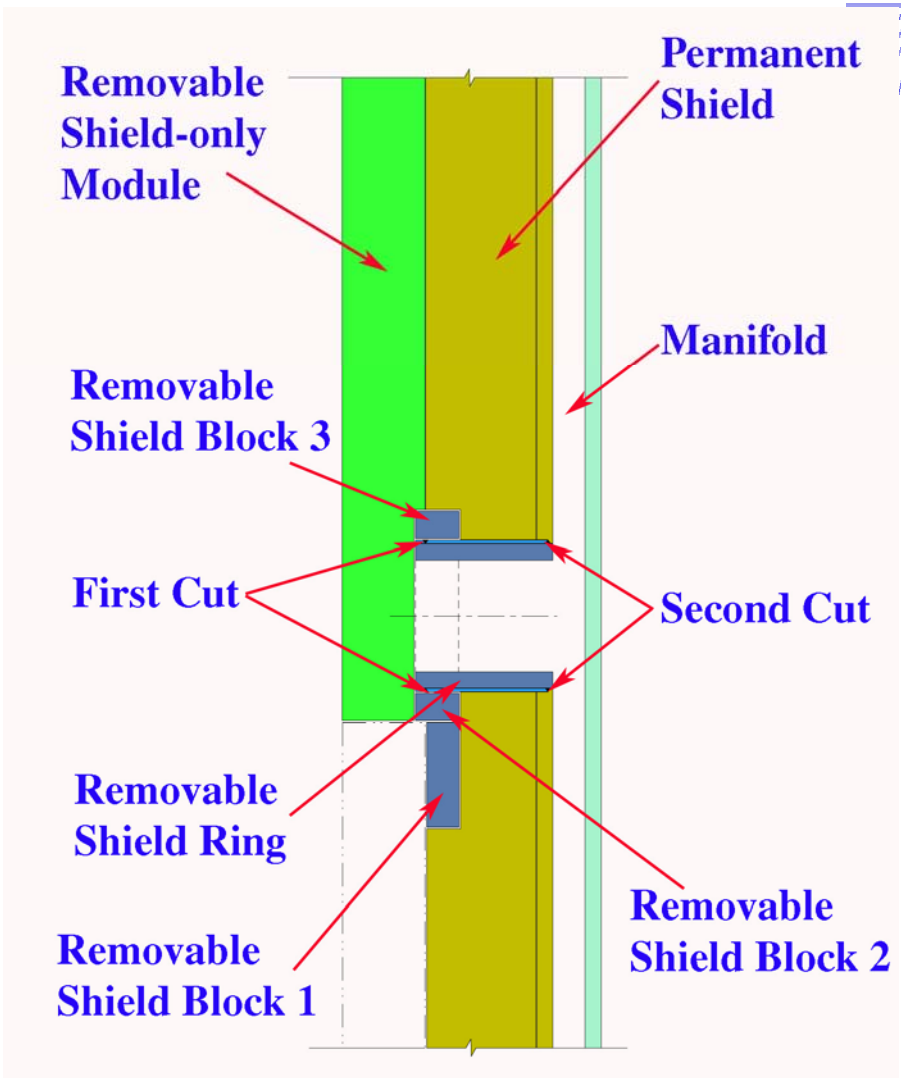
- A 15 cm He manifold is added to the HT shield, and combine the HT shield and the manifold to one component;
- The approach of the nominal breeding blanket to protect the welds and cut the access pipe in two locations is adopted.



Example Layout of the Transition and Shield-Only Zone Module for R=8.25 m

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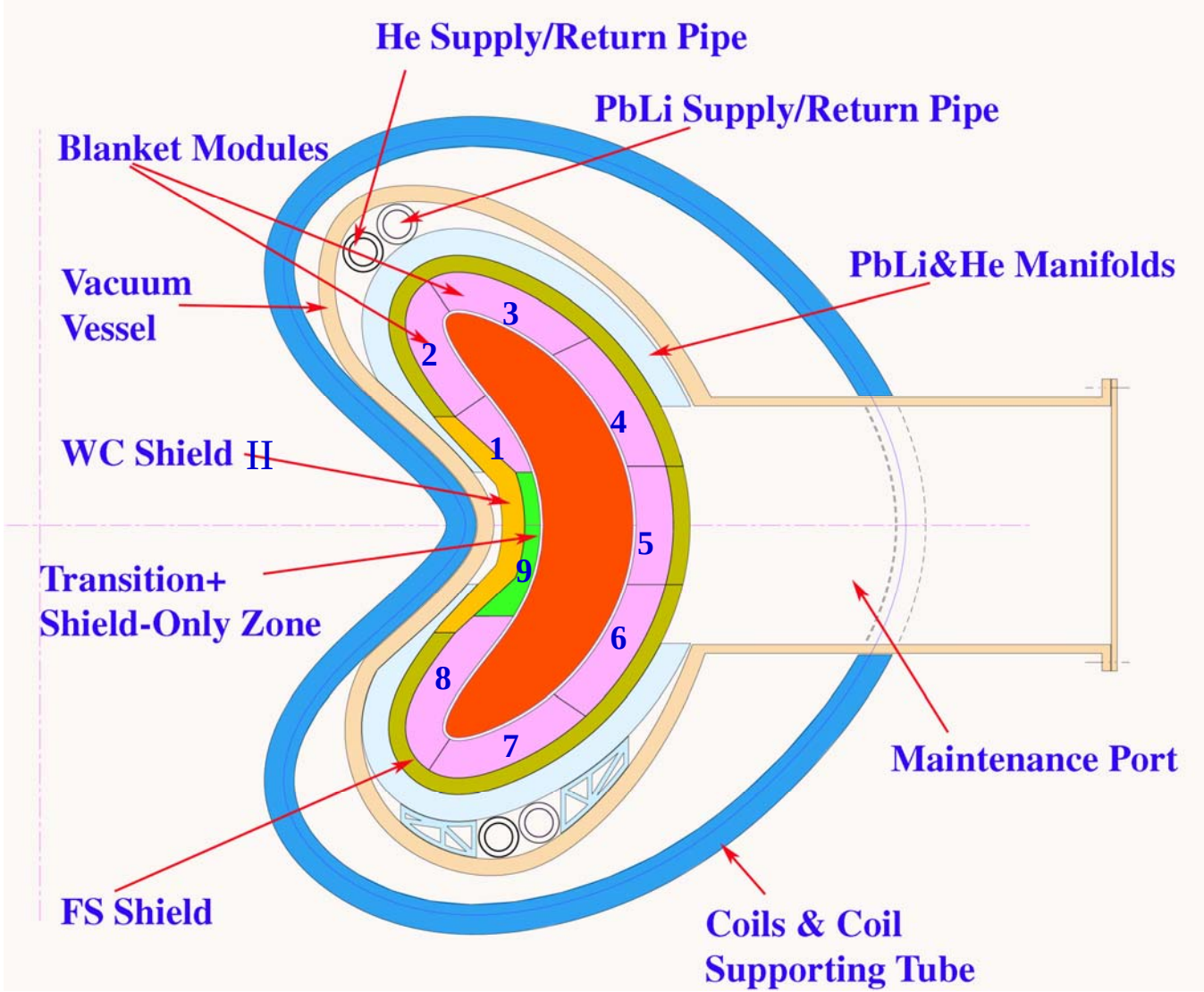
- The transition and shield-only zone module will be fed by the bottom coolant PbLi/He manifolds.
- Like FS shield, the WC Shield II modules are lifetime components.
- There is no manifolds in the shield-only zone.
- The shield-only zone covers ~6.5% of the FW area, and the transition zone covers ~13.5% of the FW area.



Possible Design of the Transition and Shield-Only Zone Module (for R=8.25 m)

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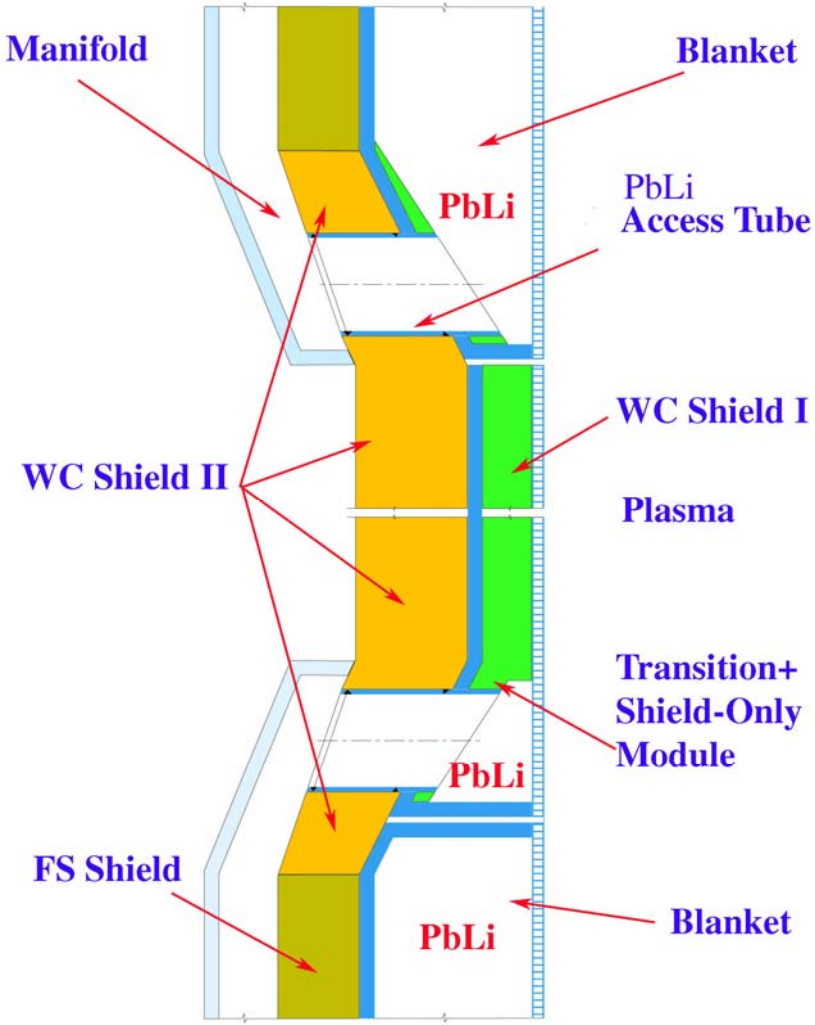
Shield-Only Zone

First wall	4.0 cm
WC shield I	17.0 cm
Back wall	5.0 cm
WC shield I	38.0 cm
Total thickness	***64.0 cm***

Regular Breeding Zone

First wall	4.0 cm
Breeding blanket	54.0 cm
Back wall	5.0 cm
FS shield I	28.0 cm
Manifold	35.0 cm
Total thickness	***126.0 cm***

- **The height of the special replacement module is about 2.5 m.**
- **There is no manifolds in the shield-only zone.**



(Not Scaled)

Cutting/Rewelding the Access Pipe to Disconnect the Special Module Is Similar to the Regular Blanket (R=8.25 m)

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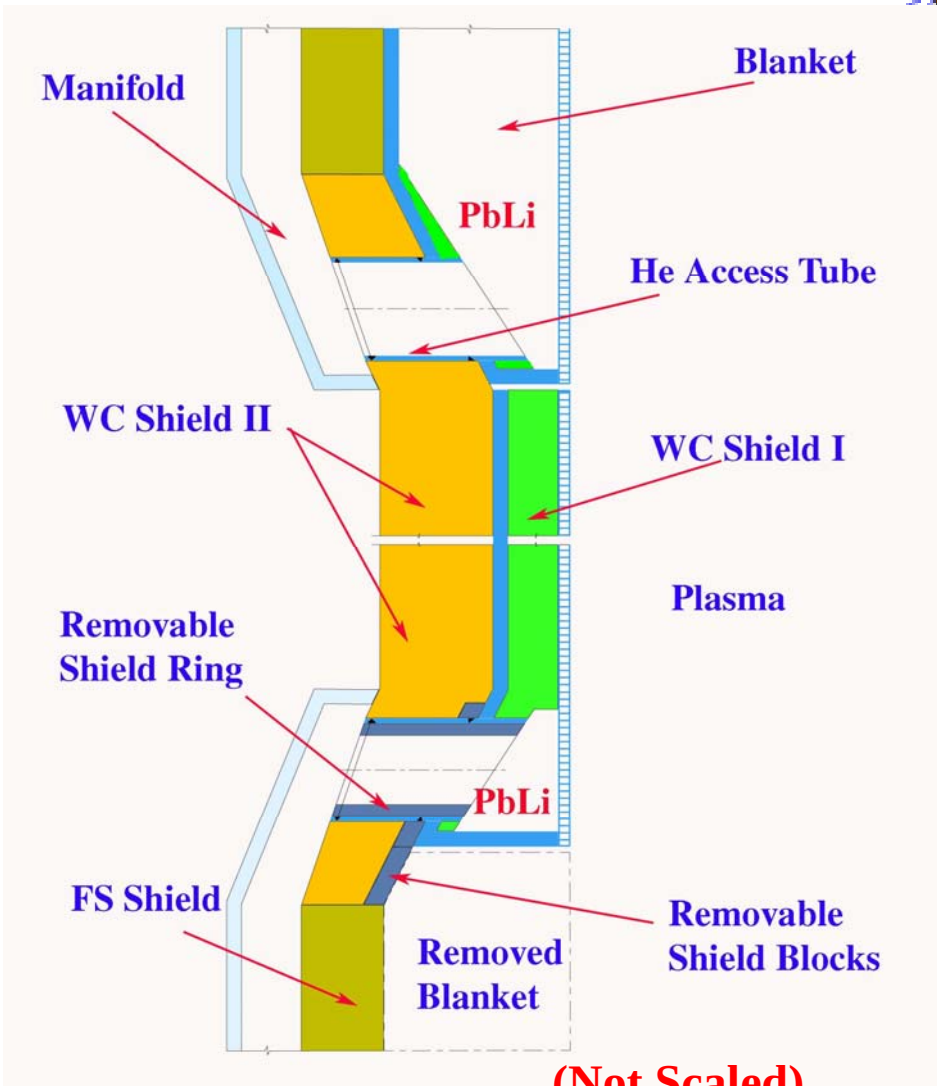
- The special module (transition + shield only zone) replacement is based on prior to removing the neighboring blanket module.
- Cutting/Rewelding the access tube to disconnect the special module is similar to the approach of the regular blanket.
- The welds are protected by removable ring inside of the access tube.
- Reweldability of manifold will be assessed by UW.



(Not Scaled)

Steps of Cutting and Disconnecting the Access Pipe to Remove the Special Module

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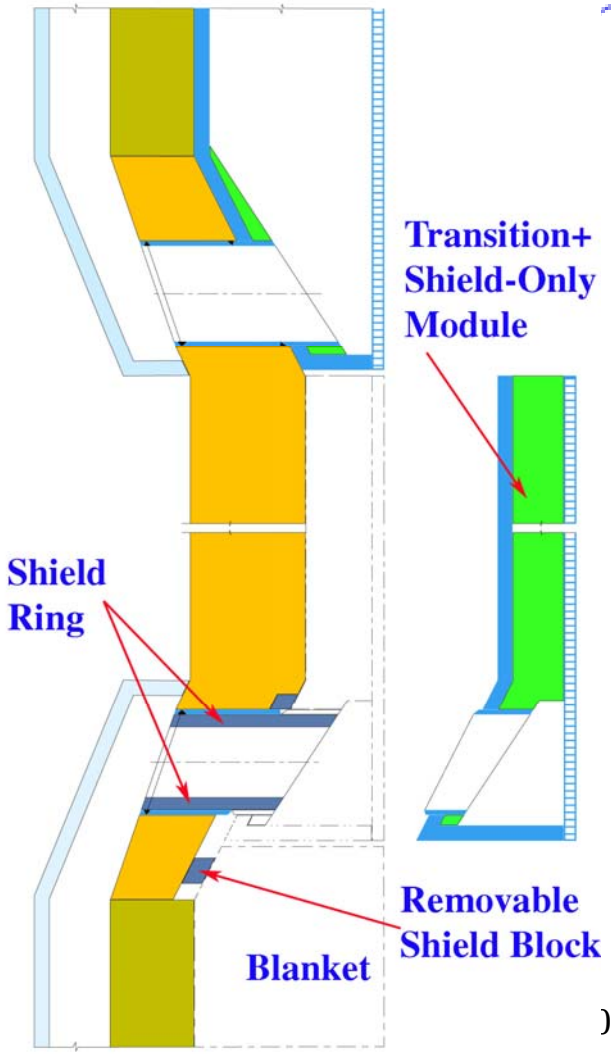
- Like the regular breeding blanket, remove three shield blocks first;
- Make the first cut near the special module with the tools from plasma side;
- Remove the special module out;
- Remove the shield ring inside the access tube out;
- Cut the second cut with in-boor tools, and remove the partial access tube out.



(Not Scaled)

Alternative Design of the Transition and Shield Only Zone Module (R=8.25 m)

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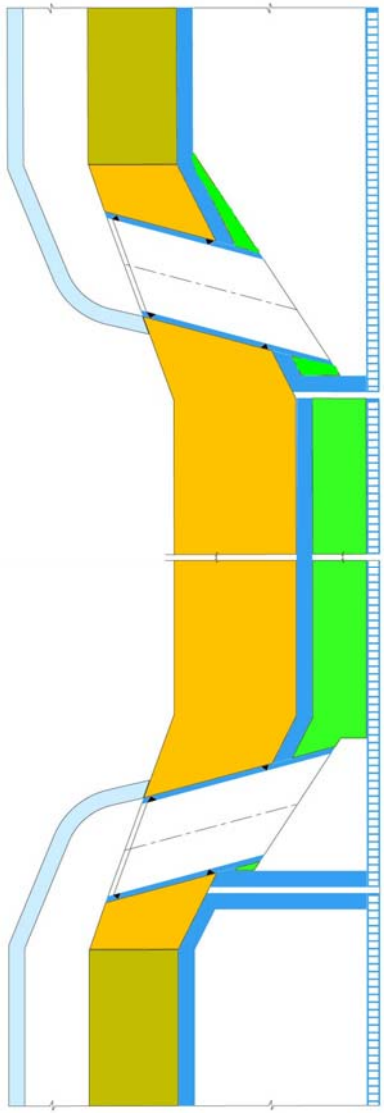
- Move coolant access pipes in the transition zone towards the regular breeding zone (away from the "shield Only" zone) in order to gain more space for local shield.
- This would increase the poloidal height of this special module.



(Not Scaled)

Summary

- Touching between coils is found for the ARE coils, some space around the winding pack for electric insulation will be needed.
- For the new design with R=~7.0 m, the available space between coils is limited for maintenance port, and the rectangular port shape has to be shaved to accommodate the space.
- A possible transition and shield-only zone module design is proposed, and the approach of protecting the welds will be the same as that of nominal blanket module.
- Reweldability of manifold will be assessed by UW.