Initial Layout of the ARIES-ACT2 DCLL Power Core Configuration

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Comparison of the ACT1 and ACT2 Power Core Components

	ARIES-ACT1	ARIES-ACT2
Major radius	**6.25 m**	**>6.25?**
FW/Blankets	**LiPb cooled SiC/SiC structure** **T_{Inlet}/T_{Outlet}=740/1030˚C** **η_{th}=57.9%**	**He cooled RAFS (F82H) blanket structure with ~2 mm ODS layer as the FW, LiPb as breeder and coolant of the blanket:** **T_{Inlet}/T_{Outlet}(He)= ~380/460˚C** **T_{Inlet}/T_{Outlet}(LiPb)= ~460/700˚C**
Structural ring or HT Shield	**He-cooled ODS steel structure** **T_{Inlet}/T_{Outlet}=650/680˚C**	**He-cooled RAFS (F82H) structure** **T_{Inlet}/T_{Outlet} (He)=~380/460˚C**
Upper/Lower divertors	**He-cooled W-based divertor and ODS steel cartridge** **T_{Inlet}/T_{Outlet}=700/800˚C**	Same as the ACT1
Vacuum vessel	**He-cooled Bainitic FS (3Cr-3WV) operating in ~400-500˚C**	Same as the ACT1
LT shield	**Water-cooled Bainitic FS and WC operating at the room temperature**	Same as the ACT1

What Design Strategy Will Be Adopted in ACT2?

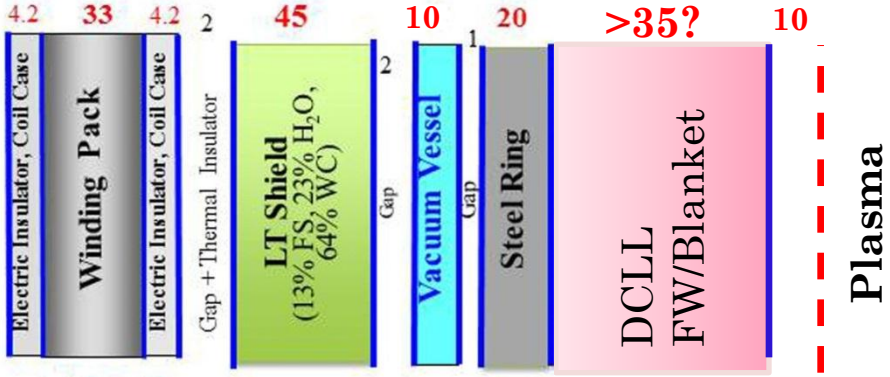
- **ACT1 design strategy**

- ✓ *Inboard:* the structural ring is not life-time component, but all components behind the structural ring are permanent components; none of the IB components are re-weldable.
- ✓ *Outboard:* the structural ring and VV are not re-weldable (at the midplane), all components behind the OB blanket are life-time components.
- ✓ Requires thinner radial builds and smaller major radius

- **ARIES old design strategy (ARIES-RS, ARIES-CS)**

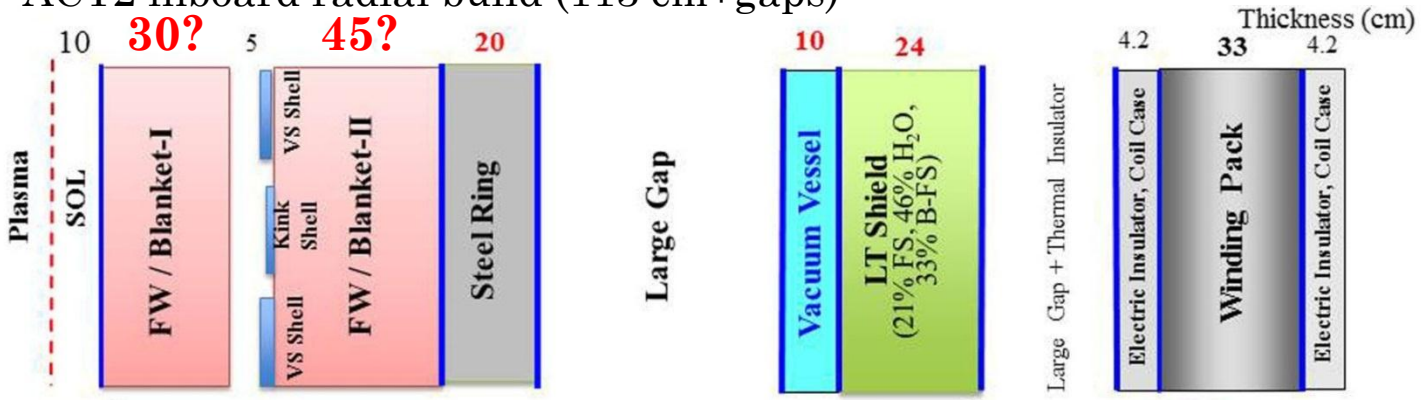
- ✓ *Inboard:* all components behind IB blanket are life-time components; the components behind the structural ring are re-weldable (such as the VV)
- ✓ *Outboard:* all the components behind the OB blanket are permanent components; the structural ring and VV are re-weldable
- ✓ Requires larger radial build, larger major radius and lager TF coils for sector maintenance

Initial Layout of the ACT2 Power Core by Using ACT1 Design Strategy



ACT2 inboard radial build (113 cm+gaps)

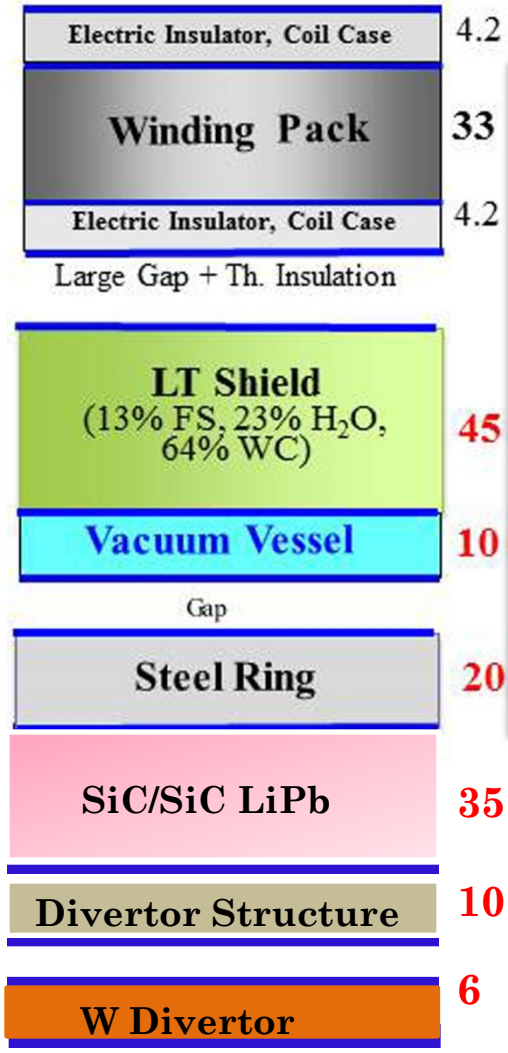
"Final Radial/Vertical Build for ARIES-ACT1 Power Core", presented by Laila at ARIES Meeting on May 31, 2012



ACT2 outboard radial build (134 cm+gap)

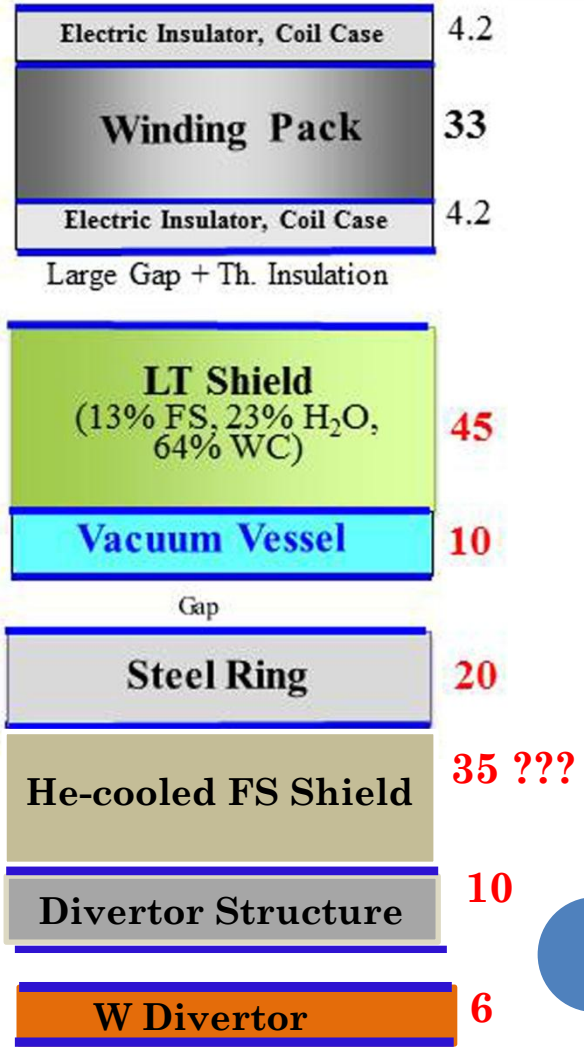
- What the blanket (IB and OB) thickness should be to meet design requirement of breeding and radiation limits if we maintain all the components behind the IB and OB blankets the same as the ACT1?

Initial Layout of the ACT2 Vertical Radial Build

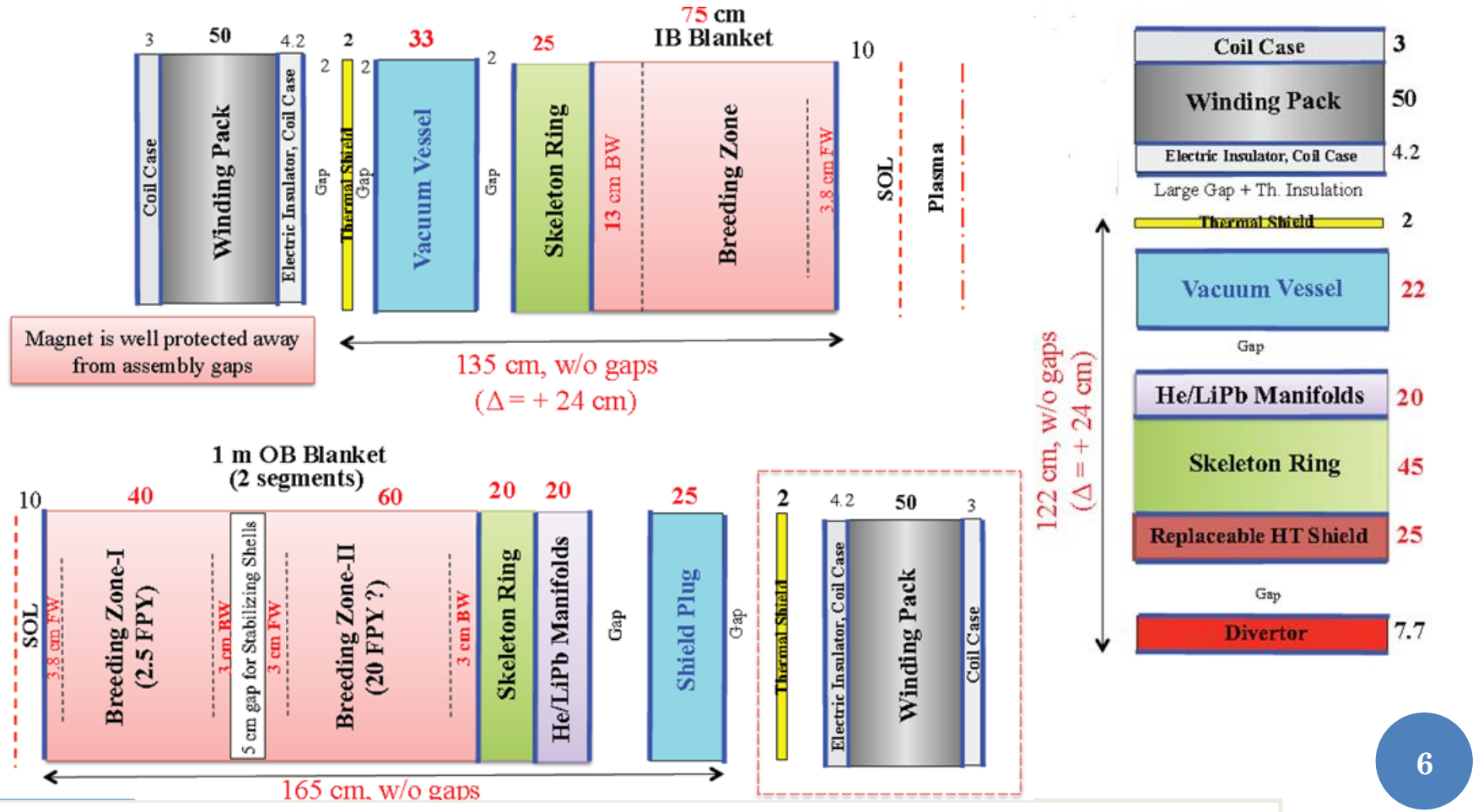


cm

- ACT2 will maintain the same design features as the ACT1 (the SR and VV should be life-time components, and re-weldable VV. Need Laila's confirmation).
- The SiC/SiC LiPb blanket part at divertor region will be replaced by He-cooled FS shield.



A Design Option for the Layout of the ACT2 By Using ARIES Old Design Strategy

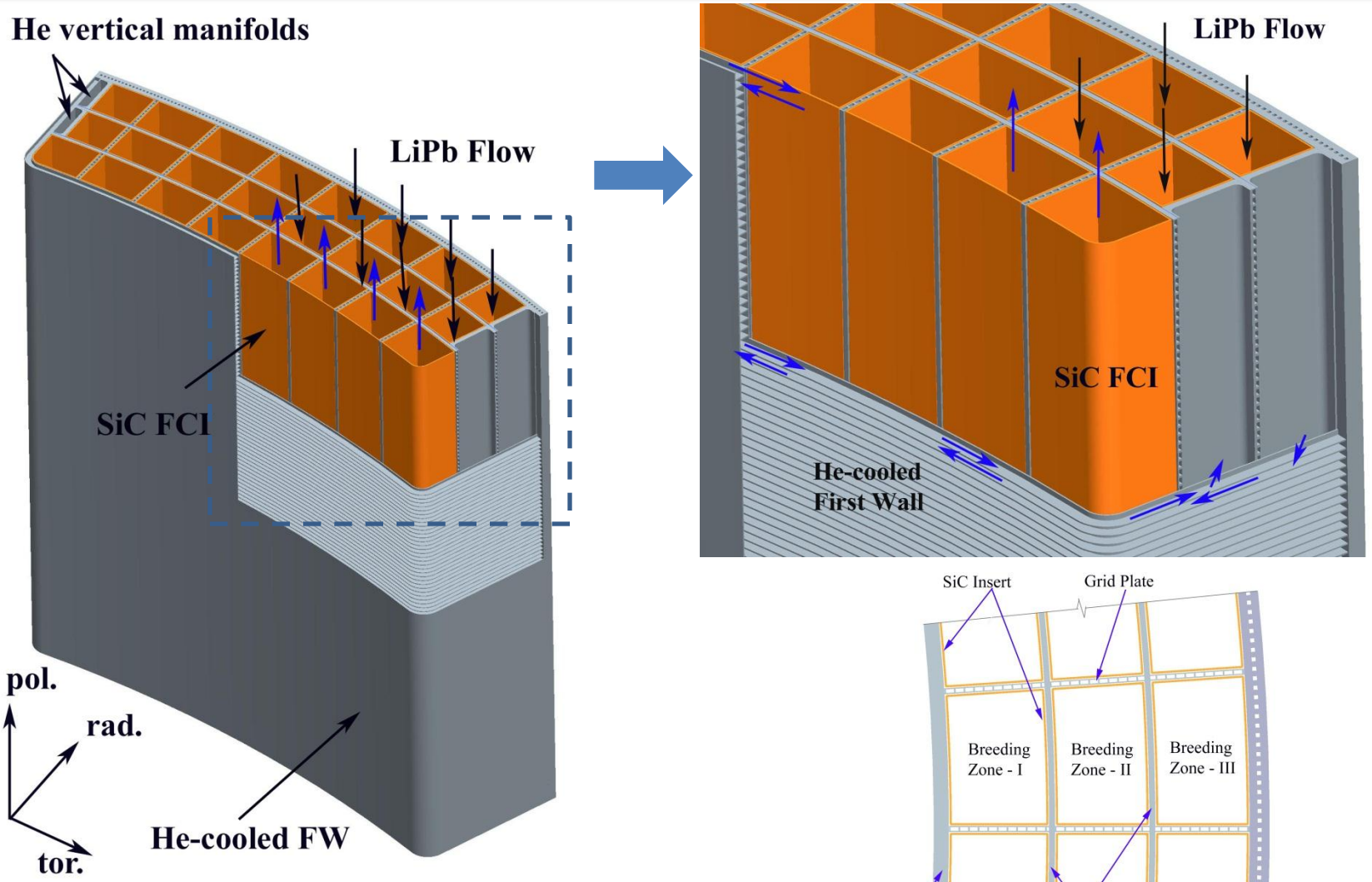


L. El-Guebaly, "ARIES-ACT-DCLL NWL Distribution and Revised Radial Build", ARIES Project Meeting, July 27-28, 2011

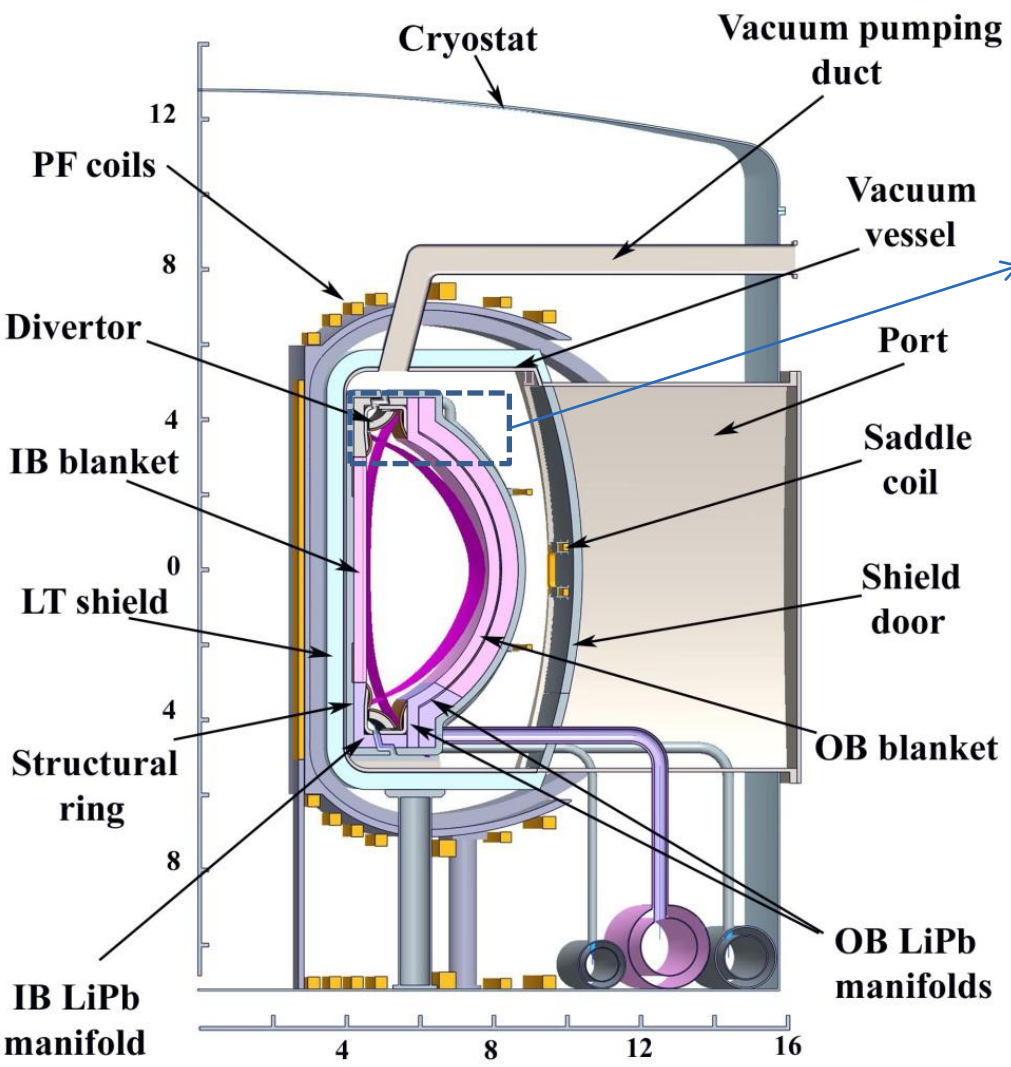
Cooling Circuits for the ARIES-ATC2 Power Core

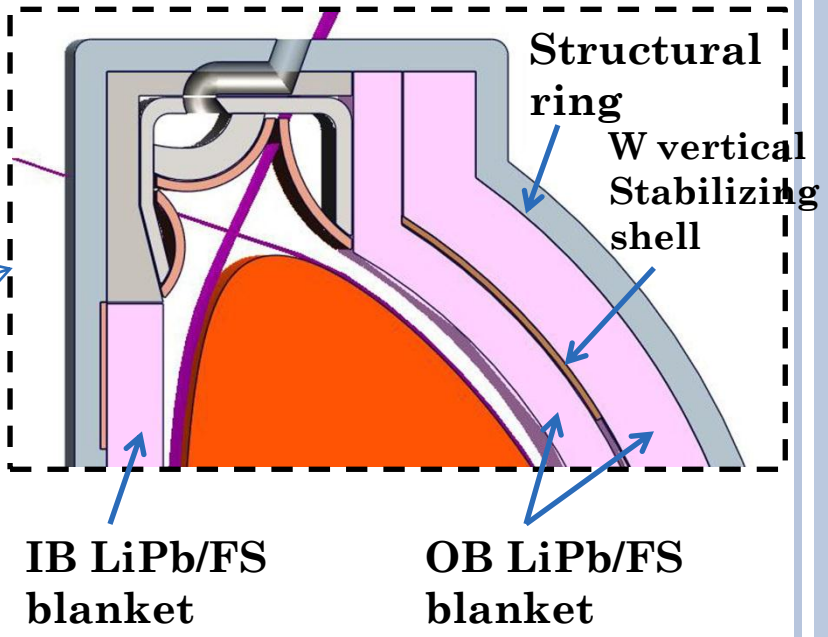
- Modular blanket design (2 m tor. x 2.0 m pol.) was utilized in the ARIES-CS and there is a LiPb manifold behind the blanket and shield.
- Like the ACT1 design, the sector design will be adopted in the ACT2 DCLL blanket, and there are 16 sector in total. The manifolds feed the LiPb and He from bottom.
- There are 10 cooling circuits:
  - ✓ 3 LiPb circuits for the IB, OB-I and OB-II blanket segments;
  - ✓ 7 He cooling circuits for the entire sector
    - 1 circuit for the IB blanket segment
    - 2 circuits for the two OB blanket segments
    - 2 circuits for the upper and lower divertor
    - 2 circuits for the structural ring
- All the LiPb and He access pipes are concentric pipes and the LiPb access pipes have the SiC FCI inside the center and annular ducts.

Example of the DCLL Blanket Design



Overall Layout of the ACT2 Will be Similar to the ACT1





Upper divertor region

- Location of the OB W stabilizing shell (By Chuck)

K=2.2 (ARIES-AT) b/a=0.33

K=1.9 (ARIES-RS) b/a=0.45

(a: minor radius)

FUTURE WORK OF THE ACT2

- Start the DCLL blanket detail design, including
  - ✓ He flow paths of cooling the FW and all grid plates, separation, back, top and bottom plates
  - ✓ LiPb flow paths
  - ✓ He manifolds
  - ✓ LiPb manifolds

- Perform thermo-mechanical analysis of the FW/blanket when the nuclear heating is available

- Start working on the overall layout of the ACT2 power core configuration once the ACT2 strawman is available