Preliminary TBR/Shielding Analyses and Build Definition for ARIES-ACT-2

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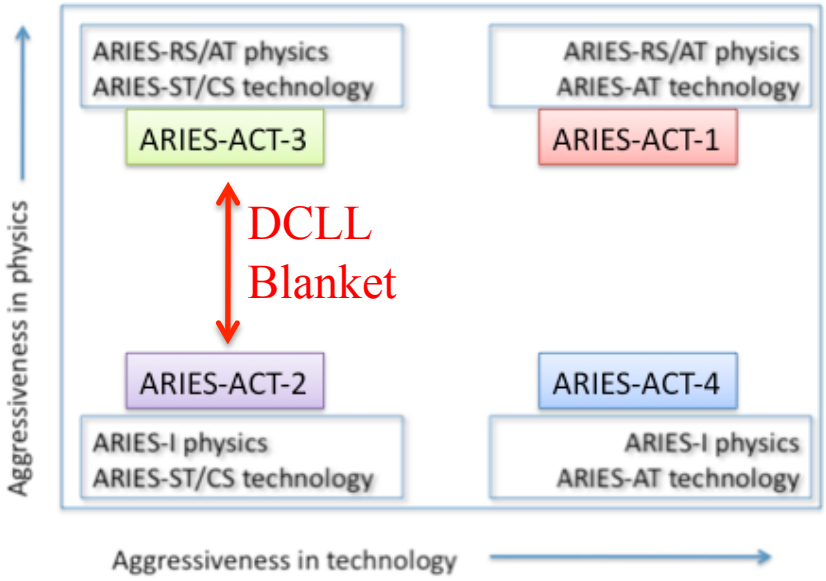


- Preliminary 3-D TBR analysis (to size IB **and** OB DCLL blankets for ARIES-ACT-2/3).
- Preliminary radial/vertical build definition for ARIES-ACT-2.

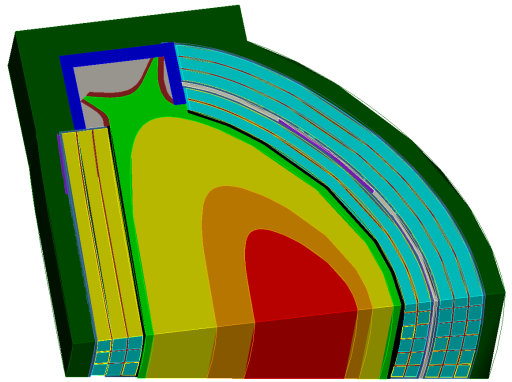
3-D TBR Analysis

DCLL Blanket Dimensions and TBR

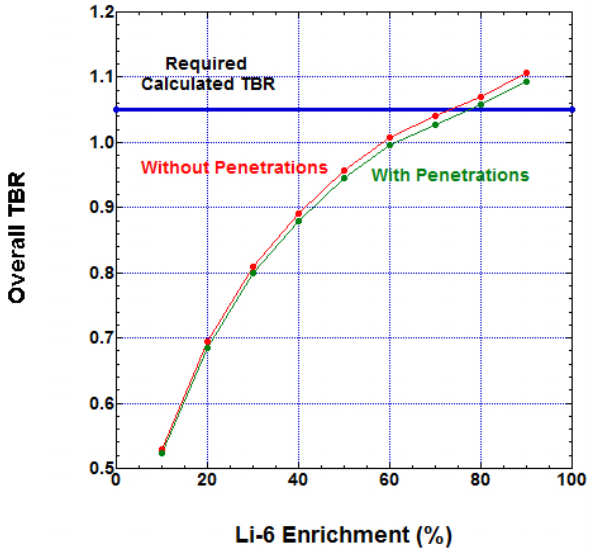
- Recommended blanket thickness (based on initial 3-D analysis presented at 1/2013 meeting):
  - 65 cm thick IB blanket
  - 1 m thick OB blanket.

- **Place holder**: 7 m^2 penetrations on OB (2% of OB FW area; to be confirmed by C. Kessel)

- **3-D calculated TBR = 1.05** with ~75% ^{6}Li enrichment.



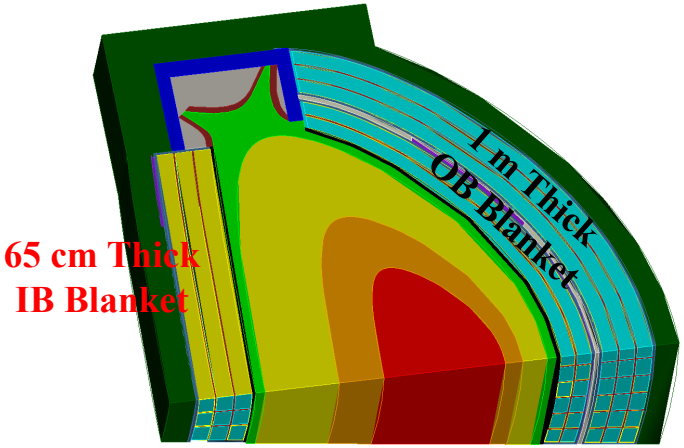
65 cm Thick IB Blanket **1 m Thick OB Blanket**



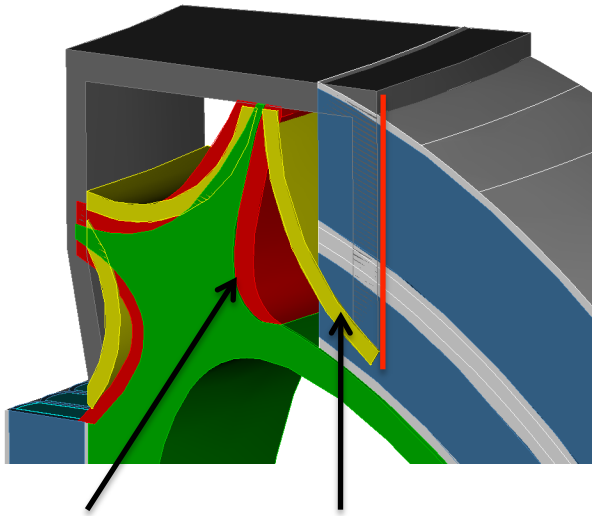
DCLL Blanket Dimensions and TBR (Cont.)

- Extending IB blanket vertically up/down and adding manifolds behind divertor increase TBR by few percent, allowing lower Li-6 enrichment (~70%).

- New divertor design (yellow) may call for wider slot. This change will reduce OB breeding by few percent (need input from UCSD on divertor design and layout).



ARIES-ACT-1 Divertor



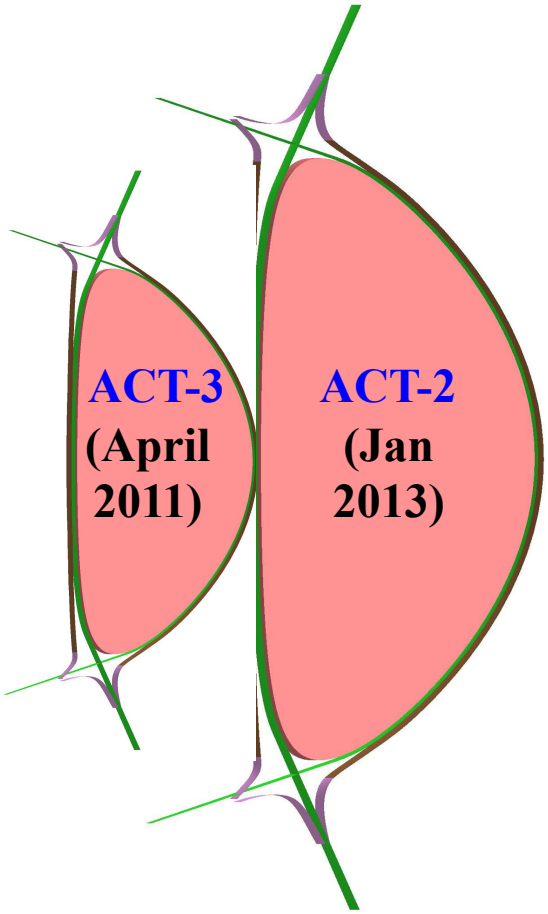
Old layout (red)

New layout (yellow)

Preliminary Radial/Vertical Build Definition

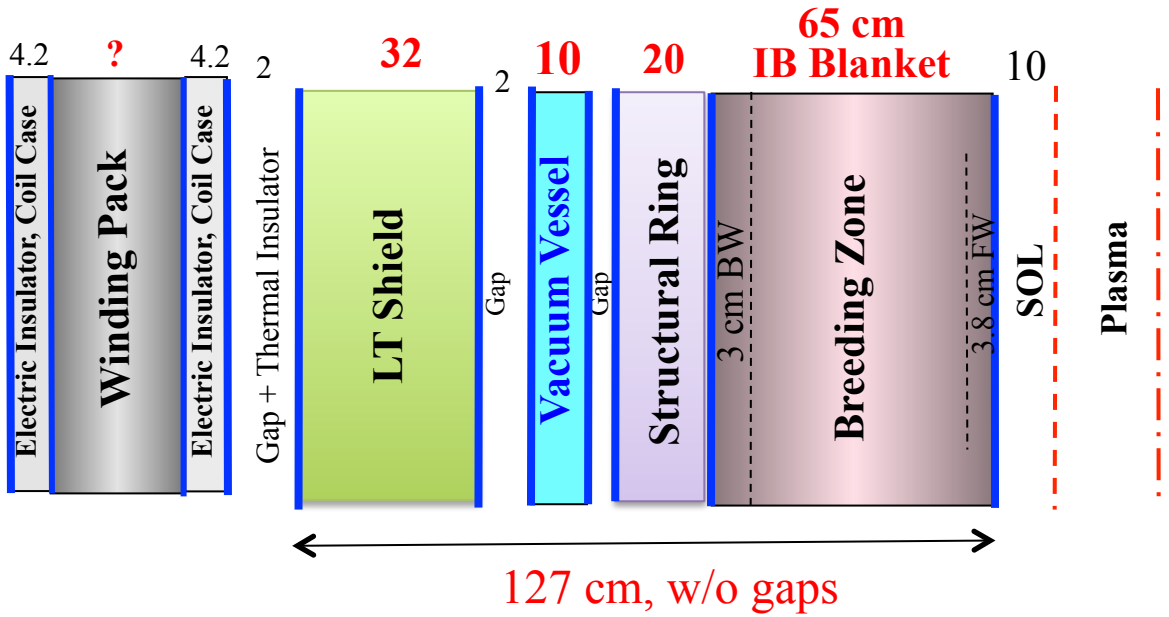
ARIES-ACT-2&3 Parameters

	ARIES-ACT-3 Aggressive Physics April 2011 (to be updated)	ARIES-ACT-2 Conservative Physics Jan 2013
Fusion Power (MW)	2767.5	~3000
Major Radius (m)	6	~ 9.5
Minor Radius (m)	1.5	~2.4
Aspect Ratio	4	4
Elongation	2.2	2.2
NWL (MW/m^2):		
Average (@ 10 cm from plasma)	3.7	~1.45
Peak IB	4.4	1.7
Peak OB	5.5	2.2
Peak div	2.2	0.9



ARIES-ACT-2 IB Radial Build

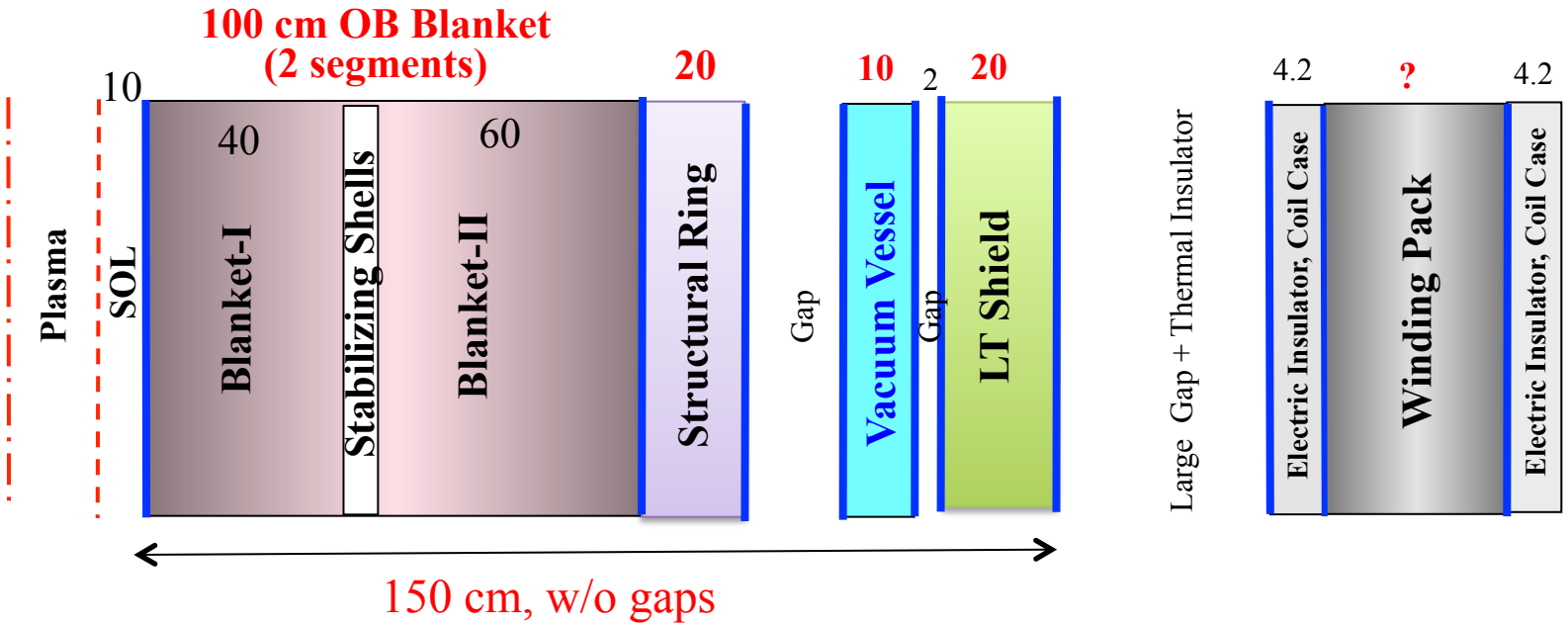
(Peak IB Γ = 1.7 MW/m^2)



- WC-free IB to control decay heat.
- SR and VV are not reweldable around midplane.
- Without gaps, SR, VV, LT shield, and magnet are life-of-plant components.
- Effect of neutron streaming through assembly gaps on damage and lifetimes of SR, VV, LT shield, and magnet should be assessed with 3-D analysis.

ARIES-ACT-2 OB Radial Build

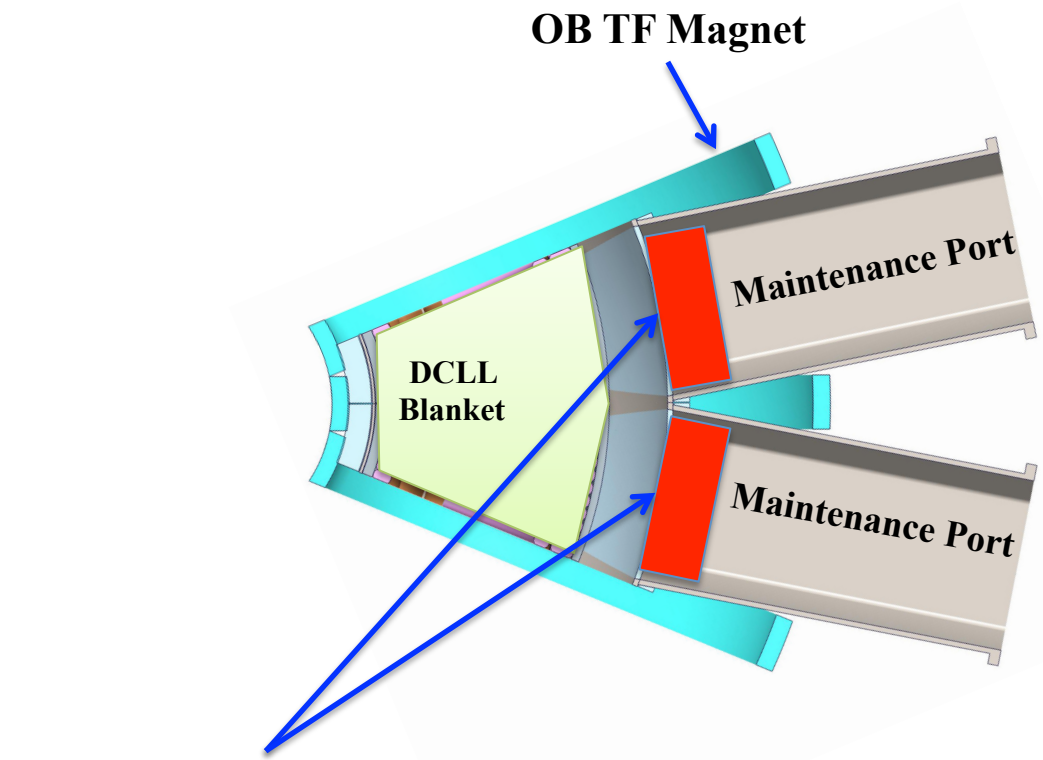
(midplane cross section through TF magnets; Peak OB Γ = 2.2 MW/m^2)



- Blanket-I lifetime = 6 FPY.
- Blanket-II, SR, and VV are life-of-plant components in absence of assembly gaps.
- SR and VV are reweldable away from assembly gaps and penetrations.
- Effect of neutron streaming through assembly gaps on damage and lifetimes of B-II, SR, VV, LT shield, and magnet should be assessed with 3-D analysis.

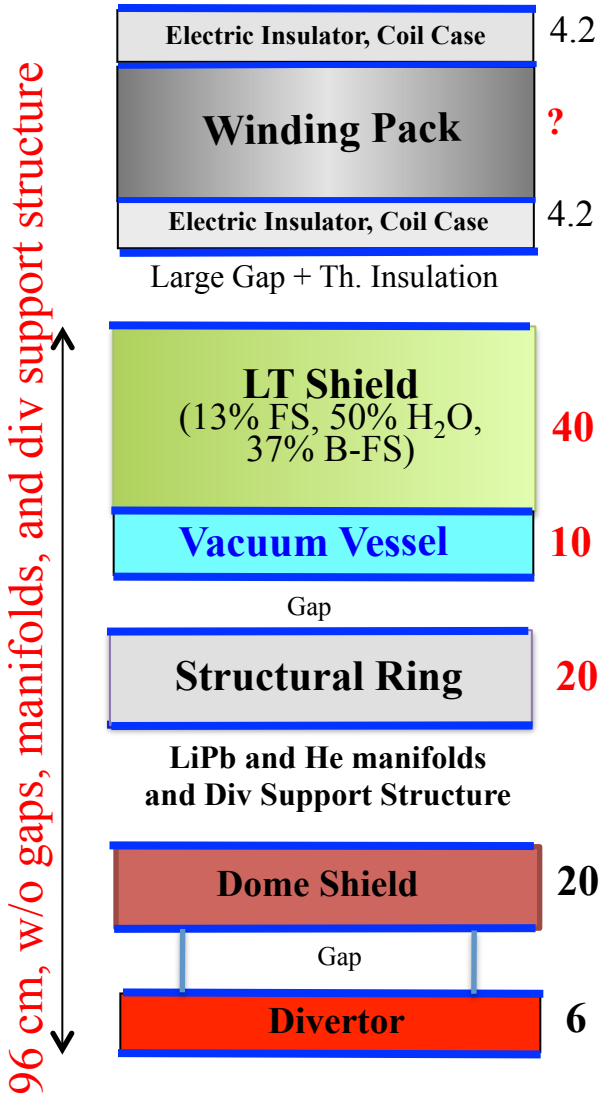
ARIES-ACT-2 OB Radial Build

(cross section between TF magnets; Peak OB Γ = 2.2 MW/m^2)



ARIES-ACT-2 Vertical Radial Build
(Peak div Γ = 0.9 MW/m^2)

- Lifetime of W-based divertor is unknown. Will be replaced with blanket.
- None of vertical components is reweldable.
- Without gaps, SR, VV, LT shield, and magnet could be life-of-plant components with careful accommodation of pumping ducts.
- Effect of neutron streaming through assembly gaps and pumping ducts on damage and lifetimes of SR, VV, LT shield, and magnet should be assessed with 3-D analysis.



Compositions

$Li_{15.7}Pb_{84.3}$ @ 580 °C; 9 g/cm^3 density; ~70% enriched Li

	Thickness (cm)	Composition (volume %)
IB Blanket	**65**	69.6% LiPb, 11.5% FS, 3.3% SiC, 15.6% He/void
OB Blanket-I	**40**	64.6% LiPb, 15.1% FS, 3.5% SiC, 16.8% He/void
OB Blanket-II	**60**	70.7% LiPb, 15.2% FS, 3.6% SiC, 10.5% He/void

Compositions (Cont.)

	Thickness (cm)	Composition (volume %)
Divertor Plates	6	9% W armor, 36% W alloy (W-TiC), 11% ODS-FS, 44% He
Structural Ring	20	80% MF82H FS, 20% He
Vacuum Vessel	10	60% 3Cr-3WV FS, 40% He (or 75% 3Cr-3WV FS, 25% He ?)
LT Shield*	32 IB, 40 div, 20 OB	20% 3Cr-3WV FS, 35% B-FS, 45% H_2O
Coil Case	3	95% JK2LB steel, 5% LHe
Winding Pack	???	75% JK2LB steel, 12% Cu, 2% Nb_3Sn, 8.5% LHe, 2.5% GFF Polyimide

* To be optimized.