Neutron Wall Loading Update

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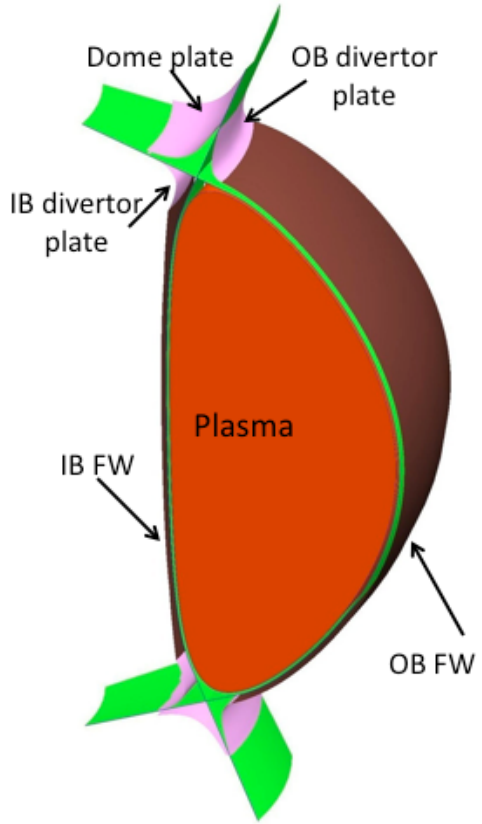
ARIES-ACT New FW/Div Configuration

- January 2011 Strawman
- **Key parameters**:
  - R = 5.5 m
  - a = 1.375 m
  - SOL = 10 cm
  - Elongation = 2.2
  - Fusion power = 1907.4 MW
  - Ave. NWL = 2.8 MW/m^2
    - @ 10 cm from plasma surface
- **Surface areas**:
  - Plasma = 475 m^2
  - FW area:
    - IB FW = 139 m^2
    - OB FW = 313 m^2
    - IB & OB FW= 452 m^2
  - Upper & lower divertors:
    - IB plate = 22.5 x 2 m^2
    - Dome = 28 x 2 m^2
    - OB plate = 21 x 2 m^2
    - Div total = 143 m^2

FW + Div Surface area = 595 m^2

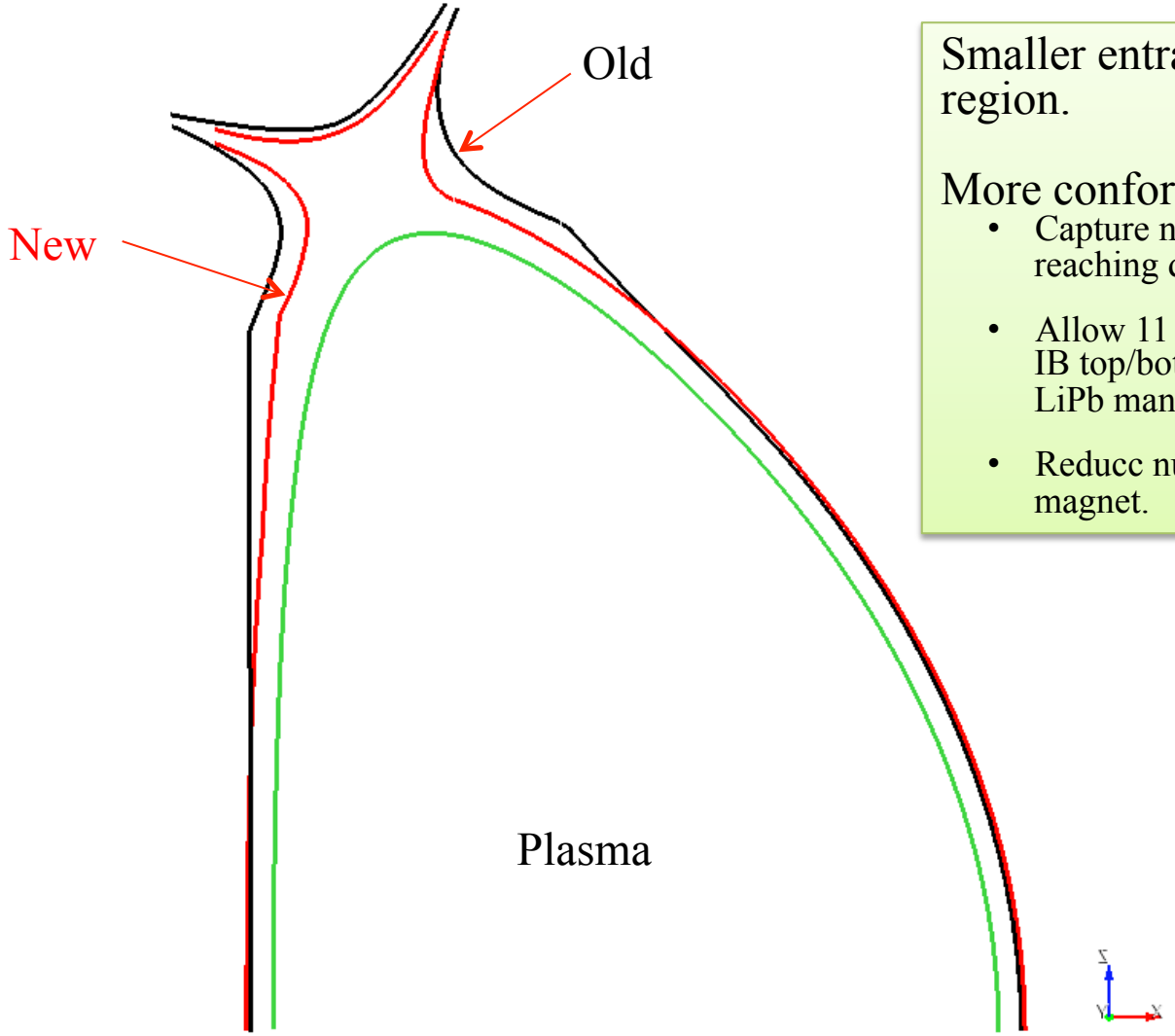
Area of wall @10 cm from plasma = 547 m^2



Main features:

- Curved IB FW (allowing 11 cm extra space at top/bottom)
- Per Kessel,
  - OB div plate @ R-a/2
  - IB div plate @ R-a

New vs. Old FW/Div Configuration



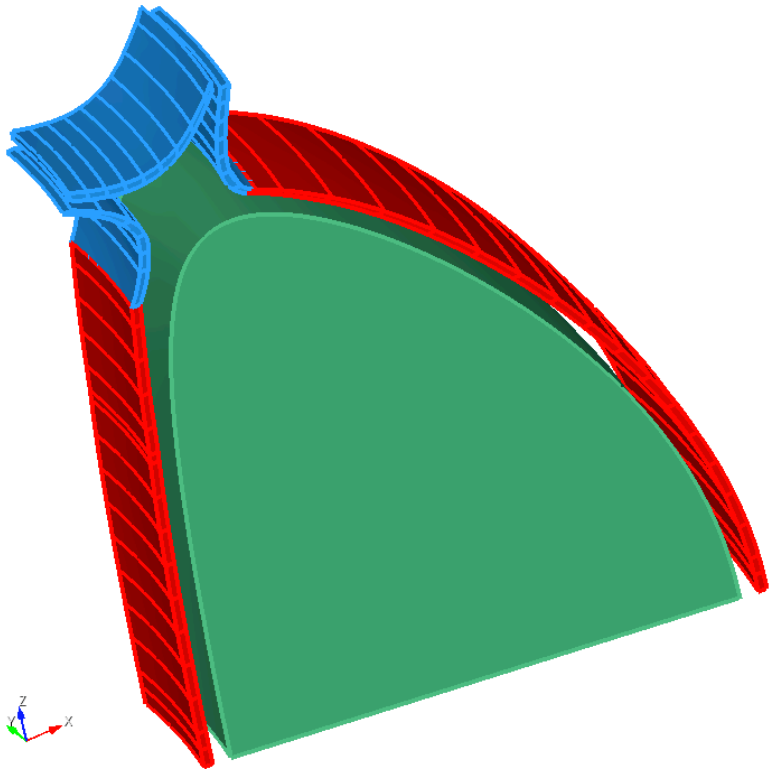
Smaller entrance to divertor region.

More conforming FW to:

- Capture neutrons before reaching divertor
- Allow 11 cm more space at IB top/bottom for DCLL He/ LiPb manifolds
- Reducc nuclear heating at IB magnet.

3-D NWL Model

- Includes:
  - Plasma boundary
  - IB & OB FW
  - IB & OB div plates and dome.
- FW and divertor segmented vertically and radially to improve accuracy.
- 10 million particle history.
- Statistical error < 1%.



MCNP 3-D Model

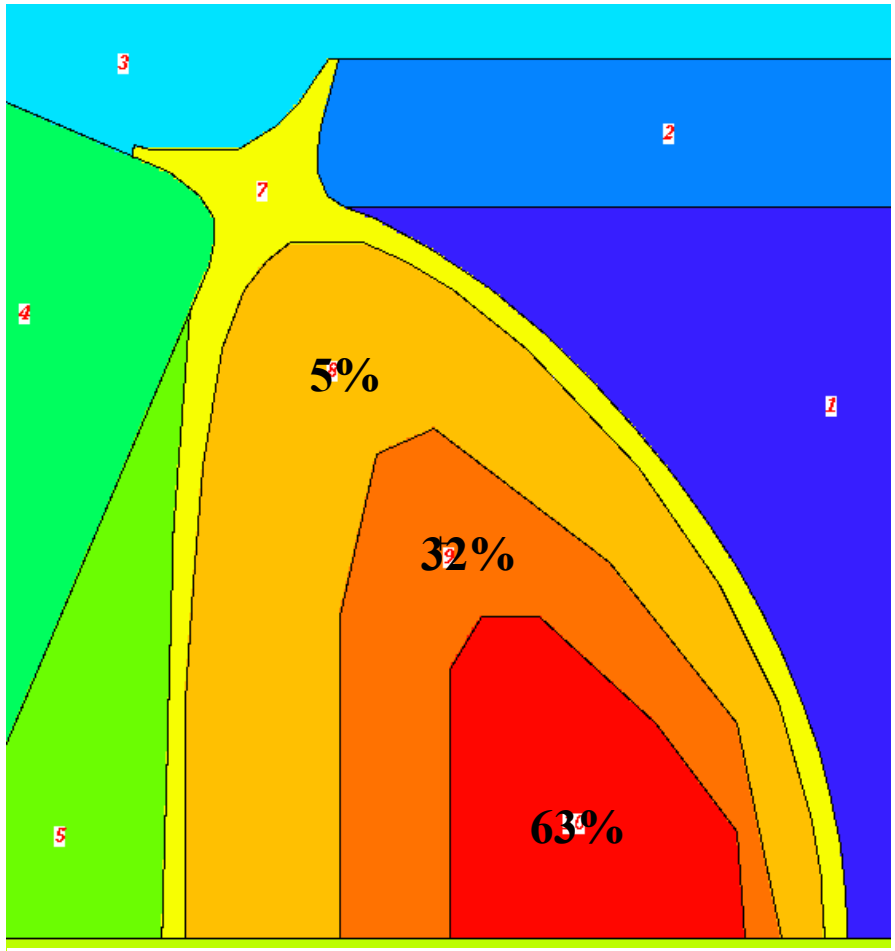
Neutron Source Sampling

Options:

1. **Uniform** within plasma boundary.
   - Unrealistic, but used to check geometry (1/2011 ARIES presentation by El-Guebaly).

2. **Three-nested source regions** with variable intensity peaking at magnetic axis:
   - Good approximation.
   - Intensities borrowed from ARIES-RS: 63%, 32%, 5%.

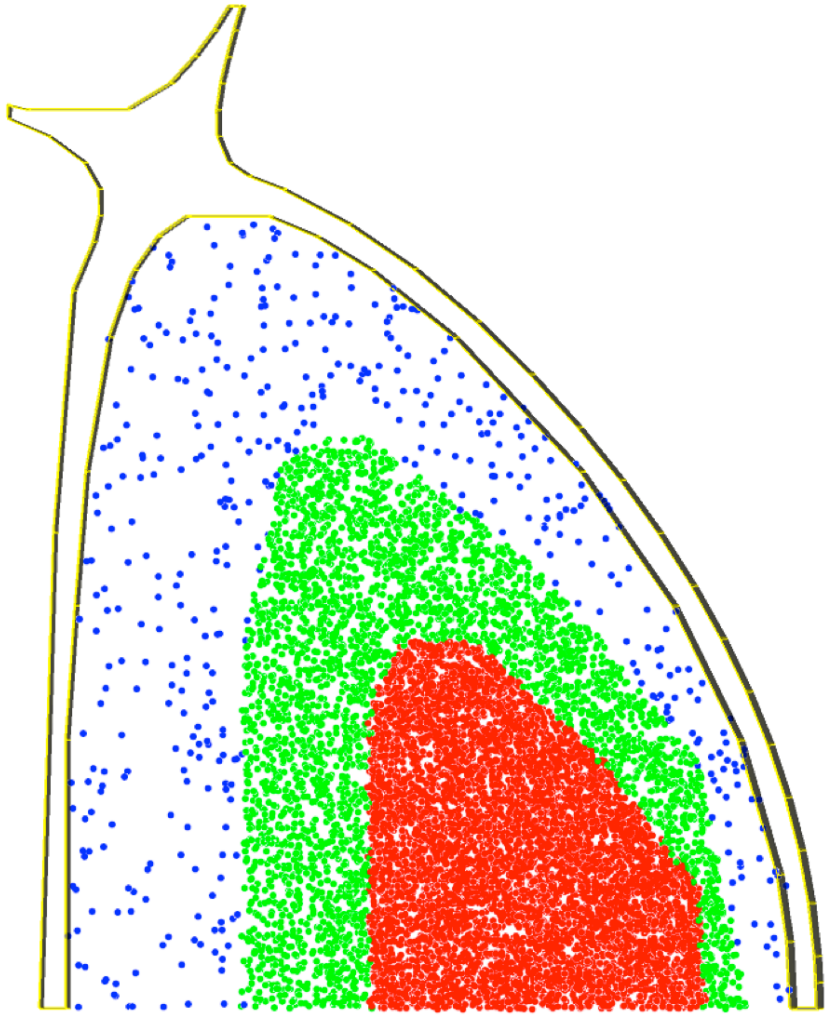
3. **Actual distribution**:
   - Source density distributed on R-Z grid not available yet.
   - Results identical to 3-nested source, except for 10% higher peak at IB midplane (refer to 5/2008 NWL presentation by Wilson).



MCNP 2-D Plot
(3-nested Source Regions)

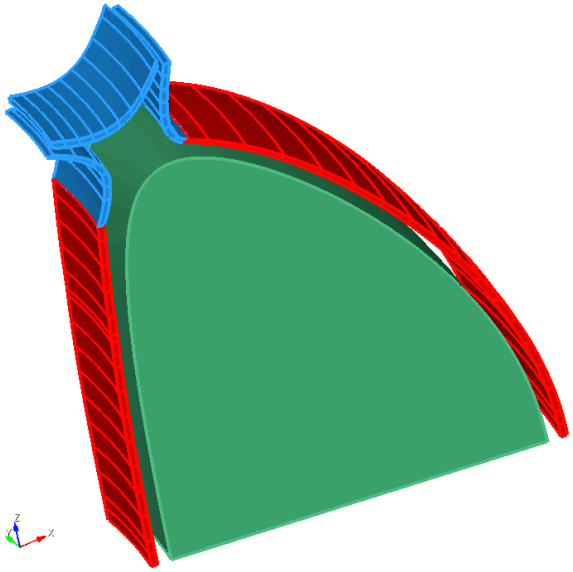
Three-nested Source Regions Within Plasma

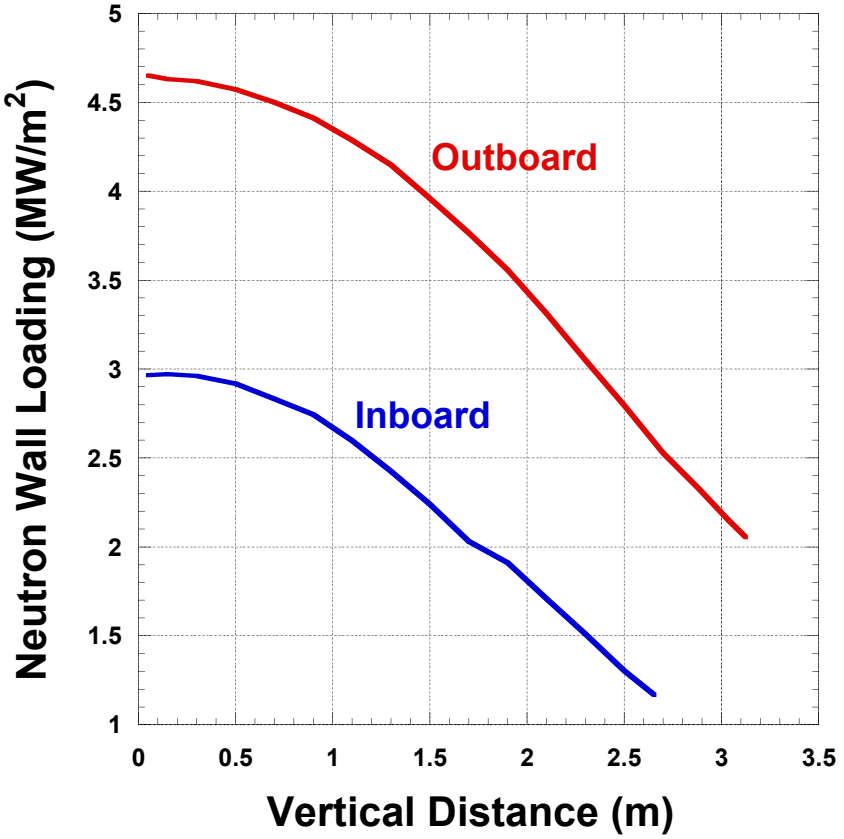
Neutron Source Intensity:
63%, 32%, 5%



(**Example**: 10,000 particles random sampling)

IB and OB Results



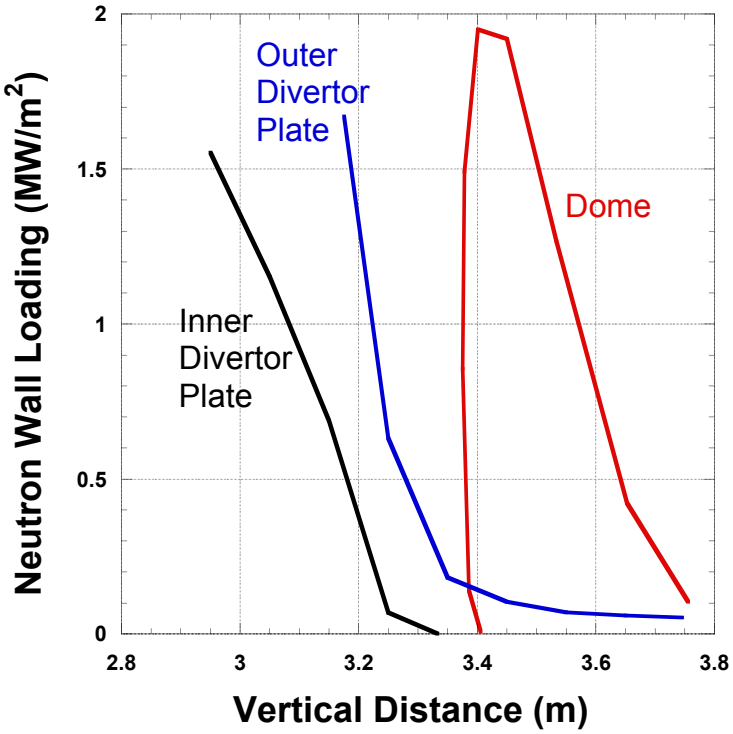


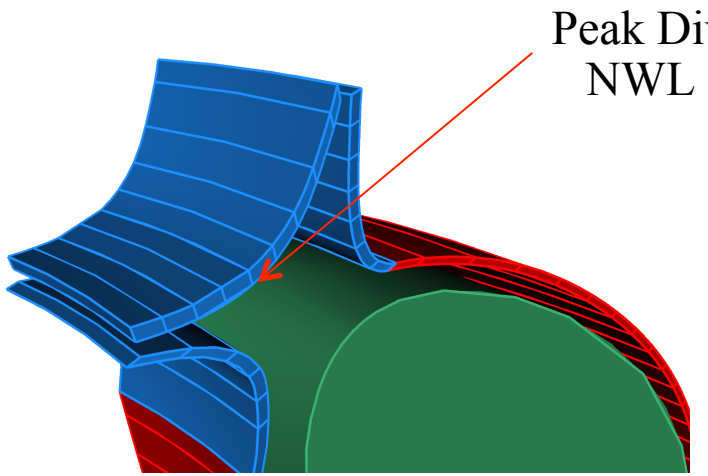
Machine Ave NWL (P_f x 0.8/area):

@ 10 cm from plasma surface	2.8
Peak OB NWL @ OB midplane	4.7
Ave OB NWL	3.6
Peak IB NWL @ IB midplane	3 x 1.1* = 3.3
Ave IB NWL	2.3

* Correction factor for actual source distribution (refer to 5/2008 NWL presentation by Wilson).

Divertor Results





Machine Ave NWL (P_f x 0.8/area):	
@ 10 cm from plasma surface	2.8
Peak Div NWL	2
Ave Div NWL	0.7

Summary of NWL Results

Machine Ave NWL (P_f x 0.8/area):	
@ 10 cm from plasma surface	2.8
Peak IB NWL	3.3
Ave IB NWL	2.3
Peak OB NWL	4.7
Ave OB NWL	3.6
Peak div NWL	2
Ave div NWL	0.7

Peak to average NWL = 1.68

Conclusions

- Peak NWLs will be used to redefine radial builds for ARIES-ACT:
  - 3.3 MW/m^2 for IB
  - 4.7 MW/m^2 for OB
  - 2 MW/m^2 for divertor.

- For ASC, peak to average NWL = 1.68 (not 1.5).