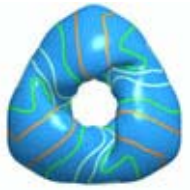
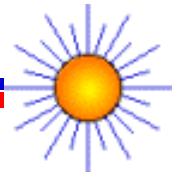
Update of the ARIES-CS Power Core Configuration and Maintenance

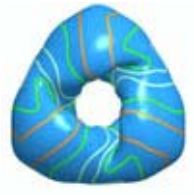


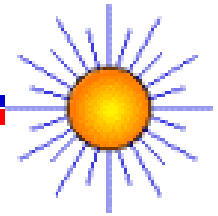


X.R. Wang
S. Malang
A.R. Raffray
and the ARIES Team

ARIES Meeting
Madison, Wisconsin
September 16, 2004

Outline

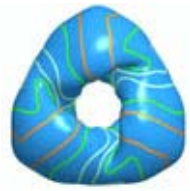


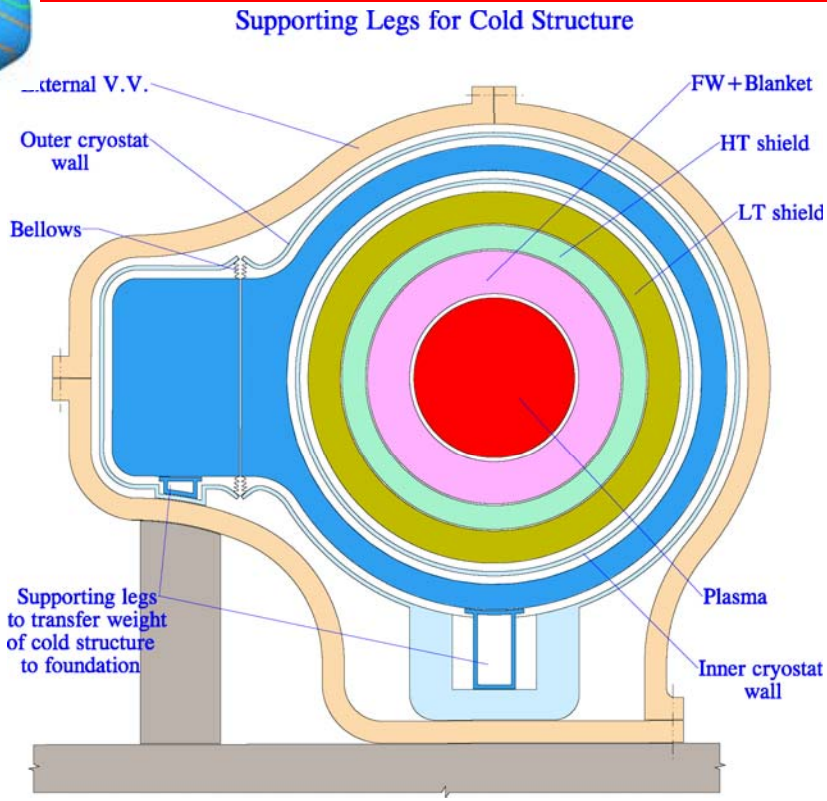


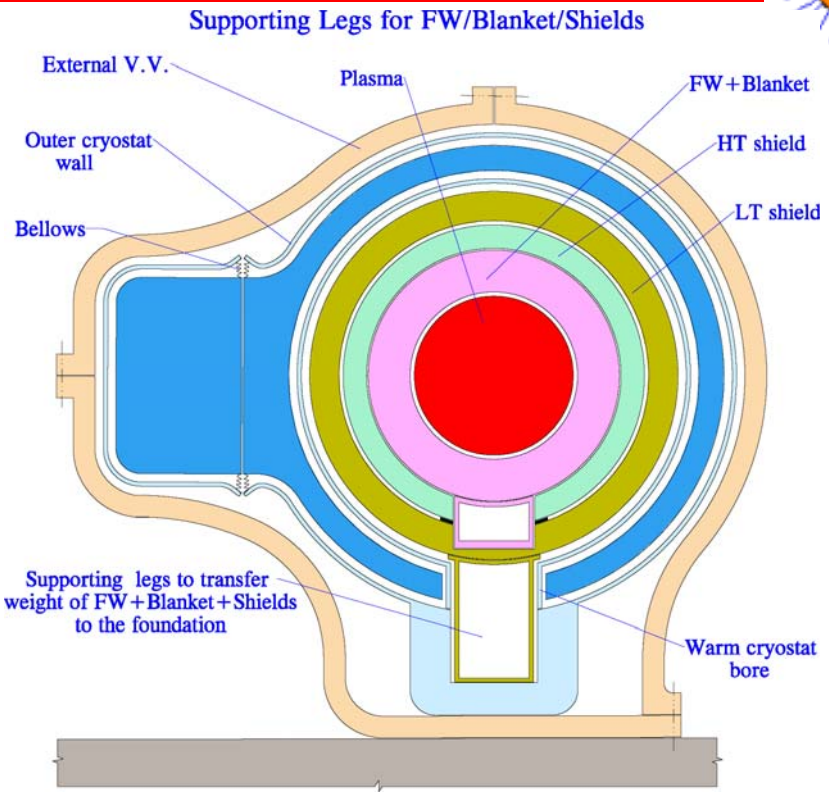
- Update of the ARIES-CS power core configuration based on NCSX-like plasma and coils, and field-period based maintenance approach.

- Update of the ARIES-CS power core configuration for modular maintenance approach.

Layout of the Power Core Components Based on Circular Plasma and Planar Coils(OLD)



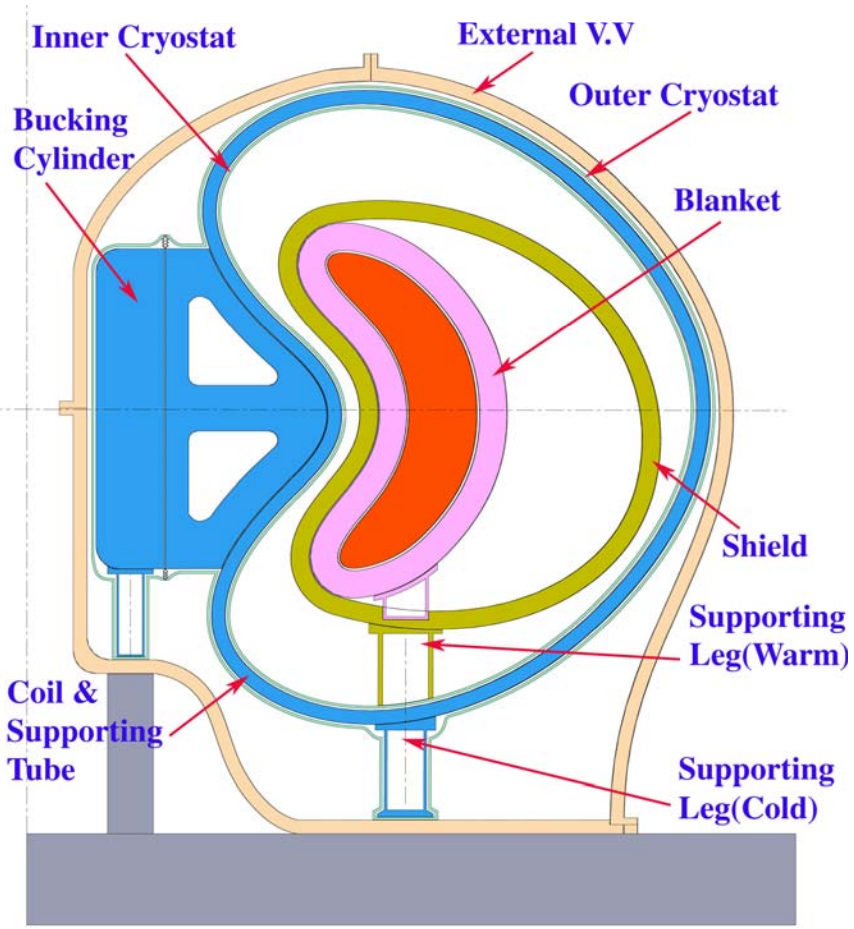




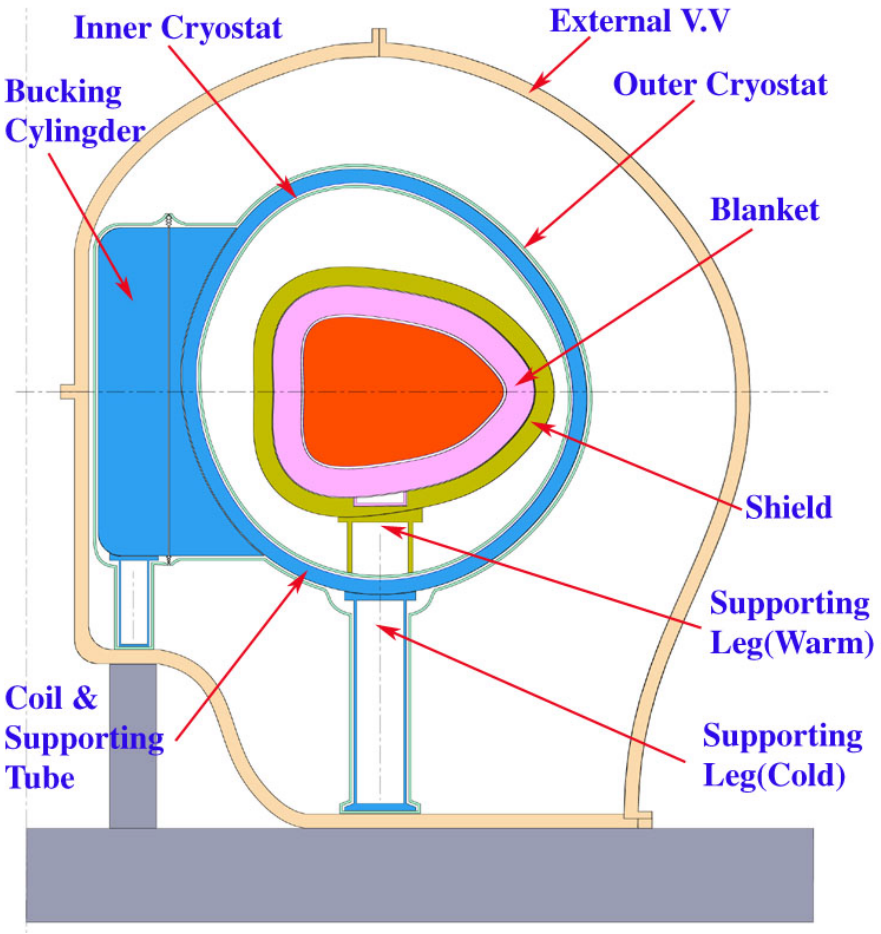
Major Features:

- The supporting tube of each field period is enclosed by a separate cryostat.
- Bucking cylinder to react the centering forces of coils is enclosed by a separate cryostat in order to be maintained at cryogenic temperature.
- All the individual cryostats containing the entire coil system and the supporting structure are enclosed by an **external vacuum vessel**.

Layout of the Power Core Components Based on NCSX-like Plasma and Coils

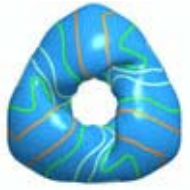


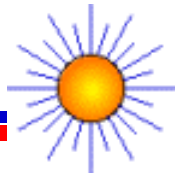
Cross-section at 0 degree

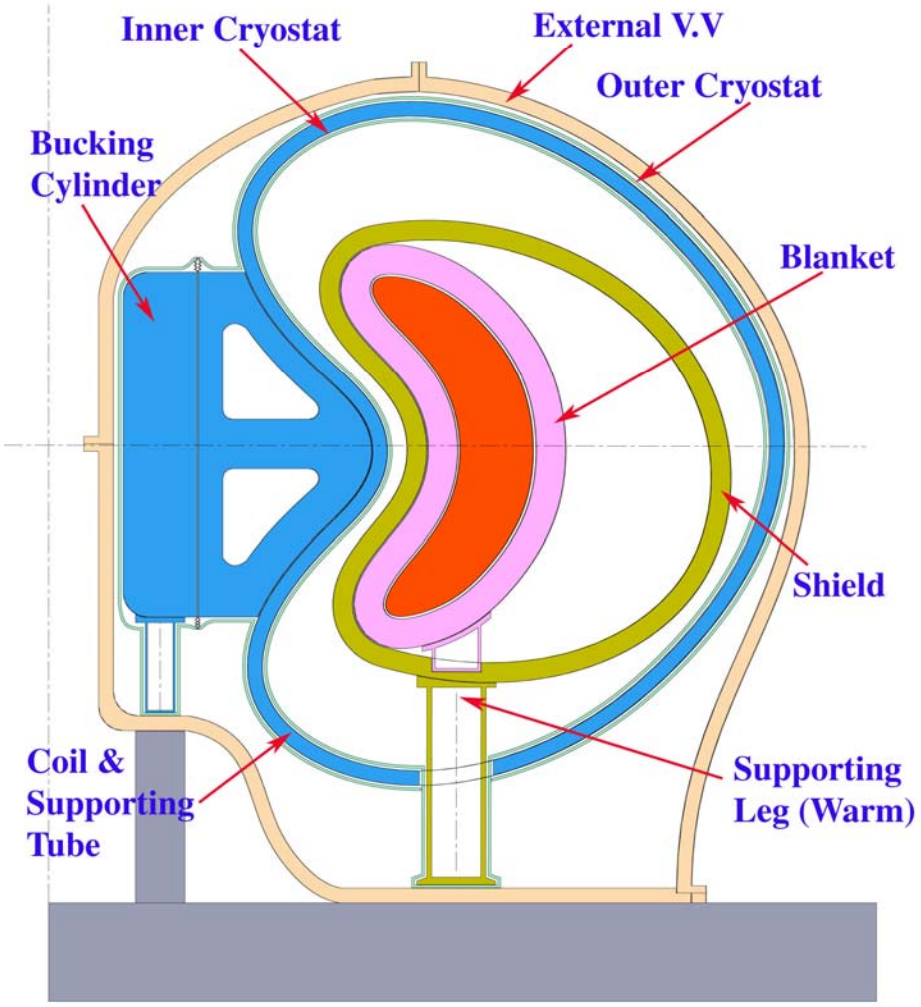


Cross-section at 60 degree

Arrangement of Supporting Legs to Support the Weight of the Blanket/Shields

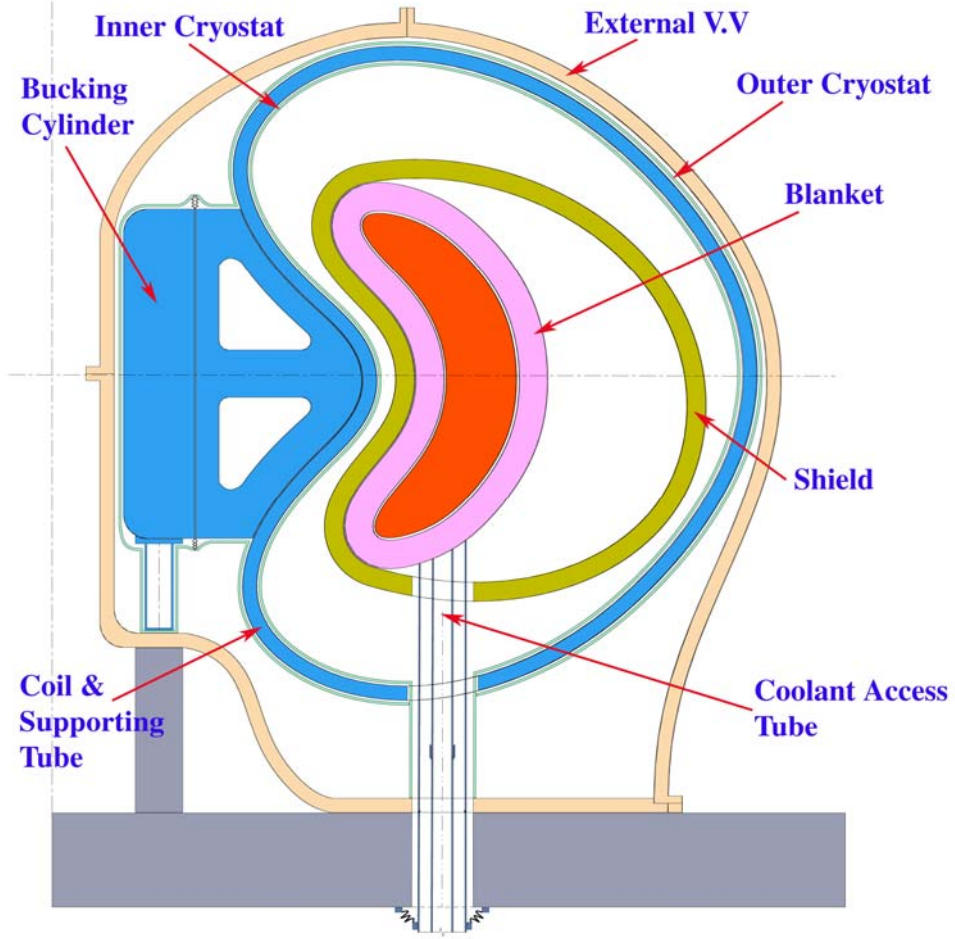






- There is nearly no limitation on the cross section of the warm legs because the warm legs are between warm regions.
- The shield rests on warm legs, transferring the weight of entire power core(~10,000 tons) to the foundation.
- 2x2 strong warm legs are needed each field period(2 units/one period) to support the weight of blanket/shields.

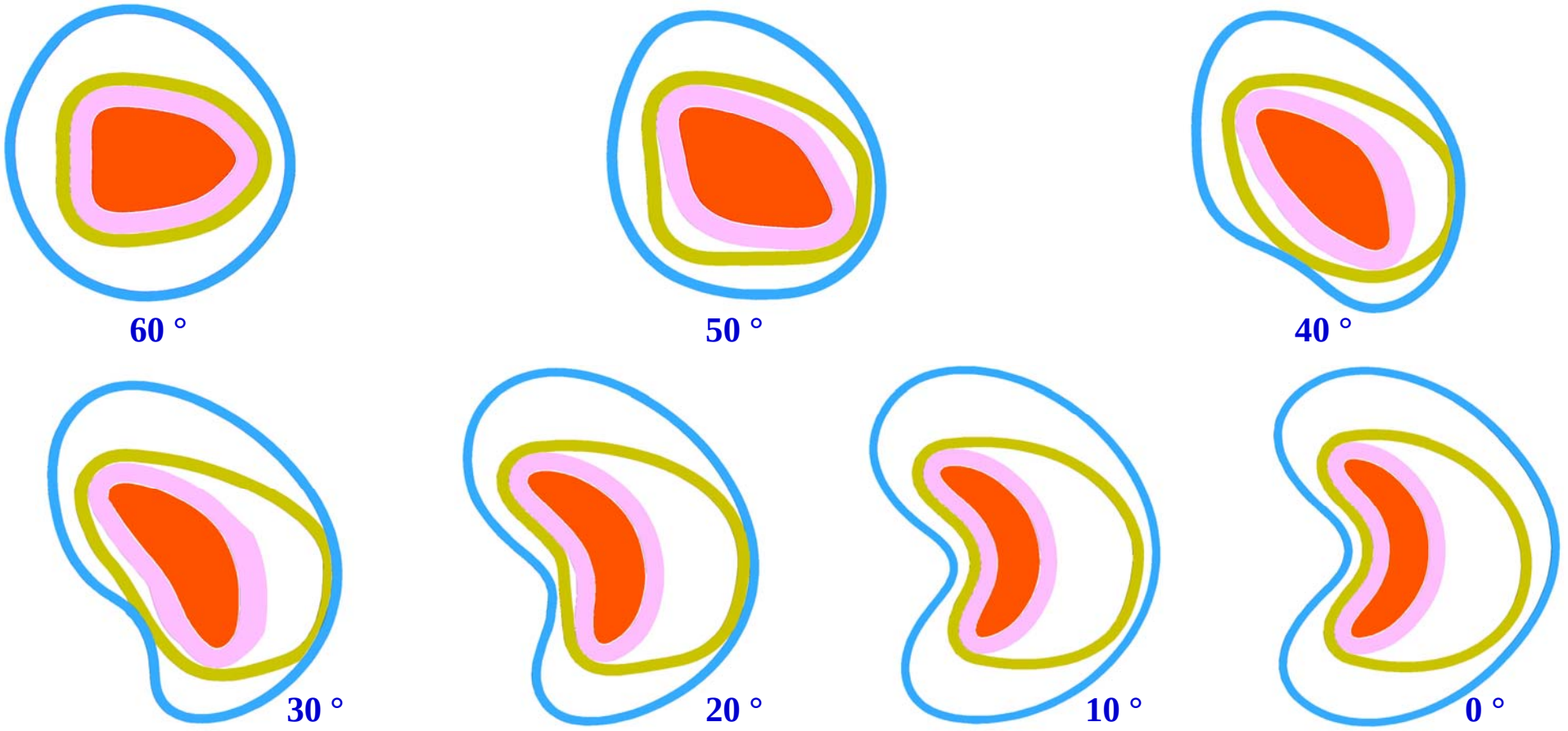
Arrangement of Cooling Access Tubes to FW+Blanket+Shields



Major Features:

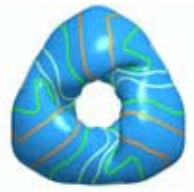
- All the access tubes are from the bottom as concentric tubes.
- Sliding joints can be used at the inner tube.
- Only outer tube has to be cut and re-welded.

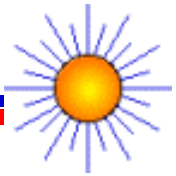
Motion Studies To Verify Clearance for the Field-Period Maintenance Approach(OLD)

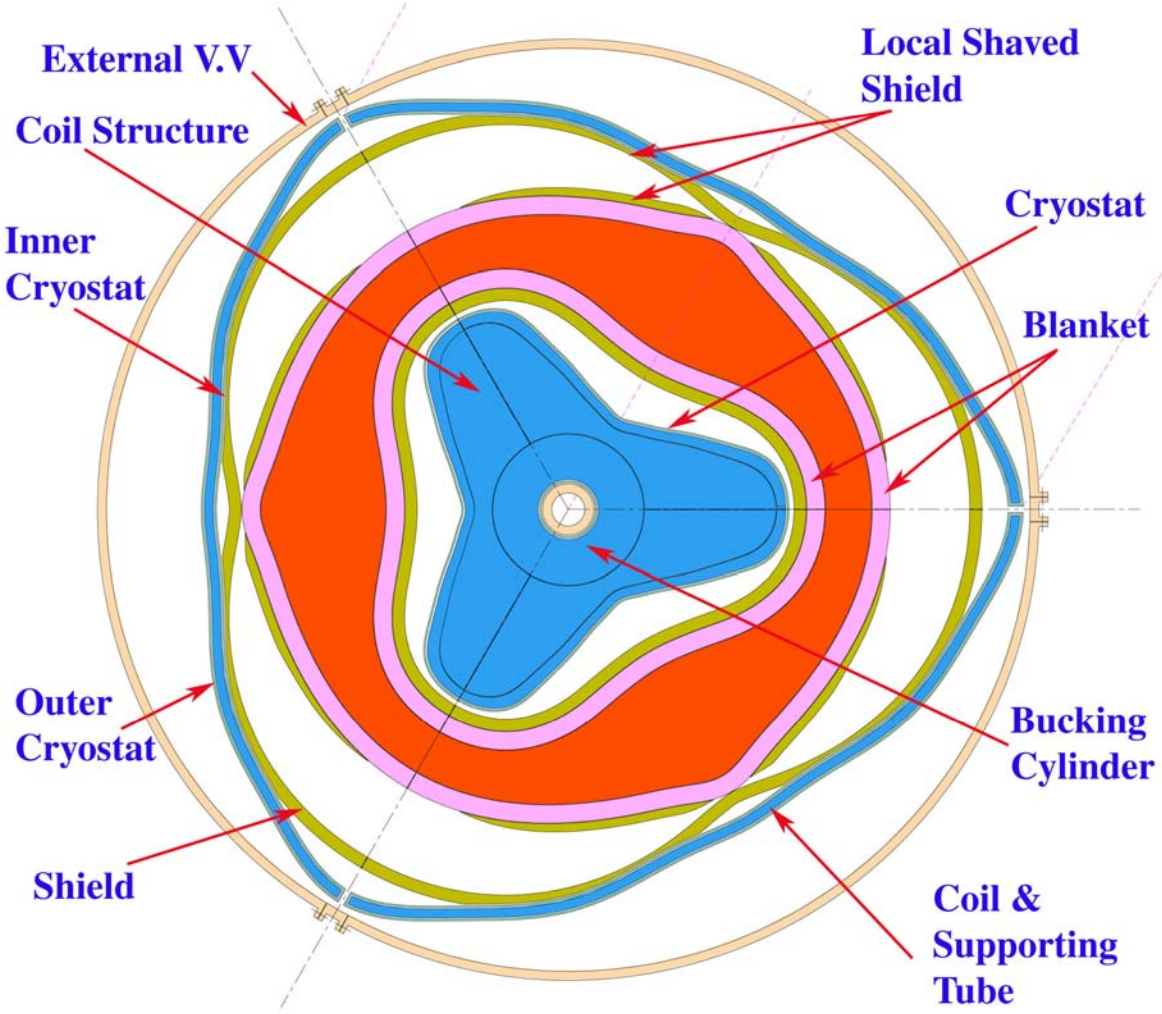


It is feasible to move the replacement unit out in toroidal direction for a combined(blanket+shield) thickness of 100 cm after locally shaving slightly the shield and adding the materials removed to the blanket.

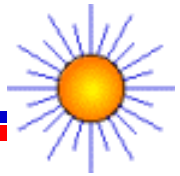
Verify Clearance for Field-Period Maintenance Approach From Top View(Cut Through Middle Plane)

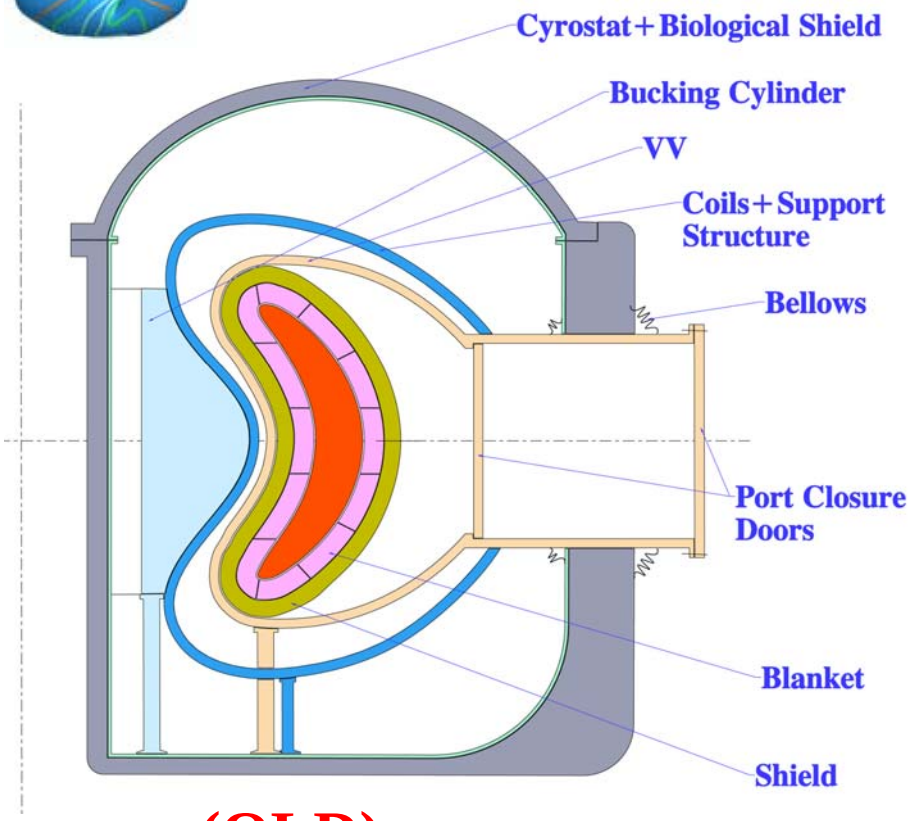


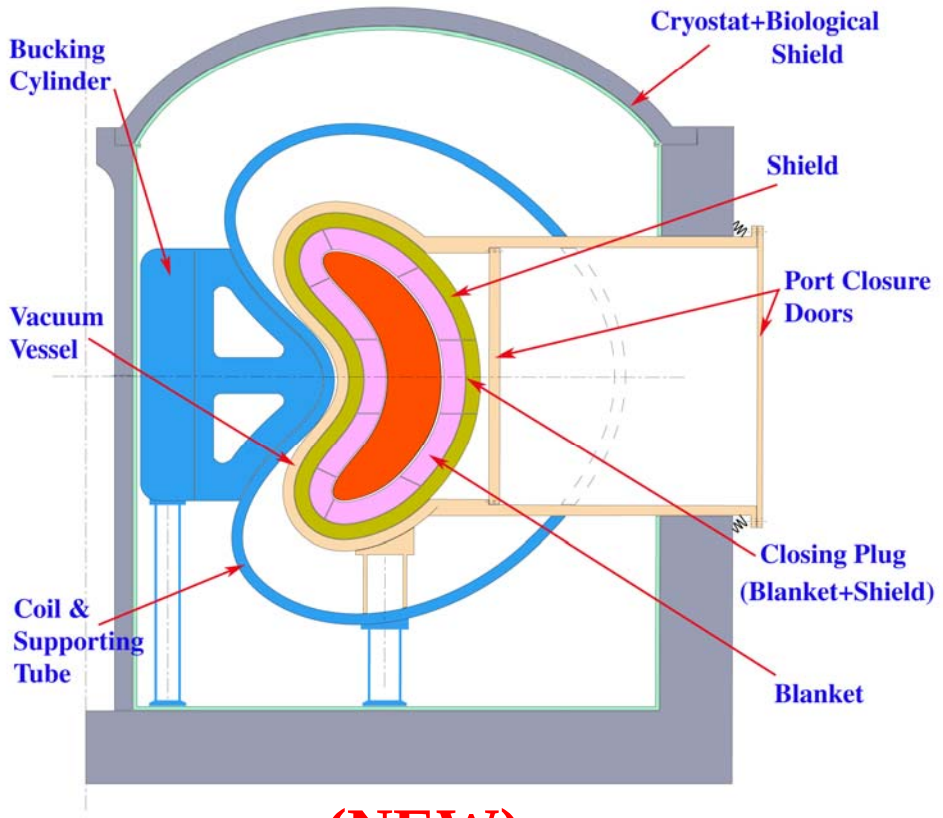




Layout of the Power Core Components Base on Modular Maintenance(at 0 degree)





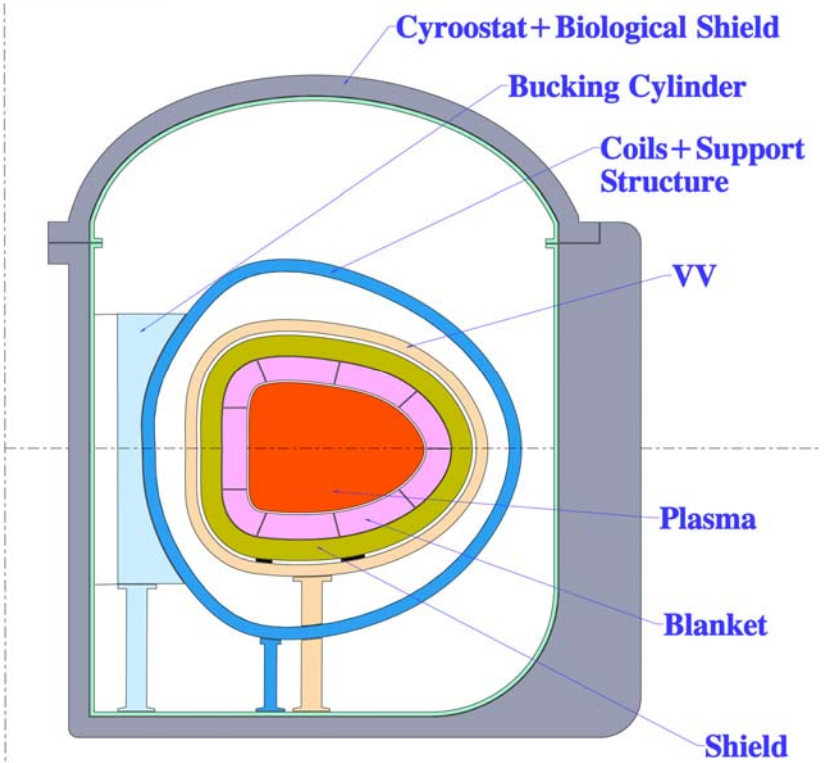


(OLD) **(NEW)**

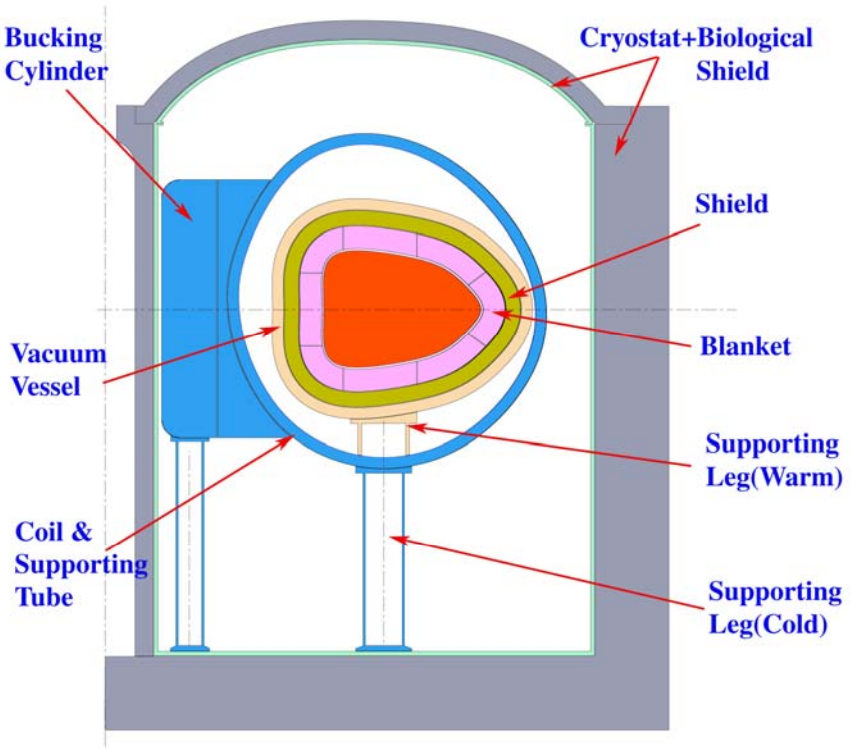
Updated the components (based on the NCSX-like configuration):

- **Geometries of the components**
- **Supporting tube, bucking cylinder, and supporting legs**
- **Vacuum vessel**

Layout of the Power Core Components Base on Modular Maintenance(at 60 degree)



(OLD)



(NEW)

Updated components (based on NCSX-like configuration):

- **Geometries of the components**
- **Supporting tube, bucking cylinder, and supporting legs**

Future Work

- Look into the NCSX-based configuration with more details, for example, the layout of the coolant supply pipes, cold supporting legs, warm supporting legs and cable connections at bottom.

- Look into the field-period maintenance approach with more details, for example, how to control the spread of radioactivity during maintenance operation.