TBR and Shielding Analyses in Support of ST-FNSF Study

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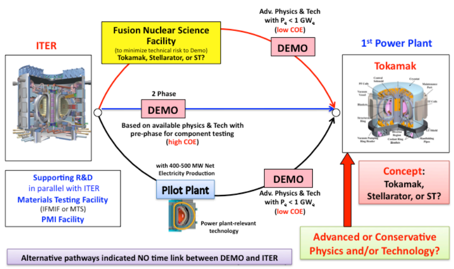
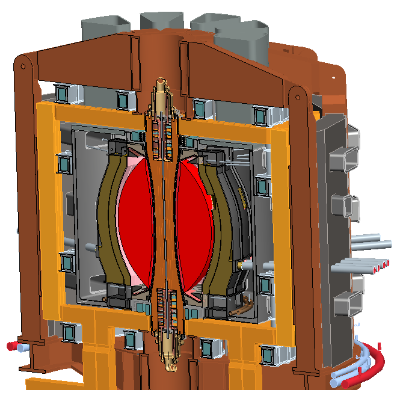
Potential Pathways to Fusion Energy

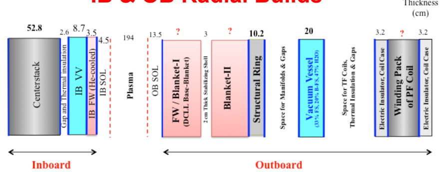




ST-FNSF Design

Major Radius	1.69	m	
Minor Radius	0.97	m	
Fusion Power	162	MW	
Plant Lifetime	~20	years	6 Full Power Years (FPY)
Availability	10-50%		
	30% average		

IB & OB Radial Builds

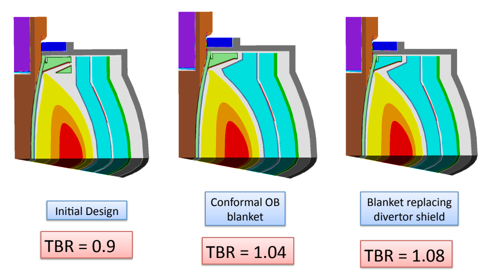


ST-FNSF Goal and Missions

- **Goal**: provide technical basis for DEMO through:
  - Design integration
  - Component and materials testing.
- **Mission elements include**:
  - Realistic neutron environment for testing
  - > 1 MW/m^2 NWL at testing components
  - Tritium self-sufficiency
  - Power plant relevant materials
  - Steady state operation
  - Rapid component replacement.

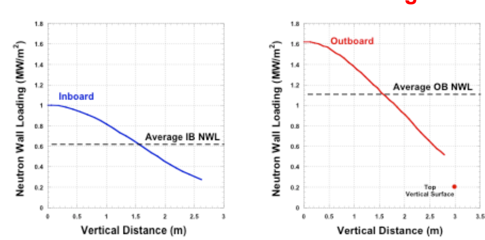
Evolution of 3-D TBR

1 m thick **homogeneous** OB **DCLL** blanket.
2 cm thick W Stabilizing Shell between blanket segments.
No penetrations or TBMs on OB (to be added in future).
1/40th model for 3-D analysis.

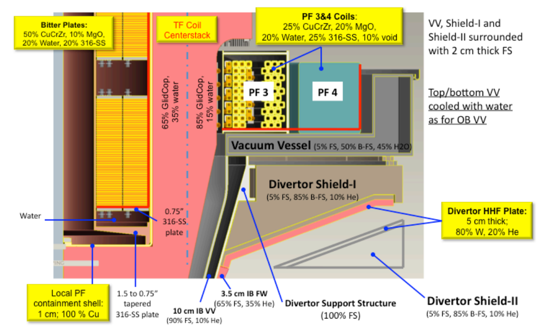


- TBR of final design will be < 1.08.
- Reasons:
  - Heterogeneity of blanket (~ 5% lower TBR)
  - Inclusion of OB penetrations and TBMs (~ 5% lower TBR).

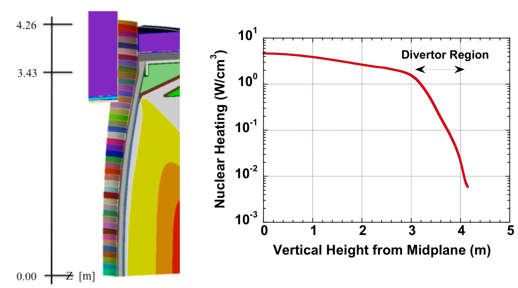
NWL Peaks at ~1.5 MW/m^2 at OB Midplane for Blanket and Materials Testing



Dose to MgO Insulator of Bitter Coil and PF 3&4 Coils < 10^{11} rad Limit @ 6 FPY



Peak Nuclear Heating at Outermost Surface of Centerstack Reaches 4.6 W/cm^3



Conclusions

- PF magnets with MgO insulator are well protected.
- Overall TBR could reach unity with extended blanket coverage and minimization of OB penetrations.
- Advanced divertors may call for larger divertor slot that reduces blanket coverage and TBR.
- Smaller machines will have difficulty achieving TBR of 1 since higher fraction of OB is devoted to TBMs and heating ports.

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