NCSX VV / PFC update

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NCSX Engr Meeting
June 27, 2001

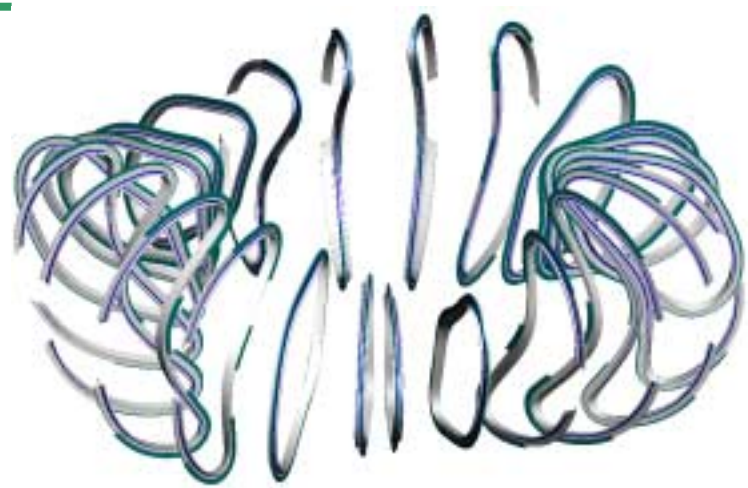
PFC requirements - PVR

- **Basic requirements**
  - **Carbon based, bakeable to 350C**
  - **NBI armor, limiters needed day 1 (at minimum)**
  - **3 MW for 0.5 s**
  - **2 cm from plasma inboard, 10 cm outboard (*TBR, working to maximize plasma-wall separation*)**
  - **Provide penetrations, accommodate in-vessel diagnostics mounted on VV**
- **Upgrade requirements**
  - **Full coverage of surfaces with carbon**
  - **12 MW for 1.2 s**
  - **Provision for divertor**

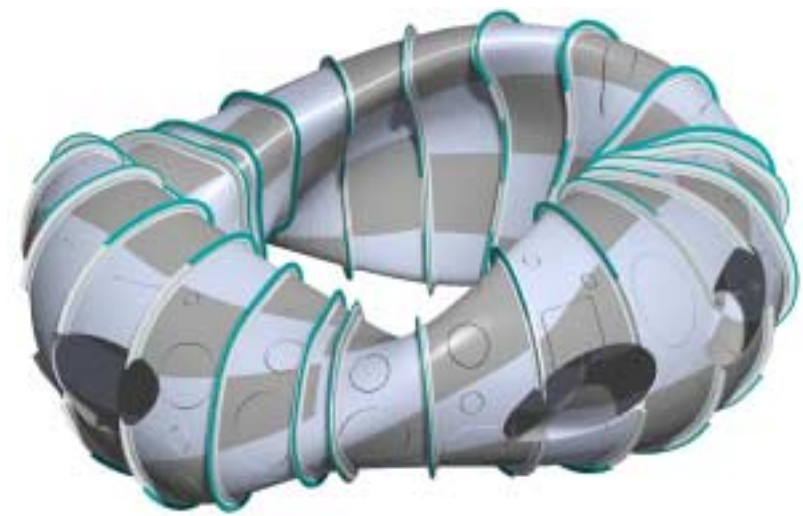
PFC design concept

- **Staged implementation planned**
  - **Initial coverage with low Z tiles mounted on poloidal ribs to form array of poloidal limiters**
  - **Panels for NB armor will also be provided**
- **Full coverage provided by mounting molded carbon fiber composite (CFC) panels on poloidal ribs**
  - **Panel size based on advice from BFG aerospace (~ 60 cm square, 1 cm thick)**
- **Ribs are separately cooled / heated with He gas for bakeout (350C) and normal operation**
- **Ribs are registered toroidally to VV but allowed to grow radially and vertically**

Poloidal ribs



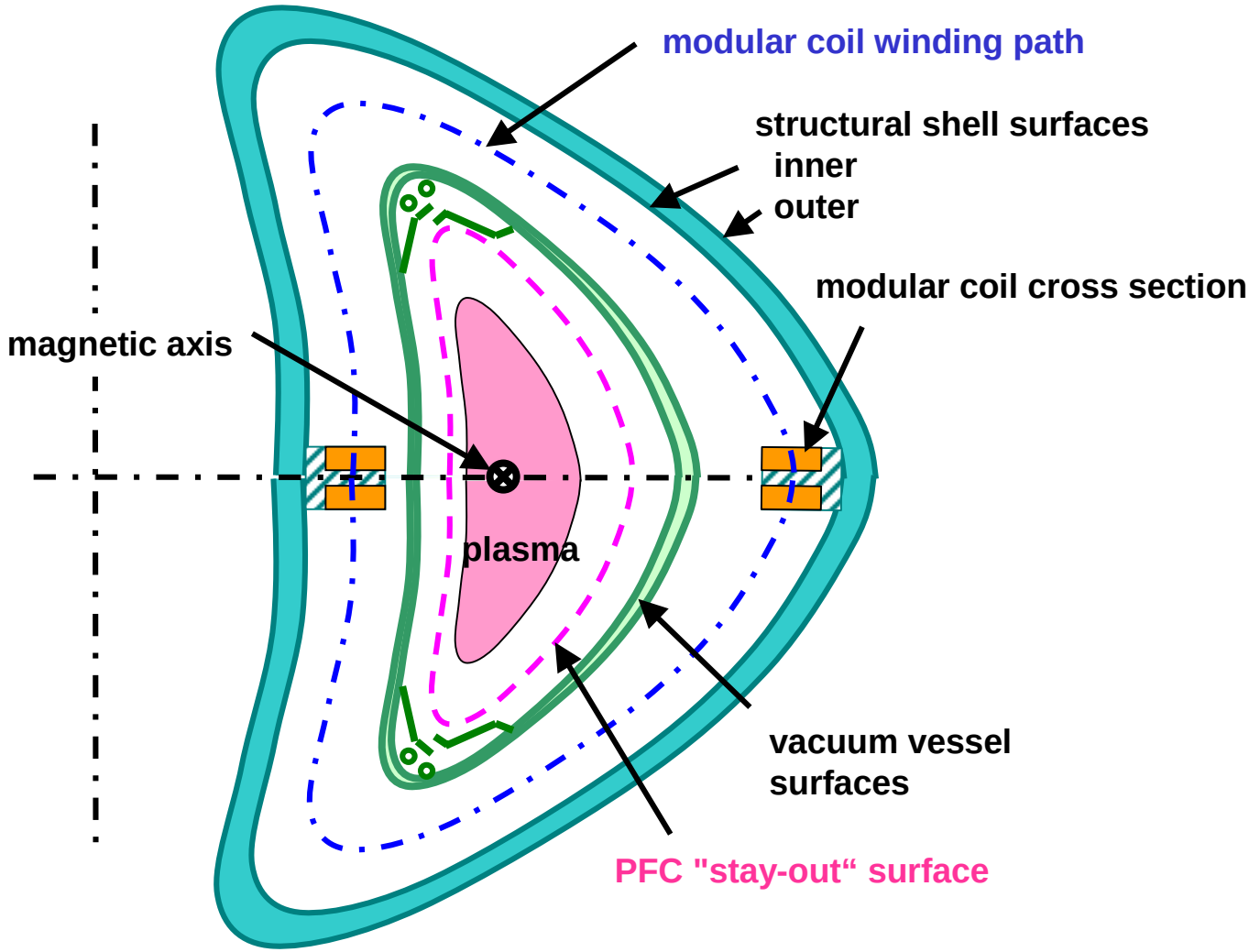
CFC panels mounted on poloidal ribs



PFC issues

Requirements	Design	Fab.	Ass'y
• PFC stayout zone • NBI armor location • divertor parameters • Limiter geometry • In-vessel diagnostics (e.g., magnetic loops)	• pumped divertor envelope • transition from day 1 to full coverage • RF launcher integration with limiters, diag. • trim coil integration • low z rail covers • inboard limiter concept	• CFC cost • Low z coating	• personnel access for –installation –reconfiguration

Reference geometry must be defined



“Stay out zone”

- **Art Grossman has field line data for MGRID_Li383_1017C2**
- **No data for 1.4 m geometry, but existing data will be scaled**
- **Initial task will be to plot field lines in 3-D space using Pro-E, then construct surface**
- **Issues include:**
  - **Is scaling ok?**
  - **How do we account for “flexibility” in the envelope?**

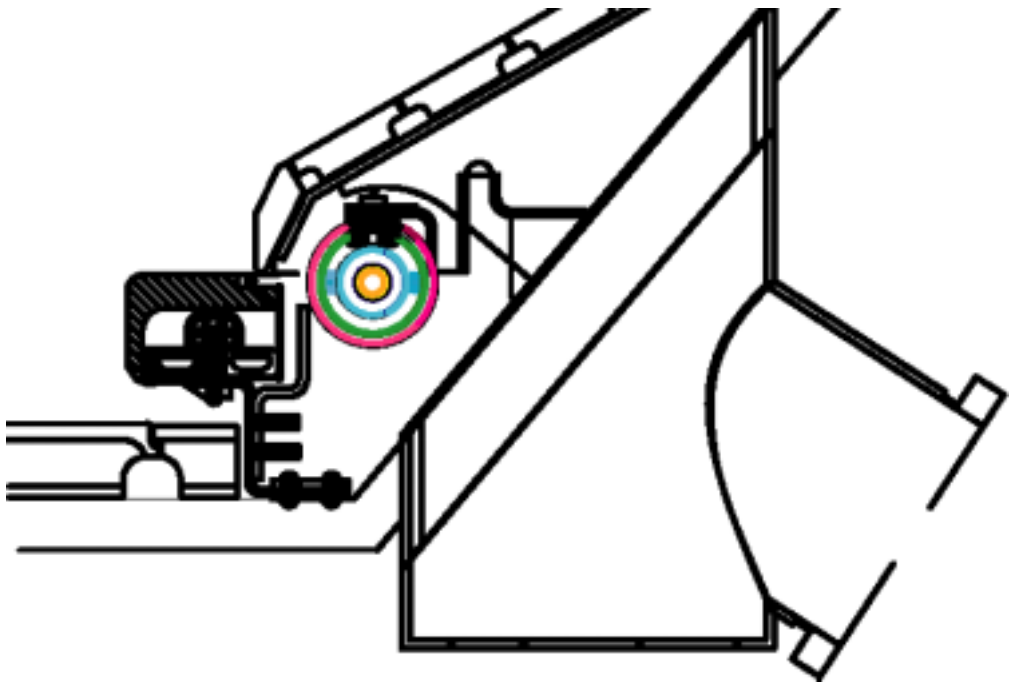
Limiter and divertor parameters

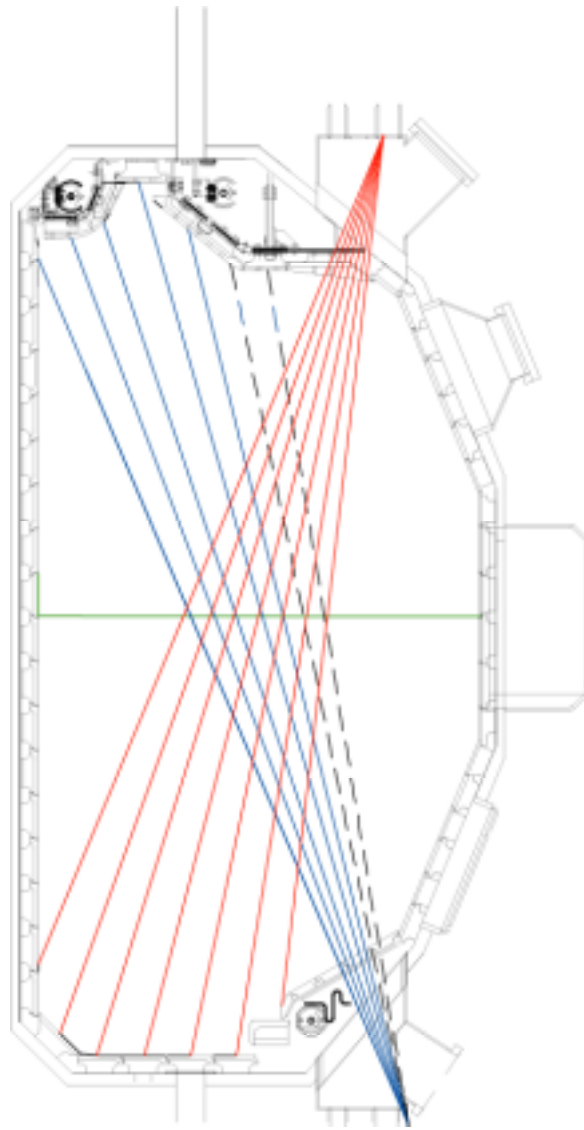
- **Limiter (day one)**
  - **3 inboard limiters, one at each bullet section**
  - **3 MW total load**
  - **Nominally 20 cm wide by 20 cm high**

- **Divertor**
  - **6 divertor assemblies, 3 top 3 bottom along ridge of plasma**
  - **Need 5000 l/s pumping at each location, will calculate slot dimensions, cryopump geometry to determine envelope**

Divertor envelope

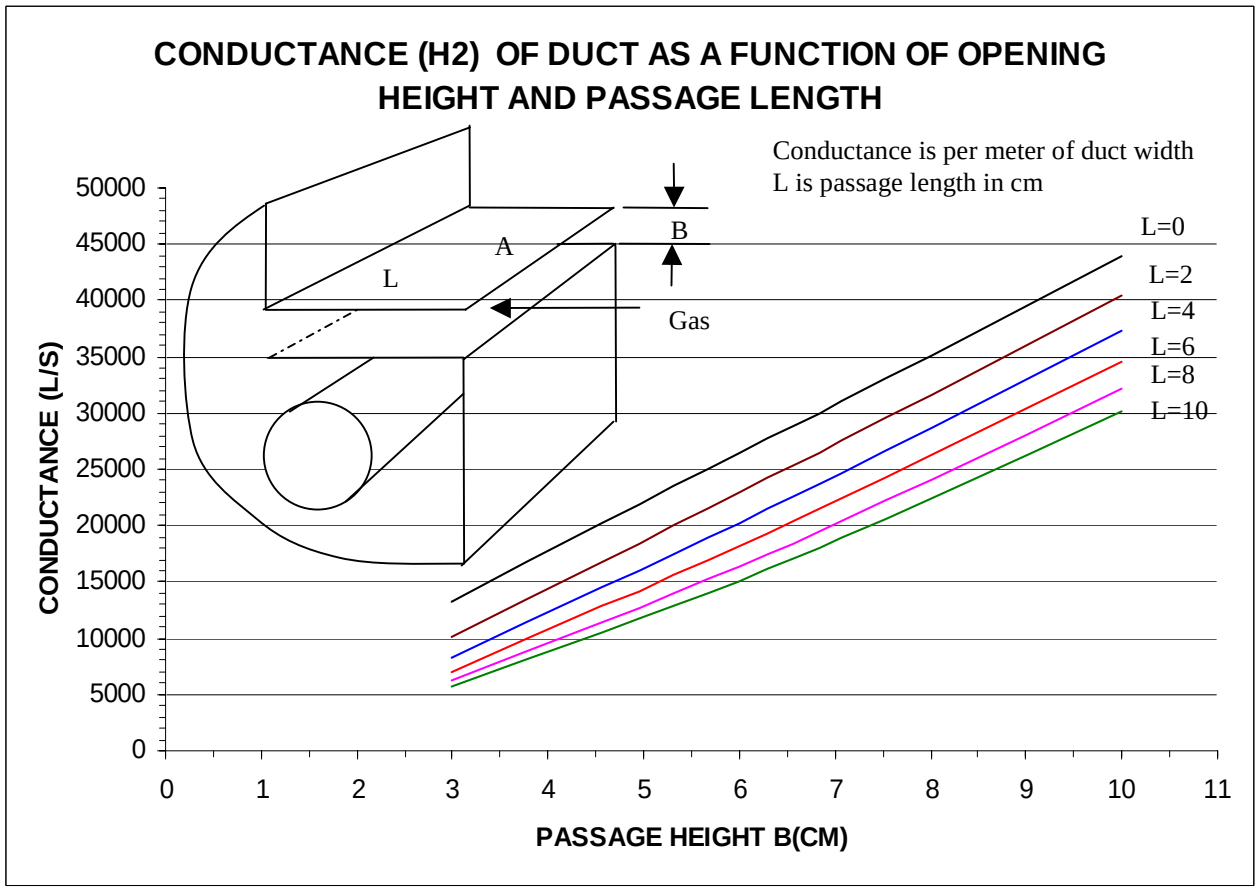
- **DIIID cryopump assumed for ref. Design**
  - **3 toroidally cont. pumps, 90 to 140 inches dia.**
  - **30,000 – 50,000 l/s each (5000 l/s per m length)**
  - **4 inches minor dia.**



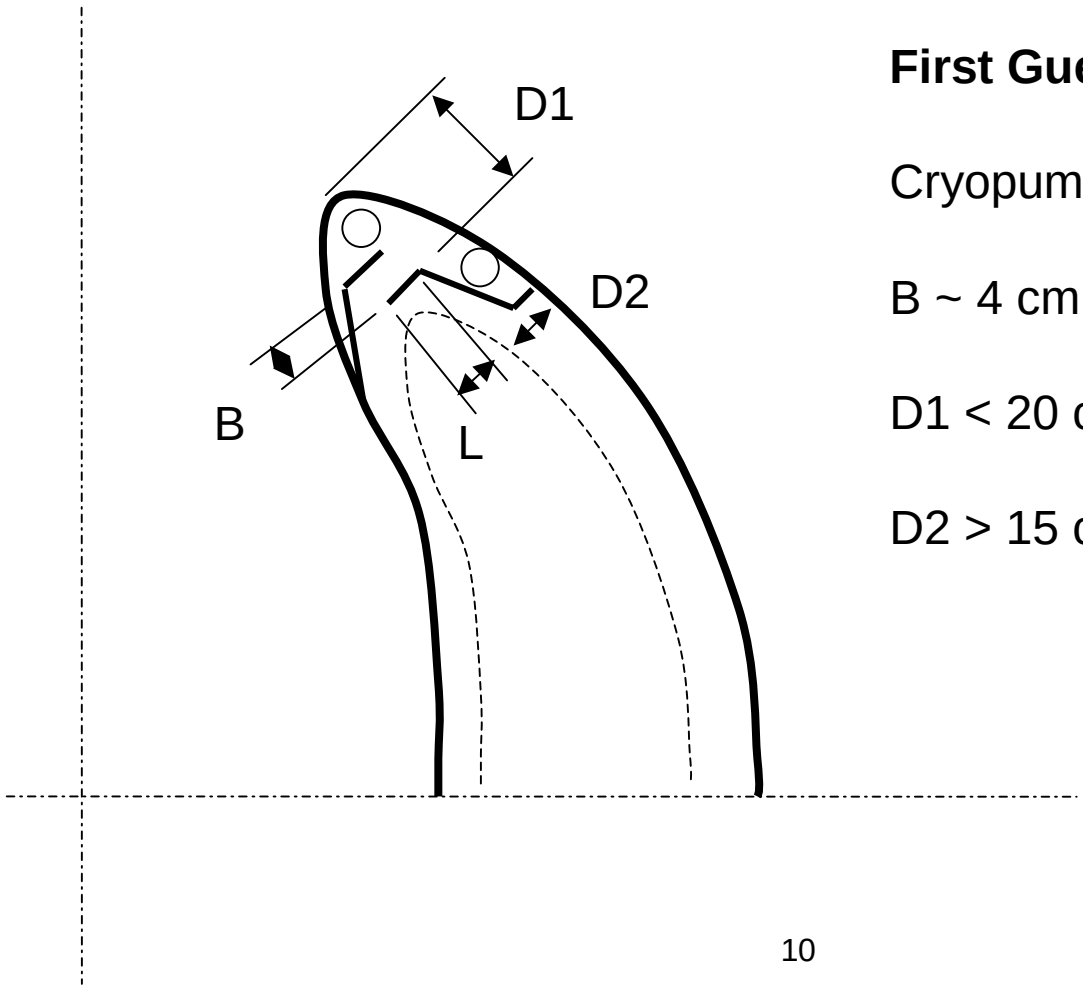


Divertor envelope (2)

- **Slot conductance dictates baffle geometry**



Divertor envelope (3)



First Guesses:

Cryopump dia. ~ 10 cm

B ~ 4 cm for 5000 l/s net

D1 < 20 cm

D2 > 15 cm

Vacuum vessel issues

Requirements	Design	Fab.	Ass'y
• RF launcher envelope • PFC / divertor envelope • Diagnostic views, incl. symmetry plane access • Plasma current for disruption analysis	• smoother shape • port integration for diagnostics • segmentation • field joint flange envelope • stresses / buckling for disruption loads • mechanics of describing vessel shape to vendors	• Cost within est.? • Process and qualified vendors • Geometric tolerance • draft spec. for procure-ment (who does final assy of port stubs)	• sliding coils over vessel • distortion during and after port welding • personnel access for field joint • Leak checking

VV / PFC deliverables

milestone		deliverable		who	when
5	update concept of VV/PFCs	5a	Define "stay-out" surface for PFCs (scrape-off layer using VMEC that includes expansion of divertor region, outboard region?)	P. Miodu-szewski	23-Jul-01
		5b	Define day 1 limiter requirements	P. Mio.	Draft 6/1
		5c	Define day 1 divertor baffle requirements	P. Mio.	Draft 6/1
		5d	Define inboard RF launcher envelope	Cole/ Majeski	Draft 6/12
		5e	Define VV assembly joint envelope and seal concept	Cole/ Goranson	
		5f	Define day 1 rail "covers" / limiters concept	Goranson	
		5g	Define trim coil attachment/alignment concept	Brown/ Cole	
		5h	Issue models and drawings of VV/PFC concept	Cole	

Summary

- **Progress made toward defining day one inboard limiter and divertor requirements**
- **Progress made toward defining “stay out” zone for 1017 coil set**
- **Still need graceful upgrade path from day one PFC system (limiter/nbi armor) to ultimate PFC system (divertor/full tile coverage)**