NCSX

WBS 1 Torus systems
Design Progress and Status

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PPPL
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Outline of Presentations

- Recent WBS 1 Progress and Overview — Nelson
- Non-Axisymmetric Coil Design — Williamson

  Requirements, Fabrication Concepts, Tool Development, Issures
- Vacuum Liner — Goranson

  Requirements, Fabrication Options, Status and Issues
- Design Integration — Cole

  Document system, Web page access, Assembly sequence and issues
- Magnetic Measurements — Georgiyevskiy

Torus Systems (WBS-1) Scope

Torus systems includes everything inside the vacuum vessel, as well as integration of these components with each other and the rest of the machine

PFCs Paul Goranson
tiles, liner, armor, limiters, R&D

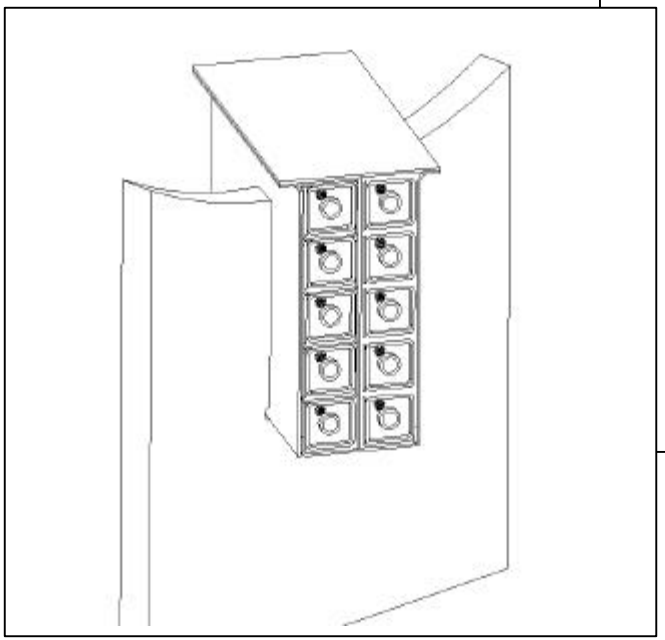
Vacuum Vessel and Vessel Structures Fred Dahlgren
mods/refurbishment of vessel, new structure

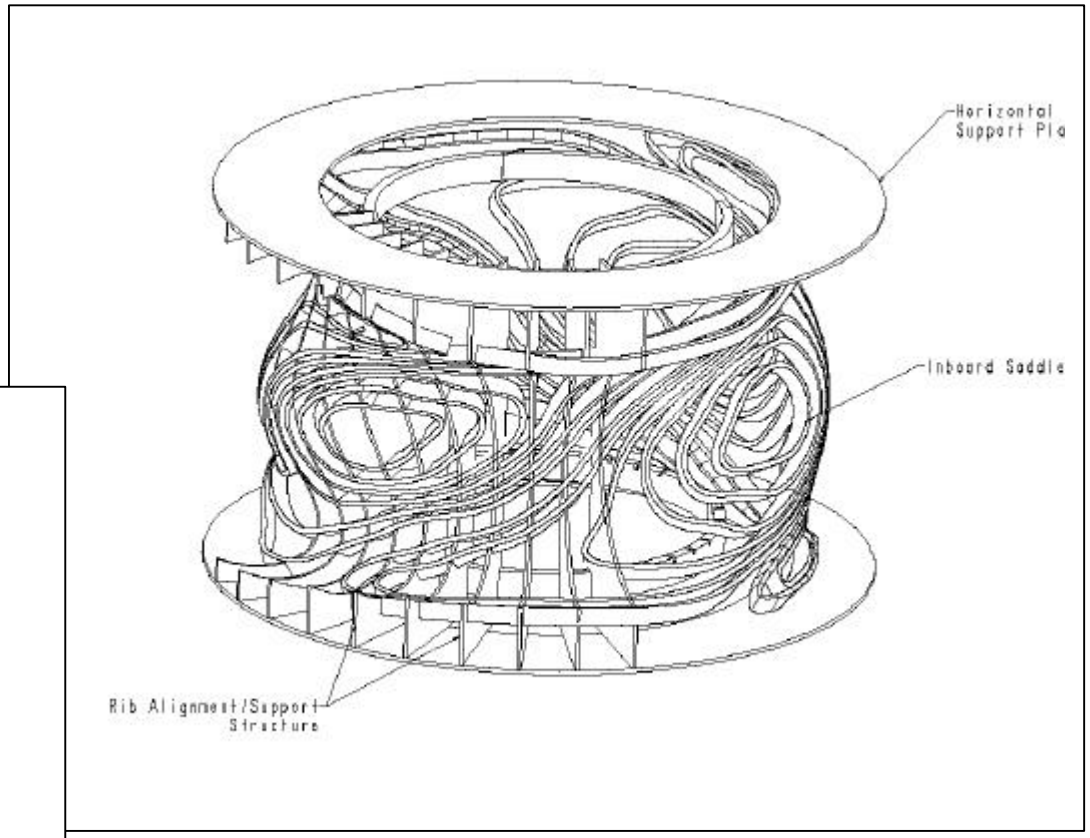
Axisymmetric Coil Systems
existing PBX coils, refurbishment and relocation

Non-Axisymmetric Coil Systems Dave Williamson
saddle, helical, other highly shaped coils

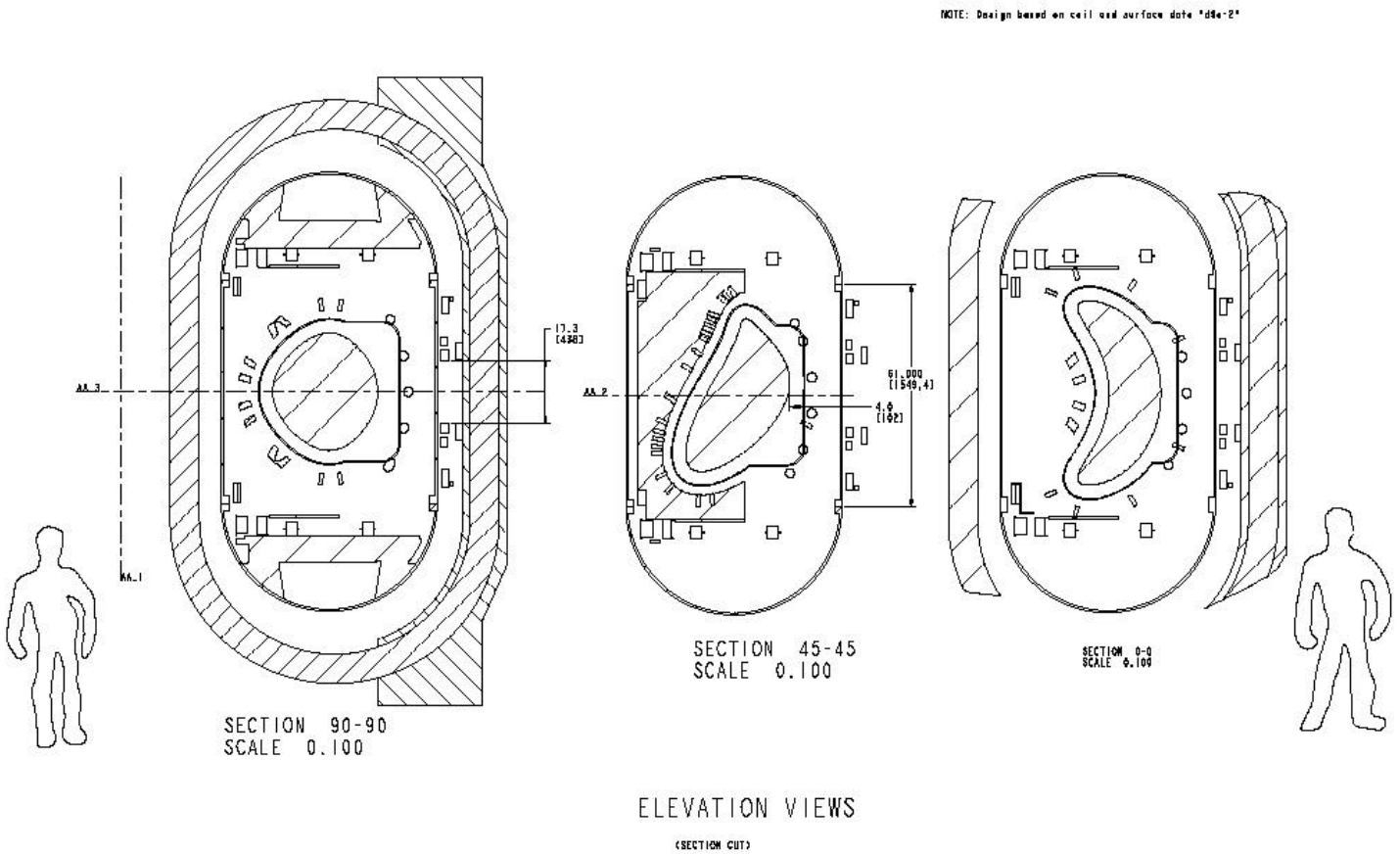
In-Vessel Measurement Systems Doug Loesser
geometric and magnetic measurements

Saddle coil array





Sections through machine



WBS-1 Goals for end of FY98

- Develop and select fabrication / winding /structure concept for saddle coils
- Develop and select fabrication concept for vacuum liner
- Develop tools for iterating 3-D coil designs between physics and engineering
- Develop design criteria and requirements to proceed with CDR
    - Identify issues (eg, what lead and crossover configurations are are acceptable fom with respect to field errors?)
    - Develop tradeoffs between requirements and cost/feasibility
    - Document decisions in design criteria document
- Produce mockup of PBX vessel for evaluation of design concepts

Recent WBS-1 Activities

Progress has been made in several areas since last April, when work began

- Pre-conceptual Design Cost Estimate for all WBS-1 systems
- Design and Fabrication Concept Development- *Primarily Saddle coils and Liner*
- Tool Development *Physics to Pro-E and (soon)back to Physics*
- Documentation System *Drawing system, file sharing, Web access*
- CDR cost estimate
- First cut at creating design criteria / parameter list
- Mockup fabrication *PBX-M vessel and small saddle coil*

General Design Criteria/Parameters

Parameter	Value	Units	Comments
No. of field periods - m	~2 to 4		
Aspect ratio	~3 to 4		
Major radius, R0	1.05 - 1.85	m	allows 30 cm to vessel wall
Minor radius, a	~ .3 to .6	m	
Plasma Current	0.4	MA	
Toroidal Field on Axis, B0			
from non-axisymmetric coils	~ 0	Tesla	QA coils have saddle geometry
from TF coils	1 to 2	Tesla	2.35T @ 1.49m max available
Pulse Length	3 to 5	seconds	limited by PBX coils
Rep rate	tbd	seconds	
Auxilliary heating power	12	MW	PBX NBI limited to.5 sec pulse

Saddle Coil Design Criteria / Parameters

Parameter	Value	Units	Comments
No. of coils	28		2 field period coil set
Current per coil	60-70	kA-turns	
Min no. of turns per coil, pulsed	tbd		Constrained by field errors, power supply
Maximum Current/turn	tbd	kA	Constrained by power supply
Coil to coil spacing, minimum	~ 3	cm	From winding centers
Coil to plasma spacing	20	cm	From winding centers
Accuracy of winding	+/- 0.5	mm	Equivalent to +/- .5% at R0

Features

- All coils are wound in place from flexible copper conductor
- Coil set is supported from radial ribs
- Coils must be canned for vacuum compatibility and vacuum pressure impregnation
- Structure must have insulating breaks to avoid toroidal current path

Mockup status

- Wooden mockup of PBX-M vacuum vessel and structure
- Modular design includes 90 degree sector with
  - vessel envelope
  - 16 x 40 inch access port
  - I-beam structures
- Provisions are included for adding
  - radial support ribs
  - coil troughs
  - coil windings
  - etc.
- Mockup should be completed by Sept 25, cost is about $3k

Issues

- Coil geometry definition will be delayed past October 1, which delays investigation of outboard coil support system, field errors, force calculations, etc.

- Coil fabrication inside vacuum vessel is still not a foregone conclusion, although progress has been made

- Vacuum liner concept shows promise, but requirement tradeoffs must be made

- FY 99 engineering budget is reduced somewhat from original plan

  - CDR schedule will not slip
  - Scope of CDR will be less detailed than original plan
  - R&D must slip until at least FY00

What next?

- From now until coil geometry becomes more clear (mid-October)
    - Continue to develop tools
    - Continue to examine options for coil and liner fabrication and assembly
    - Perform inexpensive R&D, continue dialog with cable vendors
    - Develop methodology for cost vs requirements tradeoff
- After coil set becomes more clear, prior to PVR
    - Create new Pro-E model of coil set, liner, structure
    - Perform cost vs requirements tradeoff
- Between PVR and CDR
    - Develop CDR baseline design
    - Develop bottoms up cost estimate and schedule