Physics Preparation for CDR & Coil Design

M.C. Zarnstorff

16 October 2001
NCSX Project Meeting

Physics Preparation for CDR

- Finish Coil and Vessel design (see next page)
- Device Requirements finalized 27 Nov
  - General requirements (emailed, comments by 17 Oct)
  - WBS requirements, discussions & reviews through Oct/Nov
- Resolve PVR Issues Draft 15 Mar
  - E.g., Develop diagnostics plan, neutrals analysis
- Revise PVR document for CDR design Draft 15 Mar
  - Including PVR Issue analysis

Critical Connections for Engineering

- Finish Engineering CDR coil design — 31 Oct.
  - → Finalize modular coil design
    Buildable and good physics properties
  - → Adequate VV clearance for edge design and upgrades
    - √ Design PF coils
  - → Island heal if possible

- Finalize trim coil requirements — 12 Nov
- S1, S2, S3 for CDR coils — 14 Nov
- Choose initial first wall contour for control of exhaust — 28 Nov
- Flexibility space characterization for CDR coils — 15 Feb
- Island heal (if not previously) — 15 Feb

List of anticipated research topics for the different phases of NCSX operation v0.2

Phase	Topic	Aux Power
1. Initial Operation	initiate plasma control plasma evolution	
2. Field Line Mapping	map flux surfaces verify iota and QA	
3. Initial Ohmic	Improved plasma control, plasma evolution control global confinement & scaling, effect of 3D shaping density limit & mechanisms study of Te and ne profiles. vertical stability current-driven kink stability effect of low-order rational surfaces on flux-surface topology initial study of effect of trim coils, both signs effect of contact location on plasma edge & recycling initial attempts to control plasma contact location	
4. Initial Aux. Heating	Plasma control with NB heating and CD confinement scaling w/ iota, B, … local transport measurements test of quasi-symmetry on confinement and transport perturbative transport measurements density limits with heating density control with aux. Heating test of kink & balooning stability at moderate beta effect of shaping on MHD stability pressure effects on surface quality controlled study of neoclassical tearing using trim coils use of trim coils to minimize rotation damping initial study of Alfvenic modes w/ NB ions blip measurements of fast ion confinement and slowing down wall coatings with aux. Heating effect of contact location on plasma edge & recycling initial attempts to control plasma contact location initial attempts to obtain enhance confinement regimes wall biasing effects on confinement	3MW NBI
5. Confinement & beta push	Stability tests at beta >~ 4% detailed study of beta limit scaling detailed studies of beta limiting mechanisms disruption-free operating region at high beta Enh. Conf.: Hmode Enhanced confinement, rotation effects Enh. Conf.: hot ion regimes Enh. Conf.: RI mode	3MW NBI +

	Enh. Conf.: pellets Scaling of local transport and confinement turbulence studies scaling of power or other thresholds for enhanced confinement ICRF wave propagation and damping (possible) ICRF heating of ions and electrons (possible) perturbative RF measurements of transport (possible) active mapping of Alfvenic mode stability (with antenna) edge studies (2nd generation wall, e.g. divertor) trace helium exhaust and confinement scaling of power to divertor evolution control of high beta plasmas	
6. Long Pulse	long pulse plasma evolution control equilibration of current profile beta limits with ~ equilibrated profiles edge studies (3nd generation wall) long-pulse power and particle exhaust handling compatibility of high confinement, high beta, and divertor operation	long-pulse

Modular Coil Design

Parallel Design Approaches

- Coilopt designs (D. Strickler)
- Hand modified designs (D. Williamson)
- Merged Coilopt/Stellopt

- Healing of resonant field to eliminate Islands (S. Hudson)

Analysis of Designs

- Engineering (D. Williamson)
- Physics (L-P. Ku)

Merged Coilopt/Stellopt Status

- Improved to allow targeting of coil/plasma separation

- Runs are extremely slow
  - Large number of free parameters (300 – 400 !!)
  - Contention for hecate & seaborg, loss of nirvana
  - Appears to make v. slow progress, perhaps due to redundancy in coil representation, or perhaps due to deep minima
  - ~ 1 day turn around per run

- Have (partially) completed a few runs
  - starting from 0918a14, so far
  - can improve both physics and engineering parameters, modestly
  - have not evaluated fully (LPK) to compare to free-boundary optimizations
  - have not been able to get to coil-separations and curvatures similar to hand modified design