

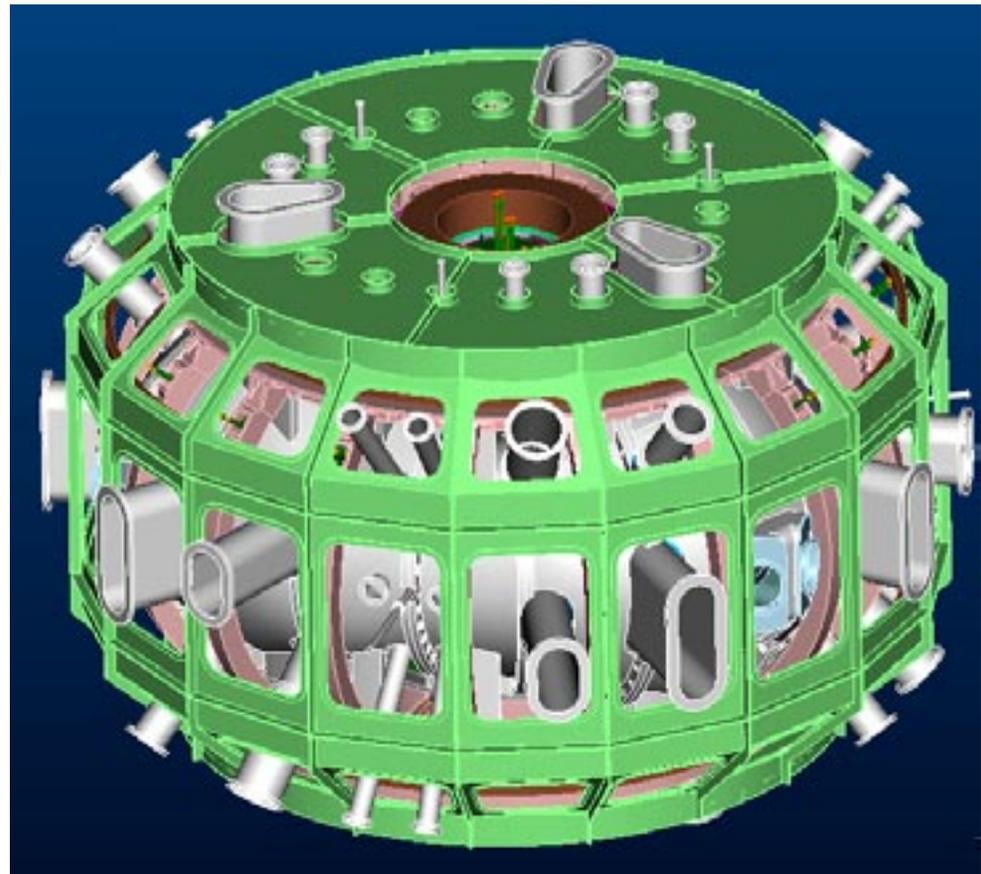
NCSX Research Program and Diagnostic Plan

(continued)

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March 28, 2002

New Conformal Cryostat Design Provides Flexibility for Diagnostics

- Small panels (not shown) can be custom-fitted to facilitate diagnostic access
- Vacuum interface boundary can be made reentrant into cryostat perimeter



NCSX Research will Proceed in Phases

Currently envisioned as:

- Initial operation - shake down systems
- Field Line Mapping
- Ohmic
- Auxiliary Heating - (3MW NBI)
- Confinement and Beta Push - (~6 MW)
- Long Pulse

(included in project cost-TPC)

Checkout Phases

1. Initial Operation

- initiate plasma: exercise coil set plasma current
Ip >25 kA
checkout vacuum diagnostics
checkout magnetic diagnostics
initial wall conditioning
- conductivity
plasma position
total stored energy
line integrated density
plasma/wall imaging
- plasma current Rogowskis
flux loops
saddle loops
B-dot probes
diamagnetic loop
fast visible cameras
1 mm interferometer

2. Field Line Mapping

- map flux surfaces
verify iota and QA
- vacuum flux surfaces
variable energy trace particles
- e-beam probe
fluorescent rod probe
high dynamic range CCD

3. Ohmic

- initial plasma control, plasma evolution control
- global confinement & scaling, effect of 3D shaping
density limit & mechanisms
study of T_e and n_e profiles.
- vertical stability
current-driven kink stability
effect of low-order rat. surf. 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

electron density profiles
electron temperature profiles
radiated power profiles
low (m,n) MHD (<50kHz)
flux surface topology
impurity species
impurity concentration
Zeff
hydrogen recycling

multichord FIR interf./ polarim.
Thomson scattering
core foil bolometer array
compact SXR arrays
visible spectrometer
abs. UV spectroscopy
filtered 1D CCD camera
moveable Langmuir probe

4. Auxiliary Heating

- plasma control with NB heating and CD
- test of kink & ballooning stability at moderate beta
 - effect of shaping on MHD stability
 - initial study of Alfvénic modes w/ NB ions
- confinement scaling w/ ι , B, ...
 - local transport measurements, perturb. meas.
- test of quasi-symmetry on confinement and transport
- density limits and control with heating
 - use of trim coils to minimize rotation damping
 - blip measurements of fast ion conf. and slowing down
 - initial attempts to obtain enhanced confinement regimes
- pressure effects on surface quality
 - controlled study of neoclassical tearing using trim coils
- wall coatings with aux. heating
- edge and exhaust charact. with aux. heating
- attempts to control wall neutral influx
 - wall biasing effects on confinement

ion temperature profile
toroidal rotation profile
poloidal rotation profile
 ι profile
fast ion loss
ion energy distribution
neutron flux
IR imaging
high frequency MHD(<5MHz)

diagnostic neutral beam
toroidal CHERS
poloidal CHERS
MSE polarimeter
fast ion loss probe
neutral particle analyser
epithermal neutron detector
high frequency Mirnov coils
compact IR cameras
neutral pressure gauges
fast tang. x-ray pinhole camera
enhanced x-ray tomography
fast scanning edge probe

5. Confinement and beta push

- stability tests at beta $> \sim 4\%$
- detailed study of beta limit scaling
- detailed studies of beta limiting mechanisms
 - disruption-free operating region at high beta
 - active mapping of Alfvénic mode stability (with antenna)
 - enh. conf.: H-mode, hot ion modes, RI mode, pellets
- enhanced confinement, rotation effects
- scaling of local transport and confinement
 - turbulence studies
 - scaling of power or other thresholds for enh. conf.
 - ICRF wave propagation and damping (possible)
 - perturbative RF measurements of transport (possible)
- divertor operation optimized for power handling
 - trace helium exhaust and confinement
 - scaling of power to divertor
- control of high beta plasmas and their evolution

radial electric field
edge/div. radiated power profile
core helium density

divertor foil bolometer arrays
divertor filtered CCD cameras
fast IR camera
He CHERS system (with DNB)
plate mounted Langmuir probes
divertor thermocouples
divertor UV spectroscopy
fluctuation diagnostics TBD

6. Long Pulse

long pulse plasma evolution control

equilibration of current profile

beta limits with \sim equilibrated profiles

edge studies (3rd generation wall)

long-pulse power and particle exhaust w/ div. pumping

compatibility of high conf., high beta, and div. ops

more detailed divertor profiles divertor Thomson scattering

divertor diagnostics (TBD)