

**NCSX Startup (WBS 85)**

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|  | SC Project Review of NCSX, April 8-10, 2008
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*NCSX CD-4 Startup*

**NCSX Startup**



* WBS 85 Objective = Safely bring NCSX on-line

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* Concerns = People Safety, Environmental Safety, Machine Safety
* WBS 85 has two main components = Documentation + Safe Startup
* Startup Strategy = 10 week Startup Plan w/ First Plasma @ week 7
* Startup Documentation = Slides 7 & 8
* Startup Staffing and Positions = Slide 9
* Basis of Startup cost & staffing requirements = TFTR (during D-T transition),

NSTX

* Risks and Mitigation = Slide 10
* Strong emphasis on pre-operational system testing and Activity Certification

Committee (ACC) reviews. ACC is an independent cognizant group made up of

PPPL and PSO membership. ACC performs detailed technical reviews including

physical walk-down of reviewed system(s). Successfully implemented during NSTX startup.

**What Startup Will Demonstrate**



**\*** Ohmically heated (first) plasma

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- 1.4 m major radius

- > 0.5 T magnetic field

-> 25 kA plasma current

- coils operated at cryogenic temperatures

- modular coils operated at 12 kA

- TF coils operated at 2 kA

-PF coils operated at 3 kA

-PF5 & PF6 operated at 2 kA

- central solenoid operated at 12 kA

- ability to maintain high vacuum in vv

- ability to bake at 150 C

- ability to perform (multiple) e-beam (surface) mapping

***\**** *see Hutch Neilson presentation for additional startup parameters*

**WBS 85 Schedule - 1**



ISTP

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Subsystem PTPs

Walk down of NCSX by

Construction Manager & Startup

Test Director

Items NCSX Transferred to Test

Director

Close out

Punch List

Subsystem PTPs Complete

NCSX Construction Complete

NCSX Operations

Issuance of Amended Safety

Certificate

Commence e-beam Mapping

**First Plasma**

**Startup Activities

Commence**

Commence Coil ISTP

Cryostat Filled

NCSX Configured for

Operational Control

ES&H Executive Safety Board

Approval

Issuance of a Limited Safety

Certificate for First Plasma & e-

beam mapping

ORA Review & ACC Review and

Walkdown



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**Startup Flow Chart**

**Documentation needed for Startup**



* NCSX Safety Assessment Document ( SAD)

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* NCSX Integrated System Test Procedure (ISTP)
* Completed (sub-system) Pre-operational Test

Procedures (PTP)

* NCSX Configuration and Interface Control Procedures
* NCSX Training Matrix
* First Plasma sub-system support procedures

Torus VV pumpdown, cryo operations, search & secure

procedures, power system procedures, coil operating

procedures, bakeout procedures, control system

procedures.

**Startup Documentation Effort**



• Documentation Costs = $345 K

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- Documentation Development Team

- Engineer @ 28.5 weeks ( 1140 hours )

- Senior Lab & Shop @ 28.5 week ( 1140 hours )

- Total for documentation development = 2280 hours

- Equivalent ~ 1.10 person years of effort

**Startup Staffing and Positions**



• Startup Team costs = $ 450 K

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- (1) Test Director = 10 weeks @ 100 % FTE

- (1) Chief Operations Engineer = 10 weeks @ 85 % FTE

1. Project Engineer = 10 weeks @ 75 % FTE
2. Machine Technicians = 10 weeks @ 85 % FTE

- (1) FCPC Technician = 10 weeks @ 75 % FTE

- (1) Cryo System Technician = 10 weeks @ 75 % FTE

- (1) AC Power Engineer = 10 weeks @ 75 % FTE

- (1) Computer Engineer = 10 weeks @ 75 % FTE

- Total Startup hours = 2720 hours

- Equivalent ~ 1.3 person years of effort to safely startup NCSX

**Risks & Mitigation**



* Incorrectly connecting power supply to coil leads -

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Coil leads to be clearly designated prior to startup,

low power compass test.

* Ground Faults - Check for ground fault conditions

during assembly (pre-startup) to mitigate impact on

startup.

* Loop Faults - Check for loop faults during assembly

(pre-startup).

* Control System - Pre-test wave forms and clock

cycles to ensure control system operation.

* Loss of sub-system components (i.e., pumps ) -

repair / replace.

**Conclusion**



* Based on the startup of similar machines at PPPL NCSX

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startup requirements are understood. Good experience

base and support for e-beam mapping from colleagues at

ORNL, UW, Auburn.

* NCSX startup concerns are mostly about safety (people,

environment, machine).

* Success of startup the result of prerequisite PTP’s, ACC

reviews, ES&H Executive Safety Board review, safety

certificate issuance, closing out post construction punch

list items.

* Completion of NCSX ISTP will transition the machine

from startup to operational.