NCSX Project Work Breakdown Structure (WBS) Dictionary
Central Controls and Computing (WBS 5)
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Work Breakdown Structure (WBS) Dictionary
Central Controls and Computing (WBS 5)

Record of Revisions

Revision	Date	Author	Description
0	9/8/2003	Simmons	Initial issue
1	2/17/2004	Simmons	Updated WBS dictionary to delete technical requirements and reflect CD-2 milestone scope.
2	7/2/2007	Simmons	Updated WBS to Reflect Scope for 2007 Rebaseline.

Work Breakdown Structure (WBS) Dictionary
Central Controls and Computing (WBS 5)

WBS Element: 5	**WBS Level: 2**
WBS Title:	**Central Controls and Computing**
Description:	Central Controls and Computing (WBS 5) will provide integrated control and monitoring, diagnostic data acquisition and data management, and timing and synchronization for NCSX. This summary-level WBS element consists of the equipment and software that provide central computing, control, and synchronization for NCSX. These systems interface with the subsystem's local I&C systems and allow for control and monitoring of NCSX experiments from the control room and includes analysis and display of the data. The systems covered under this WBS elements include: • Network & Fiber Infrastructure Systems (WBS 51); • Central Instrumentation and Control Systems (WBS 52); • Data Acquisition and Facility Computing Systems (WBS 53); • Facility Timing and Synchronization Systems (WBS 54); • Real Time Control Systems (WBS 55); • Central Safety & Interlock Systems (WBS 56); • Control Room Facility (WBS 57); and • Management and Integration (WBS 58). **MIE Project Scope:** Defined in lower-level WBS elements. In general the central facility I&C systems and capabilities will be limited to those only needed to satisfy CD-4 requirements. **Future Scope:** Future central facility I&C and data acquisition systems and capabilities will be added as the capabilities of the NCSX Project are expanded.

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WBS Element: 51	**WBS Level: 3**
WBS Title:	**Network and Fiber Optic Infrastructure**
Description:	The Network & Fiber Infrastructure Systems will provide the common backbone for all data acquisition, and I&C communications. These systems shall be designed to meet the following basic requirements: • Network Communications for critical and high-energy subsystems are required to be protected from intrusion from the local PPPL network and the wide area. • Network Communications for critical protective systems will be implemented with dual power supply switches fed from house and UPS sources. • The network is required to operate in a high noise environment close to the machine and its power sources. • Isolation of diagnostic data acquisition network traffic and the facility subsystems network traffic is required to insure that high data load will not impact facility control and monitoring. • A fiber optic facility will be required for the Timing and Synchronization System, diagnostic video cameras and real time plasma control system communications. • The network infrastructure will be implemented with fiber optic cable, twisted-pair cable, and wireless communications as appropriate for the application. **MIE Project Scope:** Where appropriate, the PPPL's existing infrastructure will be used to provide network connections to CD-4 subsystems. Additional infrastructure will be added as needed. **Future Scope:** Additional infrastructure will be added as additional capabilities are added to the NCSX Project.

WBS Element: 52	**WBS Level: 3**
WBS Title:	**Central Instrumentation and Control**
Description:	The Central Instrumentation and Control system (CI&C) will provide integrated control of NCSX through supervisory control and a common user interface to selected engineering subsystems and diagnostics instruments. It will provide process control and monitoring functions, inter-process synchronization, operator displays, alarm management, and historical trending,. It will be designed using the Experimental Physics and Industrial Control System (EPICS). **MIE Project Scope:** The EPICS infrastructure for the NCSX Fabrication Project will provide an interface with the following systems: • WBS 23 First Wall Conditioning Thermocouples and Strain Gauges; and • Other WBS 5 elements. **Future Scope:** Additional central I&C systems will be added as additional capabilities are added to the NCSX Project.

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WBS Element: 53	**WBS Level: 3**
WBS Title:	**Data Acquisition and Facility Computing**
Description:	The diagnostic Data Acquisition and Facility Computing systems will provide a software structure to collect, catalog, and manage experimental results for analysis and subsequent retrieval. The design will use the MIT-developed MDSplus software for data acquisition, data archiving and display. This system will: • Be a "shot" mode time system where initialization sequences are started before the experimental discharge and data archival is completed at some period after the discharge. • Support "shots" dedicated to an individual system's test or calibration function. • Achieve high performance and fault tolerance by storing all experimental data on reliable storage units. • Provide online access, for the life of the machine, all experimental data. • Support software interfaces to EPICS software (WBS51). **MIE Project Scope:** There is relatively a small amount of storage needs for the CD-4 milestone. Therefore, the NSTX Data Acquisition and Storage equipment will be used as much as possible. **Future Scope:** NCSX data will be transferred to the NCSX-specific system in the future.

WBS Element: 54	**WBS Level: 3**
WBS Title:	**Facility Timing and Synchronization**
Description:	The Facility Timing and Synchronization System will support at least 64 hardware events to synchronize NCSX equipment and diagnostics with the NCSX shot cycle. The events will be distributed using a network of fiber optic and hardwired components. These systems will utilize a new PPPL-developed timing and synchronization system. The new system will use a 10 MHZ time base. To coordinate computer programs across the NCSX networks, this WBS will have a software interface with the NCSX software event systems used for WBS 52 and WBS 53. **MIE Project Scope:** Provide a timing & synchronization system sufficient to synchronize the equipment and computers used for achieving the MIE Project requirements. **Future Scope:** Additional facility timing and synchronizations systems/capabilities will be added as needed.

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WBS Element: 55	WBS Level: 3
WBS Title:	**Real Time Plasma and Power Supply Control**
Description:	The real time control systems will provide real time control for the NCSX power supplies (WBS4) and the main gas injectors (WBS2). **MIE Project Scope:** Provide a PC-oriented, LabVIEW-like system to produce synchronized, open-loop power supply commands and gas injection commands. The system will also control a few gas delivery valves. **Future Scope:** Additional real time plasma and power supply control systems/capabilities will be added as needed.

WBS Element: 56	WBS Level: 3
WBS Title:	**Central Safety and Interlock System**
Description:	The Central Safety and Interlock System (CSIS) will provide experiment-wide coordination of personnel and hardware interlocks. The fail-safe system will be constructed from mechanical components, hardwired devices, and safety-rated programmable/electronic components, networks, and software. Each NCSX high-energy subsystem will interface with the CSIS. An access control system will be incorporated to grant access to (hazardous) experimental areas for only authorized/trained personnel, when those areas are safe. UPS and Standby power will be used for critical components. **MIE Project Scope:** Provide a limited CSIS, sufficient to achieve safe operation of the NCSX device. **Future Scope:** Additional central safety and interlock systems/capabilities will be added as needed.

WBS Element: 57	WBS Level: 3
WBS Title:	**Control Room Facility**
Description:	**MIE Project Scope:** None. NCSX will utilize the old PBX-M control room and DAS computer rooms, and the basic refurbishment of these facilities is covered by PPPL infrastructure improvement project funds. Other WBS 5 elements will use the NCSX Control Room and NCSX Computing Center to the limited degree necessary for the MIE.

WBS Element: 58	WBS Level: 3
WBS Title:	**Management and Integration**
Description:	**MIE Project Scope:** Planning and interface definition for Central Controls and Computing systems.