NCSX Fabrication Project

Work Breakdown Structure (WBS) Dictionary

Central I&C Systems (WBS 5)

Revision 0

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Work Breakdown Structure (WBS) Dictionary
Central I&C Systems (WBS 5)

WBS Element: 5	**WBS Level: 2**
WBS Title:	**Central I&C Systems**
Description:	NCSX operations are divided into six phases: 1. Initial Operation 2. Field Line Mapping 3. Initial Ohmic 4. Initial Auxiliary Heating 5. Confinement and Beta Push 6. Long Pulse The NCSX Construction Project includes Central I&C capabilities required through the Field Line Mapping Phase of operation (that is, Phases 1 and 2). All equipment in the Construction Project will be installed prior to first plasma (that is, the start of Phase 1 – Initial Operation). Included in the Construction Project are all the engineering and physics design efforts starting with the preliminary design phase (Title I) and ending with completion of the Construction Project, all the necessary Research and Development (R&D) to support the design effort, all component fabrication, assembly, and installation activities, and all system level commissioning and testing. Integrated systems testing of the entire NCSX device is covered in Integrated Systems Testing (WBS 76). This summary-level WBS element consists of the central instrumentation and control (I&C) systems that provide the central supervisory control and data handling systems for NCSX. These systems interface with the subsystem local I&C systems and allow for control and monitoring of NCSX experiments from the control room (local or remote) and the analysis of the results. The central I&C systems covered under this WBS elements include: • TCP/IP Infrastructure Systems (WBS 51), • Central Instrumentation and Control Systems (WBS 52), • Data Acquisition & Facility Computing Systems (WBS 53), • Facility Timing and Synchronization Systems (WBS 54), • Real Time Control Systems (WBS 55), • Central Safety Interlock Systems (WBS 56), and • Control Room Facility (WBS 57)

NCSX WBS Dictionary
Central I&C Systems

WBS Element: 51	WBS Level: 3
WBS Title:	**TCP/IP Infrastructure Systems**
Description:	The TCP/IP network infrastructure will provide the common backbone for all data acquisition, and I&C communications. The network will consist of an extension of the NSTX Physics and Engineering networks. The Engineering network is behind a secure firewall. All cable and switch infrastructure will minimally support 10/100Mbps Ethernet and all uplinks will use the existing 1 Gigabit Ethernet infrastructure already in place for NSTX. The Test Cell Ethernet infrastructure will be implemented with fiber optic cable. 12 network drops in the test cell and control room will be deployed for Day One operations. The cost basis will assume current prices for 10 Mbps and 100Mbps Ethernet equipment. New switch port modules will be deployed in five locations: 1. D-Site FCPC 2. D-Site MG 3. C-Site S1 area 4. C-Site NCSX Control Room 5. PPLCC Two fiber optic distribution panels will be located in the Test Cell on each side of the machine. A fiber optic infrastructure consisting of 144 fibers between D-Site and C-Site RF building will be deployed for facility timing and synchronization, and real time data acquisition. 120 fiber optic cables for diagnostic and I&C requirements will be deployed between the control room and the test cell. A wireless Ethernet transceiver will be deployed in the test cell to aid in troubleshooting, and for use by collaborators.

WBS Element: 52	WBS Level: 3
WBS Title:	**Central Instrumentation and Control Systems**
Description:	The central process control system will provide supervisory control and a common user interface to all engineering subsystems and high-energy systems. It will provide the synchronization between two or more operating machines at PPPL using shared power conversion resources. It will support current and historical trending, alarm logging, mimic displays, machine state archival, and process control and monitoring functions for NCSX. It will be designed using the Experimental Physics and Industrial Control System (EPICS). The EPICS infrastructure for the following subsystems will be designed. Day One operations will include the required I/O for control and display pages for WBS 21 Fueling Systems, WBS 4 Magnet Power Systems, WBS 62 Water Systems and WBS 63 Cryogenic Systems. • WBS 21 Fueling Systems • WBS 22 Vacuum Pumping Systems • WBS 23 First Wall Conditioning Thermocouples for Bakeout, GDC • WBS 24 RF Heating Systems, ICH • WBS 25 Neutral Beam Heating Systems • WBS 42 Motor Generators • WBS 43 Magnet Power Systems • WBS 62 Water Systems • WBS 63 Cryogenic Systems

WBS Element: 53	WBS Level: 3
WBS Title:	**Data Acquisition & Facility Computing Systems**
Description:	The design will use the existing MIT developed MDSplus software for data acquisition, data archiving and display. Individual diagnostic local control and data acquisition hardware will be designed with standard PC architecture or in Compact PCI chassis. The work will include Day One support of Diagnostic Field Line Mapping with a maximum of 32 channels of Magnetics sensors. Two diagnostic operator interface units and two PCs/CPCI units with I/O channels as specified by WBS3 will be purchased and deployed for Day One operations. Legacy CAMAC will not be used in the design of the NCSX DAS. An additional facility compute server/cluster will be deployed for the data acquisition system. A tape library expandable to 0.5PB-1.0PB, and disk storage area network (RAID 5) will be deployed after the first year of operations. A standard Computer Interface Specification will be designed for use at PPPL and remote collaborators. The standard will be composed of a set of interfaces specifications to MDSplus, Timing Systems, Inter-process Communications (IPCS), and networking. This specification will insure a smooth integration of diagnostics and facility systems into the DAS. For example, the MDSplus specification will include interface specifications for Labview VIs, IDL functions, Visual Basic DLLs, COM objects, VC++ DLLs, Java, Fortran and EPICS.

WBS Element: 54	WBS Level: 3
WBS Title:	**Facility Timing and Synchronization Systems**
Description:	A new timing and synchronization technology is required for NCSX. The old CAMAC based TFTR Timing System, developed in the late 70's, with only a 1MHz time base will not be adequate for NCSX. A requirement for a 10 MHZ time base and an off-the-shelf or existing solution for NCSX is highly desirable. An internally developed Field Programmable Gate Array (FPGA) PCI design running at 10MHz will be deployed for NCSX. We will have two years of operational experience on NSTX with this system and will use the existing design for NCSX. Specifications: • Timing granularity of ~100ns • Overall accuracy +/- 1us with contention • 128 or greater event triggers • Fiber optic broadcast transmission This activity will provide the engineering design and test of a PCI clock encoder module and manpower to write driver software.

NCSX WBS Dictionary
Central I&C Systems

WBS Element: 55	WBS Level: 3
WBS Title:	**Real Time Plasma and Power Supply Control Systems**
Description:	Real Time Plasma Control System will share the system developed for NSTX. The NSTX system consists of a Sky Computer Inc. high-speed array processor with a Force Inc. host control computer, a real time data acquisition system and Front Panel Data Port communication links to remote digitizers. This work package will provide a new real time data acquisition system in the NCSX test cell. It will consist of ADCs, timing and clock interfaces, Digital I/O, and a communication interface to the existing NSTX processor. The real time software is divided into two functions, the power supply real time control system (PSRTC) and the plasma control system (PCS). The PSRTC will calculate the alpha control signal required by the power conversion firing generators. The alpha control signal is communicated to the power supply building via a custom designed fiber link, however a new interface may be in place in 2005. This signal is calculated using coil currents, machine state permissives, and fault conditions. The PCS will use the existing user-interface/data server software system developed at General Atomics. It consists of real time control category routines (i.e. gas, shape, position, etc.), a waveform manager, hooks to IDL user interface and internal messaging and lock management software. The Day 1 system will consist of a new software PSRTC to support NCSX requirements. It will include 64 channels of remote digitizers for magnetics sensors in the test cell, Systran FiberExtreem Fiber Channel communications links providing real time data transfer between the two voltage classes in the Test Cell and Power Supply building. The PCS infrastructure will be available for limited plasma control on Day 1, however, the system will be capable of expansion to several hundred real time signals.

WBS Element: 56	WBS Level: 3
WBS Title:	**Central Safety Interlock Systems**
Description:	The Central Safety Interlock System will provide system-wide coordination of personnel and hardware interlocks. Its primary man machine interface will be EPICS. The Central Safety Interlock System will be a fail-safe, hybrid system. Mechanical components and hardwired devices will provide primary protective functions. Each NCSX high-energy subsystem will interface with the Central Safety Interlock System. A badge reader access control system will restrict access to the Test Cell for only authorized/trained personnel. UPS and Standby power will power critical components.

WBS Element: 57	WBS Level: 3
WBS Title:	**Control Room Facility**
Description:	The PLT and PBX control room area is approximately 2400 sq. ft. and will be used for Day-One operations of NCSX. Approximately 1200 sq. ft. of the contiguous PLT DAS computer area will be integrated with the main control room area to support PPPL physicists, engineers and visiting collaborators in future years of operation. WBS57 will be responsible for the following facilities: • Installation of 4 dual workstation tables wired for network and power. • Installation of 6-12 equipment racks wired for network and power. • Test Cell PA system • Diagnostic machine microphones data included in MDSplus tree • Wireless Ethernet to support visitors and laptop computers