

TO: A. vonHalle
FROM: P. Sichta

SUBJECT: Closeout note for Central Instrumentation and Control, Job 5201

Date: July 23, 2008

Scope

- Like NSTX, will use the EPICS software.
- Supervisory and integrated control of NCSX engineering subsystems and diagnostics.
- System provides data trending, alarm logging, operator displays, and integrated process control and monitoring functions for NCSX.
- NCSX Test Cell audio and video support.

Status

- This job has completed the CDR phase, but awaits a PDR based upon the approved workscope.

Interfaces

WBS52 will ultimately interface with most NCSX subsystems. For MIE it will be limited to a few, depending upon the approved workscope.

Specifications

An SDD and Data Dictionary have been completed and are on the NCSX website.

Schematics and PIDs

none.

Models

none.

Drawings

none.

Analyses

none.

Testing

none.

Costs

Costs are posted on the NCSX website.

Remaining Work

- PDR, FDR, Installation and test.

Lessons Learned:

none.

Conclusion:

Upon job resumption, review current technologies and proceed to PDR.

NCSX Candidate Process Control I/O Form Factor

P. Sichta

Rev 0: 19DEC00 REV 1:30JAN02

<i>Availability & EPICS Support</i>	Compact PCI	VME	PCI	Ethernet device	Fieldbus (ControlNET, CANbus, CANopen, etc...)
High-speed Digitizer (5 MHz)	✓	✓✓	✓		
Med-speed Digitizer (100 KHz)	✓	✓✓	✓		
Low-speed Digitizer (10 KHz)	✓	✓✓	✓		
Scanning Analog Input	✓	✓✓	✓	✓	✓✓
Analog Output	✓	✓✓	✓	✓	✓✓
Digital Input Digital Output	✓	✓✓	✓	✓	✓✓
Prog. Timed Gate	✓	✓✓	✓	✓	✓

✓ = Product currently available

✓✓ = EPICS support currently available

NCSX Candidate Process Control I/O Form Factor

P. Sichta

Rev 0: 19DEC00 REV 1:30JAN02

Cost	CompactPCI	VME	PCI	Ethernet (Sixnet)	Fieldbus (G3/ControlNET)
4 SSH chans High-speed Digitizer (>5 MHz)	2,800(b)	4,400	1,300		
16 SSH chans Med-speed Digitizer(100 KHz)	3,000 (a)	6,000			
16 SSH chans Low-speed Digitizer(10 KHz)		4,000	450		
16 chans Scanning A/D	450	500	400	800	1,600
8 chans Analog Output	900	1,000	900	1,600	700
16 bits Digital Input	600	750	90	450	500
8 bits Digital Output	300	500	400	250	100
8 chans Prog. Timed Gate	800	1,600	500	600	500

Notes:

1) Costs are in \$US and only a representative figure. The cost excludes the supporting equipment, such as comm link interface, local processor, chassis, and power supply (supporting equipment listed separately).

2) Cost of communication cabling is excluded.

3) Cost of operating system and software and licenses are excluded.

a) \$2,995:Alphi Technology CPCI-AD8 opt-8:Dec2000,
\$3,295:General Stds CPCI-ADADIO:Dec2000.

b) ~\$2,800:Chase Scientific AD410-14-256K-CPCI:Dec2000.

NCSX Candidate Process Control I/O Form Factor

P. Sichta

Rev 0: 19DEC00 REV 1:30JAN02

<i>System Overhead</i>	CompactPCI	VME	PCI	Ethernet	Fieldbus (G3/ControlNET)
Local CPU	1,000	1,000	1,000		1,060
Chassis	1,500 (8 slots)	2,000 (12 slots)			130 (4 slots)
Power Supply	300	400		100	180
Other					Loop Driver = \$1,000/10 Loop i/f =\$220
Total Overhead	2,300	3,400	1,000	100	1,700

Notes:

- 1) Costs are in \$US and only a representative figure.
- 2) Cost of communication cabling is excluded.
- 3) Cost of operating system and software and licenses are excluded.

Central Controls and Computing

WBS51 & 52

P. Sichta

WBS5 Work Package Manager

Agenda



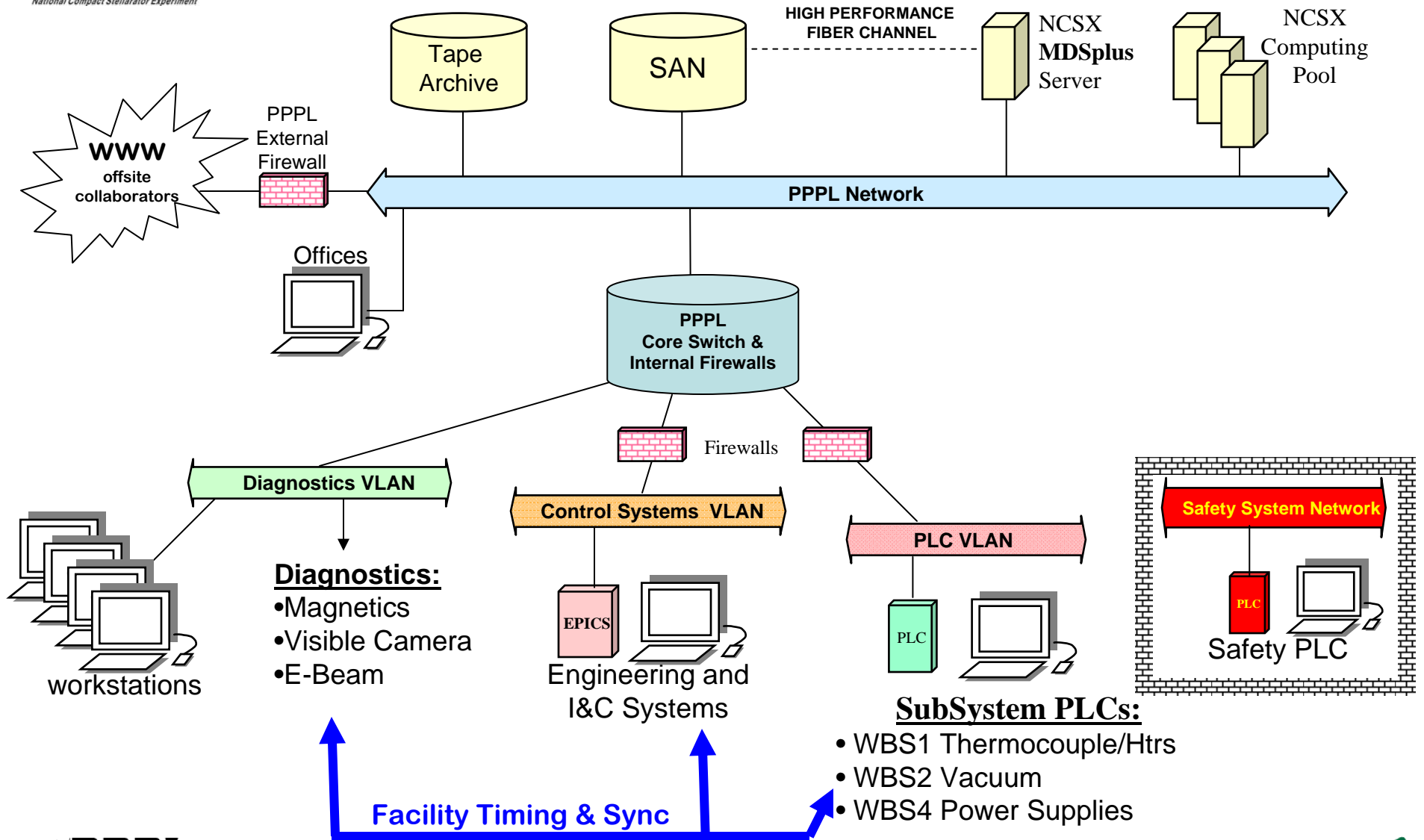
- Introduction
- Requirements and Interfaces
- Cost and schedule
- Risks and mitigation
- Responses to past review recommendations

Introduction

Central Controls and Computing will provide the equipment and services to support: 1) integrated and remote control; 2) data acquisition, analysis, and storage; 3) facility timing and synchronization; 4) central safety and interlocks.

- **Network and Fiber Optic Infrastructure (WBS 51)**
- **Central Instrumentation and Control (WBS 52)**
- **Data Acquisition and Facility Computing (WBS 53)**
- **Facility Timing and Synchronization (WBS 54)**
- **Real-Time Plasma and Power Supply Control (WBS 55)**
- **Central Safety and Interlock System (WBS 56)**
- **Management and Integration (WBS 58)**

NCSX Computing Overview



- Diagnostics:**
- Magnetics
 - Visible Camera
 - E-Beam

- SubSystem PLCs:**
- WBS1 Thermocouple/Htrs
 - WBS2 Vacuum
 - WBS4 Power Supplies



Requirements



- An *NCSX System Design Description* (SDD) was written in 2003, before CD-2. The primary elements of that design remain intact.
- My current estimate is derived from the SDD, ongoing technical discussions and design reviews, and recent experience with similar systems on NSTX.
- A **WBS5 System Requirements Document** (SRD, BSPEC) will be reviewed and approved prior to the *Preliminary Design Review* for each WBS5 element.
- Design Complexity & Maturity
 - Many of the technologies for WBS5/NCSX are currently in use on NSTX, so complexity is low for our experienced staff.
 - The *current workscope* has completed neither **Preliminary** nor **Final design**, so the maturity is medium.

CD-4 Interface List



WBS51 Network & Fiber Optic	WBS1 Thermocouple/Heater Local I&C WBS2 Vacuum/Fueling Systems WBS3 Diagnostics WBS4 Power Systems
WBS52 Central I&C	WBS1 Thermocouple/Heater Local I&C WBS2 Vacuum/Fueling Systems WBS4 Power Systems
WBS53 Data Acquisition and Management	WBS1 Thermocouple Local I&C WBS2 Vacuum/Fueling Systems WBS3 Diagnostics WBS4 Power Systems
WBS54 Timing & Synchronization	WBS3 Diagnostics WBS4 Power Systems
WBS55 Real-Time Control	WBS2 Vacuum/Fueling Systems WBS4 Power Supply Control
WBS56 Central Safety and Interlocks	Access Control: WBS4 Power System Areas, WBS7 Test Cell. SubSystem Interlocks: WBS4 Power Systems. NCSX (Global) E-Stop.

Basis of Estimate



- Labor:
 - referenced actual engineering hours from FY97-99 for the NSTX first plasma.
 - experience with similar activities for NSTX.
 - ‘expert’ estimates (e.g. Erik Perry).

- M&S
 - recent purchase of parts for NSTX and other lab infrastructure projects.
 - catalog prices.
 - includes spares and service contracts.
 - selective use of NSTX equipment.

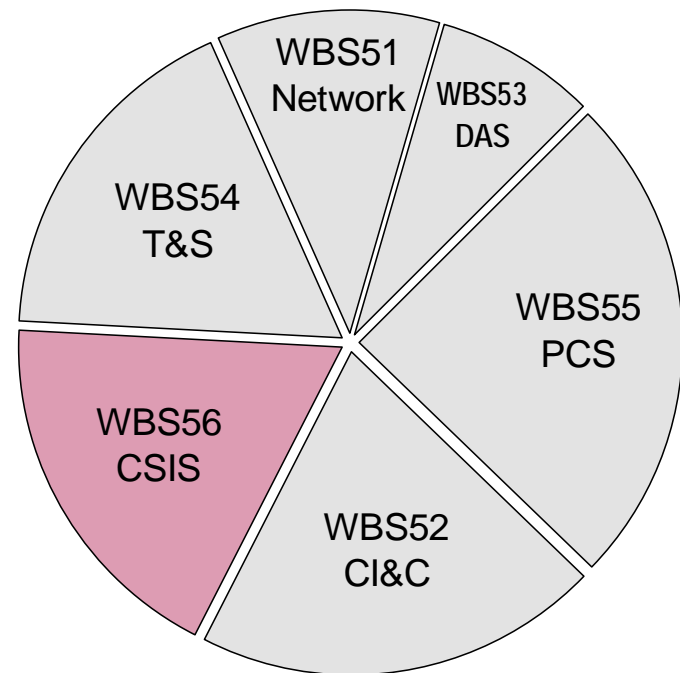
WBS5 Aggregate Cost

Reference *WAFs* for labor and M&S detail for WBS51-58.

http://ncsx.pppl.gov/Rebaseline/Rebaseline_index.htm

WBS5 ETC = \$ 2.1 M

Softwr/Elec Engineering: **3.6 years**
Elec/Mech/Draft Tech: **3.1 years**
'Materials & Services': **\$ 432 K**

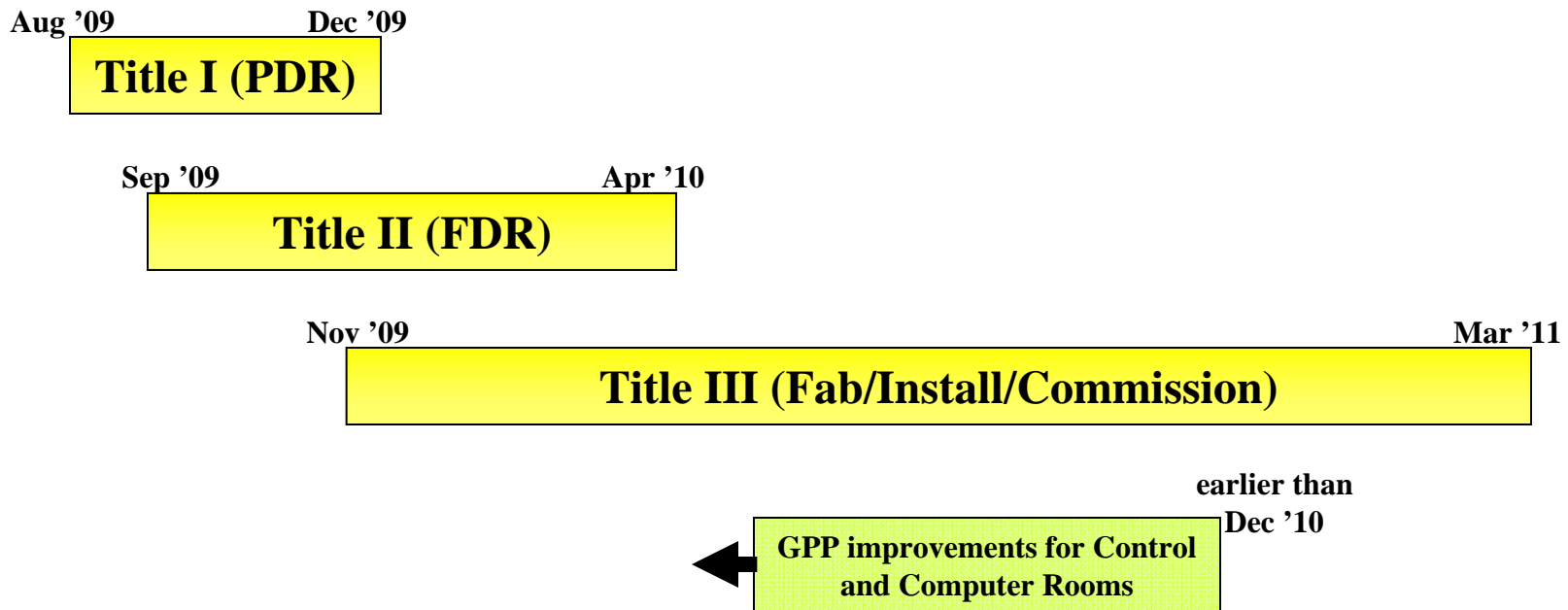


WBS51–WBS56 Aggregate Schedule



Reference *Resource Loaded Schedule* pages 53-56
for schedule detail for WBS51 – WBS58.

http://ncsx.pppl.gov/Reviews/FY08/BCP_2008/Docs/NCSX_RLS0403.pdf



Schedule (51,52)



Activity ID	MILE-STONE LEVEL	Activity Description	Duration (work days)	SHIFTS	Forecast Start	Forecast Finish	Total Float	Cost to Complete from 2/1/08	Fiscal Year						
									FY08	FY09	FY10	FY11	FY12	FY13	
453-1-5	FF	Coil Test	40		21JUN11	22AUG11	11	13,965.96							
453-1-6	Trim	Coil Coil Test	40		21JUN11	22AUG11	11	136,368.66							
453-1-8		Testing FTPs, ISTPs	40		21JUN11	22AUG11	11	159,275.76							
5 - Central I&C Systems															
51 - Network and Fiber Infrastructure															
Job: 5101 - Network and Fiber Infrastruct-SICHTA															
R51-10		Preliminary Design	30		01OCT09*	11NOV09	265	8,977.30							
R51-11		PDR	0			11NOV09	265	0.00							
R51-20		Final Design	60		12NOV09	17FEB10	265	11,919.00							
R51-21		FDR	0			17FEB10	265	0.00							
R51-30		Procurement	60		18JUN10*	13SEP10	180	95,270.68							
R51-50		Installation	80		14SEP10	13JAN11	180	97,809.22							
R51-60		Test	14		14JAN11	02FEB11	180	7,390.48							
52 - Central Instrumentation & Control															
Job: 5201 - I&C Systems-SICHTA															
R52-10		Preliminary Design-Infrastructure	20		03AUG09*	28AUG09	218	9,847.00							
R52-11		PDR	0			28AUG09	218	0.00							
R52-20		Final Design-Infrastructure	45		31AUG09	02NOV09	218	20,115.35							
R52-21		FDR	0			02NOV09	218	0.00							
R52-25		Preliminary Design-Subsystems	50		03NOV09*	25JAN10	256	5,754.80							
R52-27		Final Design-Subsystems	50		26JAN10	05APR10	256	21,644.80							
R52-30		Procurement	65		03NOV09	15FEB10	291	100,681.80							
R52-40		EPICS Programming - Base	40		03NOV09*	11JAN10	218	11,509.60							
R52-50		EPICS Programming - VDCT db editor	40		03NOV09*	11JAN10	406	5,754.80							
R52-60		IOC Programming - MDSplus data & events	40		03NOV09*	11JAN10	406	17,264.40							
R52-70		OPC - EPICS/PLC Interface	40		12JAN10	08MAR10	218	25,507.20							
R52-80		Appl. Programming-T/C	148		09MAR10	05OCT10	218	35,716.41							
R52-90		Programming - misc.	90		09MAR10	14JUL10	276	20,141.80							
R52-100		Installation	90		30AUG10*	13JAN11	154	112,538.22							
R52-110		Test	40		14JAN11	10MAR11	154	25,140.72							

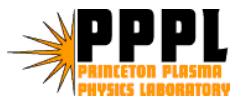


Schedule (58)



Activity ID	MILE -STONE LEVEL	Activity Description	Duration (work days)	SHIFTS	Forecast Start	Forecast Finish	Total Float	Cost to Complete from 2/1/08	FY					
									FY08	FY09	FY10	FY11	FY12	FY13
58 - Central I&C management and Integration														
Job: 5801 - Central I&C Integr& Oversight-SICHTA														
R58-20		WBS58 -FY08 Management & Integration LOE	250*		01OCT07A	30SEP08	1,521	14,454.84						
R58-30		WBS58 -FY09 Management & Integration LOE	249		01OCT08*	30SEP09	1,272	16,773.60						
R58-40		WBS58 -FY10 Management & Integration LOE	248		01OCT09*	30SEP10	1,024	17,264.40						
R58-50		WBS58 -FY10 Management & Integration LOE	248		01OCT10*	28SEP11	776	18,139.20						

5 - Facility Svstems



Risks and Mitigation



Reference *NCSX Risk Register* (page 2, item 'e') for WBS5 risks.

http://ncsx.pppl.gov/Reviews/FY08/BCP_2008/Docs/RR_Rev28a.pdf

Risk Description	Mitigation Plan	Likelihood	Consequence	Risk Ranking
Loss of staff with experience in specialized software will delay availability of Central I&C system.	Staff have recently been brought on board in anticipation of growing NCSX I&C needs. The planned shutdown of NSTX after FY10 will increase the availability of similar resources for NCSX.	VU	Marginal	Low

Response to Past Review Findings



1. Work with ES&H on Safety System Requirements and design basis.

- PPPL's *ES&H Directives Manual, section 2-5 "Personnel and Safety Interlock Systems"* is in the process of being updated.

2. Document Basis of Estimate

- A WBS5 notebook has been prepared to compile the design basis.
 - Copies of recent requisitions for similar equipment.
 - Catalog cut-sheets with prices.
 - Actual NSTX engineering-hours (labor) tabulation for first plasma.

Conclusion



The NCSX central controls and computing are **similar in both function and scale to NSTX**. The availability of a technically diverse and **experienced staff** provides confidence that the WBS5 work elements will effectively support the NCSX project's CD-4 objectives.