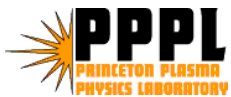# Central Controls and Computing

WBS5

P. Sichta

WBS5 Work Package Manager

Agenda

- Introduction

- Requirements and Interfaces

- Cost and schedule

- Risks and mitigation
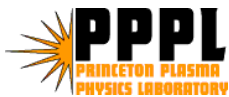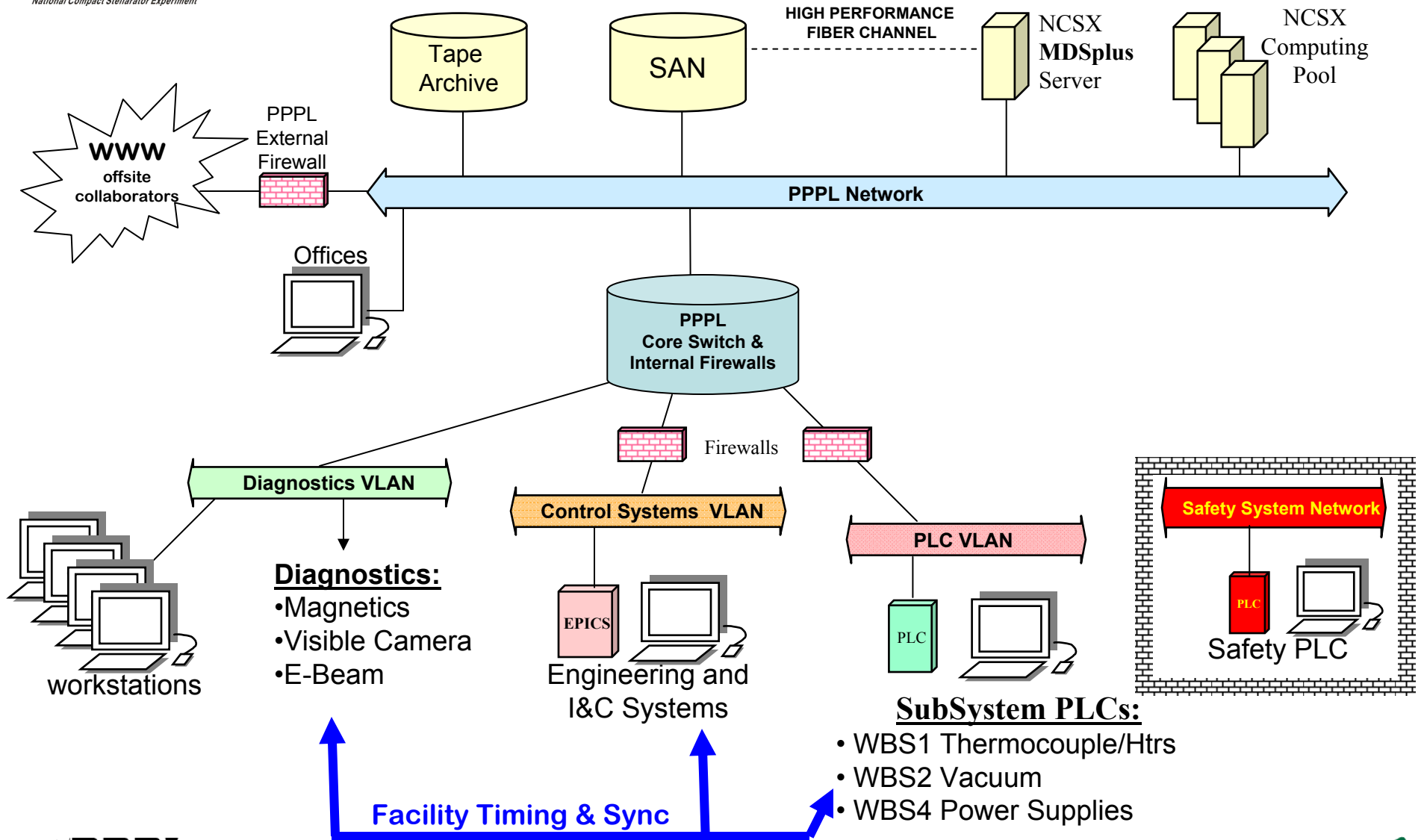
- Responses to past review recommendations

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

NCSX National Compact Stellarator Experiment

Tape Archive

SAN

HIGH PERFORMANCE FIBER CHANNEL

NCSX **MDSplus** Server

NCSX Computing Pool

WWW offsite collaborators

PPPL External Firewall

PPPL Network

Offices

PPPL Core Switch & Internal Firewalls

Firewalls

Diagnostics VLAN

Control Systems VLAN

PLC VLAN

Safety System Network

workstations

Diagnostics:
• Magnetics
• Visible Camera
• E-Beam

EPICS

Engineering and I&C Systems

PLC

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

PLC

Safety PLC

Facility Timing & Sync

PPPL PRINCETON PLASMA PHYSICS LABORATORY

ornl OAK RIDGE NATIONAL LABORATORY

4/1/2008 PS

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.
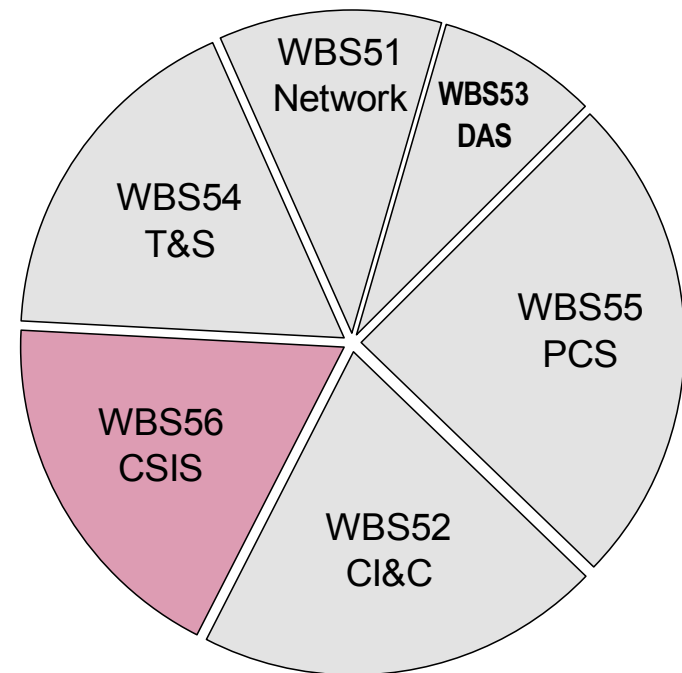   - selective use of NSTX equipment.

WBS5 Aggregate Cost

Reference *WAF*s for labor and M&S detail for WBS51-58.
http://ncsx.pppl.gov/Rebaseline/Rebaseline_index.htm

WBS5 ETC = $ **2.1** M
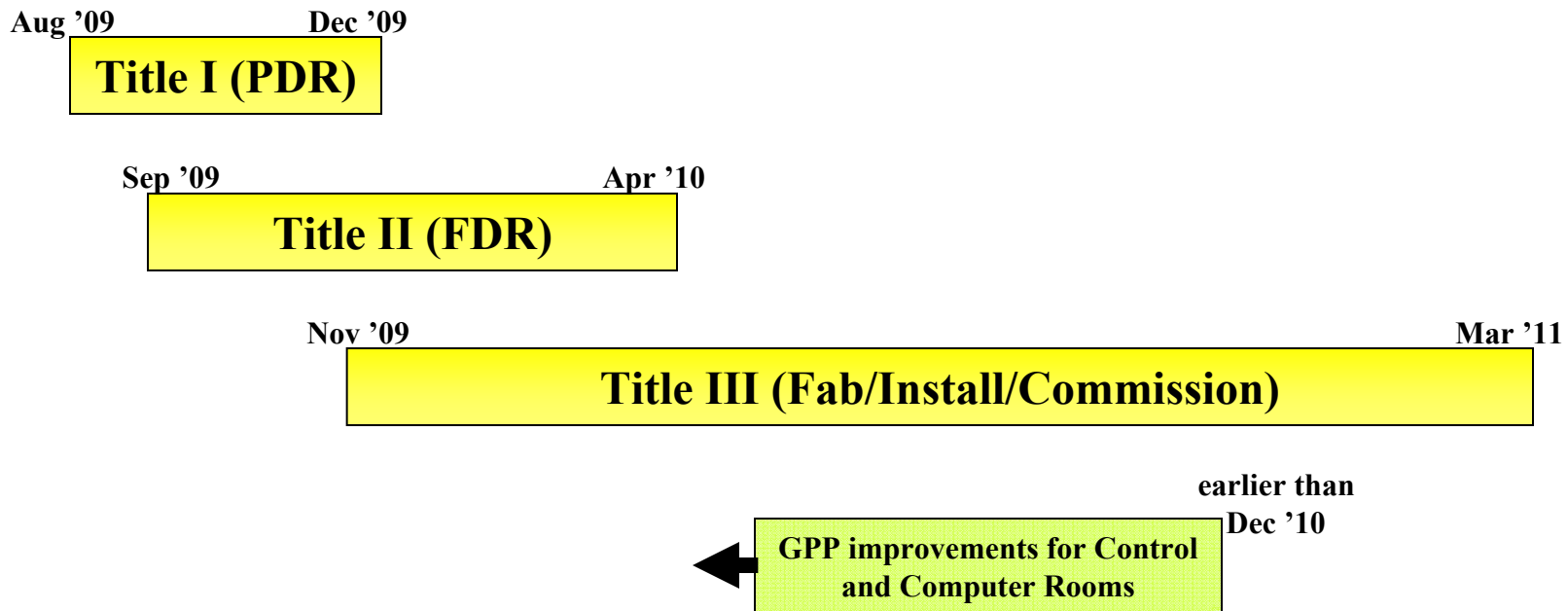
Softwr/Elec Engineering:	**3.6 years**
Elec/Mech/Draft Tech:	**3.1 years**
'Materials & Services':	**$ 432 K**

PPPL
PRINCETON PLASMA
PHYSICS LABORATORY

ornl
OAK RIDGE NATIONAL LABORATORY

# 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

Aug '09   Dec '09

Title I (PDR)

Sep '09   Apr '10

Title II (FDR)

Nov '09   Mar '11

Title III (Fab/Install/Commission)

earlier than
Dec '10

**GPP improvements for Control
and Computer Rooms**

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
453-1-5		PF Coil Test	40		27JUN11	22AUG11	11	13,965.06
453-1-6		Trim Coil Coil Test	40		27JUN11	22AUG11	11	136,368.68
453-1-8		Testing PTPs, ISTFs	40		27JUN11	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
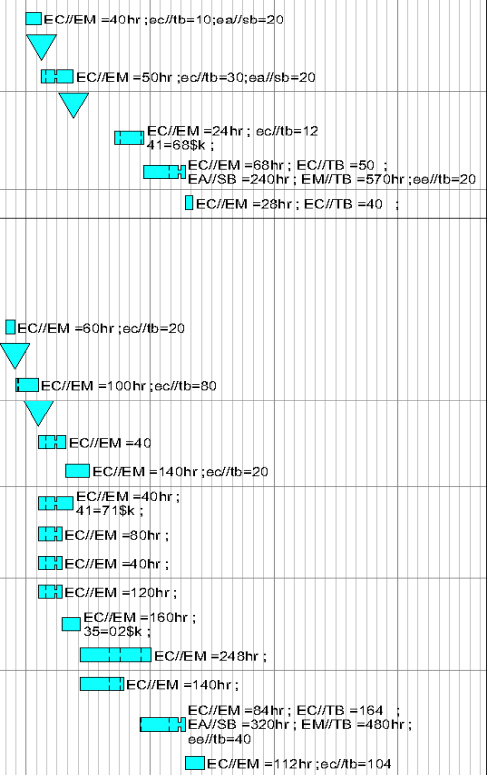
Schedule (53,54)

Activity ID	MILE-STONE LEVEL	Activity Description	Duration (work days)	SHIFTS	Forecast Start	Forecast Finish	Total Float	Cost to Complete from 2/1/08	FY08	FY09	FY10	FY11	FY12	FY13
53 - Data Acquisition & Facility Computing														
Job: 5301 - Data Acquisition-SICHTA														
R53-10		Preliminary Design	30		03AUG09*	14SEP09	182	5,591.20		EC//EM =40hr ;				
R53-11		PDR	0			14SEP09	182	0.00						
R53-20		Final Design	30		15SEP09	26OCT09	182	11,378.72		EC//EM =80hr ;				
R53-21		FDR	0			26OCT09	182	0.00						
R53-30		Procurement	30		27OCT09	09DEC09	182	32,291.40		EC//EM =20hr; 37=02 ; 41=$22k				
R53-40		Installation	30		10DEC09	01FEB10	182	3,006.00		EC//TB =40 ;				
R53-50		MDSplus Installation	20		02FEB10	01MAR10	182	11,509.60			EC//EM =80hr ;			
R53-60		MDSplus Programming - Tree Design	20		02MAR10	29MAR10	182	11,509.60			EC//EM =80hr;			
R53-70		MDSplus Programming - Shot Sync	20		30MAR10	26APR10	182	11,509.60			EC//EM =80hr ;			
R53-100		Applications Support (3 Diags)	60		27APR10	21JUL10	182	8,632.20			EC//EM =60hr ;			
R53-110		Programming - Misc.	60		27APR10	21JUL10	182	23,019.20			EC//EM =160hr ;			
R53-80		MDSplus Programming - Dispatcher	60		23AUG10*	15NOV10	160	23,641.28			EC//EM =160hr ;			
R53-90		MDSplus Programming - Acquisition	55		16NOV10	10FEB11	160	12,092.80				EC//EM =80hr ;		
R53-120		Test	14		11FEB11	02MAR11	160	12,227.60				EC//EM =60hr ; EC//TB =40 ;		
54 - Facility Timing & Synchronization														
Job: 5401 - Facility Timing & Synchron.-SICHTA														
R54-10		Preliminary System Design	30		02NOV09*	15DEC09	202	11,403.80		EC//EM =60hr ;ec//tb=4;ea//sb=20				
R54-11		PDR	0			15DEC09	202	0.00						
R54-20		Final SystemDesign	40		16DEC09	19FEB10	202	17,052.80		EC//EM =80hr ;ec//.tb=8;ea//sb=40				
R54-21		FDR	0			19FEB10	302	0.00						
R54-30		Preliminary Design - Clock Dist.	20		22FEB10	19MAR10	302	15,311.10			EC//EM =20hr ; EE//EM =70hr ;ec//tb=4			
R54-40		Final Design - Clock Dist.	30		22MAR10	30APR10	302	25,664.84			EC//EM =20hr ; EE//EM =128hr ;ec//tb=8			
R54-50		Test - Clock Dist.	40		29JUN10	24AUG10	262	42,142.08			EC//EM =24hr ; EE//EM =120hr ; EE//TB =200hr ;ec//tb=24			
R54-60		Procurement	90		22FEB10*	28JUN10	212	101,257.28			EC//EM =44hr ; 41=$71k			
R54-70		UNT - Timing & Seq Emulation (FPGA Pgm)	90		16DEC09*	30APR10	342	14,901.40			EC//EM =20hr ; EC//TB =160 ;			
R54-80		UNT - Device Driver Prog (EPICS/MDSplus)	120		19APR10	06OCT10	202	23,058.08			EC//EM =160hr ;			
R54-90		Central Clock (EPICS) Programming	30		07OCT10	17NOV10	202	12,092.80			EC//EM =80hr ;			
R54-100		Installation	90		30AUG10*	13JAN11	169	50,074.31			EC//EM =56hr ; EA//SB =40hr ; EC//TB =80 ; EM//TB =340hr ;			
R54-110		Test	25		14JAN11	17FEB11	169	45,340.80				EC//EM =80hr ; EC//TB =100 ; ee//tb=300		
55 - Real Time Plasma & Power Supply Control Sys														
Job: 5501 - Real Time Control System-SICHTA														
R55-10		FCPC - Preliminary Design	30		01OCT09*	11NOV09	209	20,611.52		EC//EM =80hr ;ea//sb=40;ee//em=24				

RB08 NCSX Project Sheet 54 of 71

Schedule (55,56)

Activity ID	MILE-STONE LEVEL	Activity Description	Duration (work days)	SHIFTS	Forecast Start	Forecast Finish	Total Float	Cost to Complete from 2/1/08
R54-110		Test	25		14JAN11	17FEB11	169	45,340.80

55 - Real Time Plasma & Power Supply Control Sys

Job: 5501 - Real Time Control System-SICHTA

Activity ID	MILE-STONE LEVEL	Activity Description	Duration (work days)	SHIFTS	Forecast Start	Forecast Finish	Total Float	Cost to Complete from 2/1/08
R55-11		PDR	0			11NOV09	209	0.00
R55-20		FCPC -Final Design	60		12NOV09	17FEB10	209	38,767.40
R55-21		FDR	0			17FEB10	209	0.00
R55-30		FCPC - Procurement	65		19APR10*	20JUL10	167	178,272.60
R55-40		Host Programming	115		21JUL10	10JAN11	172	17,751.25
R55-42		ACQ Programming	115		21JUL10	10JAN11	167	11,834.16
R55-45		PCS programming	115		21JUL10	10JAN11	167	17,751.25
R55-48		PSRTC Programming	115		21JUL10	10JAN11	167	34,432.57
R55-50		FCPC PLC Intgration-EPICS Prog	115		21JUL10	10JAN11	167	5,917.08
R55-51		FCPC Data Acq & Ctl Installation	115		21JUL10	10JAN11	167	34,910.26
R55-60		FCPC -Test	30		11JAN11	21FEB11	167	34,645.00
R55-70		GISRTC - Preliminary Design	30		01OCT09*	11NOV09	219	10,696.80
R55-71		PDR	0			11NOV09	219	0.00
R55-80		GISRTC -Final Design	60		12NOV09	17FEB10	219	11,103.20
R55-81		FDR	0			17FEB10	219	0.00
R55-90		GISRTC - Procurement	60		18MAY10*	11AUG10	156	21,130.30
R55-100		GISRTC Programming	115		12AUG10	01FEB11	156	11,915.30
R55-110		GISRTC - Installation	115		12AUG10	01FEB11	156	33,107.79
R55-120		GISRTC -Test	25		02FEB11	08MAR11	156	19,004.40

56 - Central Safety and Interlock Systems

Job: 5601 - Central Safety &Interlock Sys-SICHTA

| Activity ID	MILE-STONE LEVEL	Activity Description	Duration (work days)	SHIFTS	Forecast Start	Forecast Finish	Total Float	Cost to Complete from 2/1/08
R56-10		Requirements, Codes&Standards	30		03AUG09*	14SEP09	191	5,591.20
R56-20		Preliminary Design	45		15SEP09	16NOV09	191	19,182.49
R56-21		PDR	0			16NOV09	191	0.00
R56-30		PLC Training	15		17NOV09	09DEC09	191	19,363.00
R56-35		Final Design	80		10DEC09	12APR10	191	43,600.00
R56-36		FDR	0			12APR10	191	0.00
R56-40		Procurement	60		13MAY10*	06AUG10	169	95,435.50
R56-50		Safety PLC Programming	100		09AUG10	06JAN11	169	29,677.96
R56-60		Installation (4 subsystems)	100		09AUG10	06JAN11	169	98,334.55
R56-63		Installation for DARM's access control (2)	100		09AUG10	06JAN11	169	14,569.94
R56-66		Installation add'l test cell doors	100		09AUG10	06JAN11	169	19,305.59
R56-70		Test	30		07JAN11	17FEB11	169	27,343.60
R56-70M	2	Compl Central Safety&Interlock Sys Pre-ops Tests	0			17FEB11	169	0.00

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
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
6 - Facility Systems								
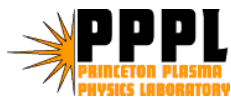
Risks and Mitigation

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.