Work Authorization Document

NSTX Upgrade Project

Control Account #:	4100	**Title:**	Center Stack Diagnostics
WBS	1.4.1	**Title:**	Plasma Diagnostics
Period of Performance:	23 February 2009 through 26 August 2013		
Authorized Budget:	$836	**Control Account Manager:**	Kaita
Revision #:	0	**Revision Date:**	July-11

Authorized Work Description:

The Plasma Diagnostics provide information on discharge parameters to characterize NSTX plasmas and guide its operation for optimized performance. The diagnostic subsystems included in this WBS are:

- Magnetic measurement diagnostics;
- Current density profile diagnostics;
- Laser and microwave diagnostics;
- Visible and total radiation diagnostics;
- Ultra violet and x-ray diagnostics;
- Particle measurement diagnostics;
- Divertor diagnostics; and
- Plasma Edge and vacuum diagnostics.

The NSTX Center Stack Upgrade will require new magnetics diagnostics to be installed This WBS element includes the design and fabrications of Center Stack magnetics diagnostics to replace units removed with the old Center Stack. Installation of these diagnostics is included in WBS element 1.1.3.3.4.

Attachments:

1- A detailed Control Account schedule showing all work packages and planning packages.

2- Budgeted Cost by month.

3- Original Work Authorization Form (WAF)

4- WBS Dictionary sheet that defines the scope of work for this WBS element.

Control Account History

ECP#	Implement Date	Prior Budget	New Budget	Signature

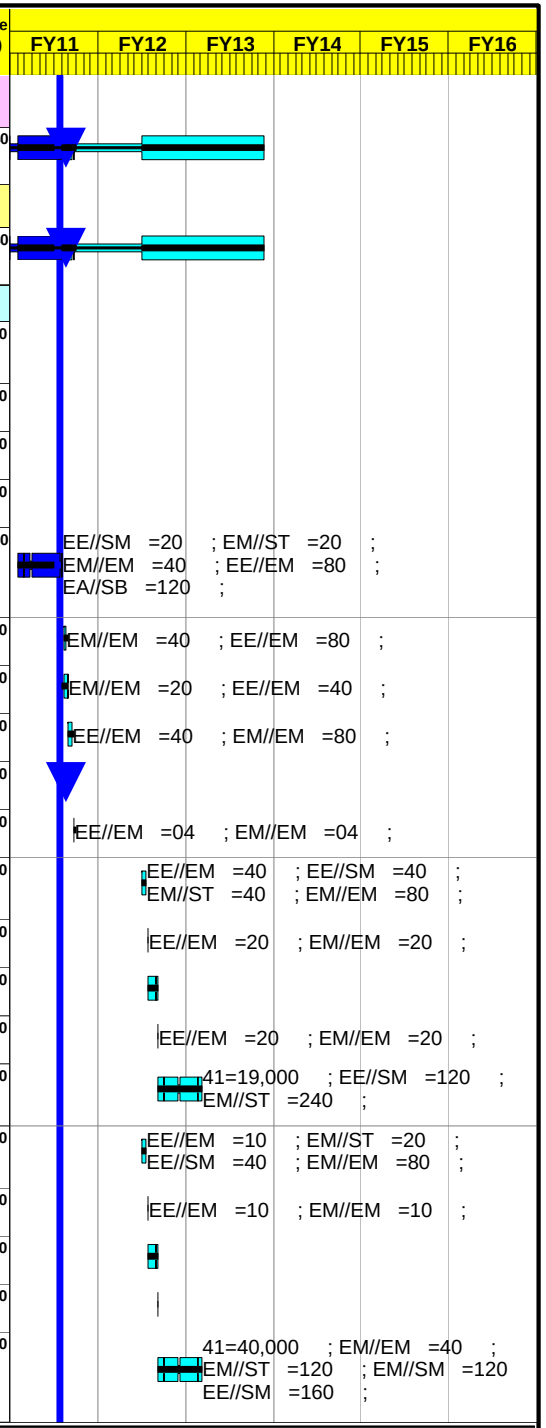
Approvals	Name	Signature	Date
NSTX-U Project Manager	R. Strykowsky		
Control Account Manager	Kaita		
Functional Manager	M. Bell		

NSTX Upgrade Project

Activity ID	Activity Description	Work Days	BASELINE START	Forecast Start	BASELINE FINISH	Forecast Finish	Schedule Slip (Days)	Total Float	Budgeted Cost	PPCT	Earned value cost (BCWP)	Planned value cost (BCWS)
Subtotal		1,129	23FEB09A	23FEB09A	26AUG13	26AUG13	0	14	835,574.14		127,872.46	131,896.40

Job: 4100 - Center Stack Diagnostics-KAITA

Activity ID	Activity Description	Work Days	BASELINE START	Forecast Start	BASELINE FINISH	Forecast Finish	Schedule Slip (Days)	Total Float	Budgeted Cost	PPCT	Earned value cost (BCWP)	Planned value cost (BCWS)
Subtotal		1,129	23FEB09A	23FEB09A	26AUG13	26AUG13	0	14	835,574.14		127,872.46	131,896.40
4100-0017	Prelim Dsn-Design Drawings	25	03MAY10A	03MAY10A	07JUN10A	07JUN10A	0		0.00	100	0.00	0.00
4100-0018	Prelim Dsn-PDR Prep	10	08JUN10A	08JUN10A	21JUN10A	21JUN10A	0		0.00	100	0.00	0.00
4100-0019	Prelim Dsn-CONDUCT PDR	2	22JUN10A	22JUN10A	23JUN10A	23JUN10A	0		0.00	100	0.00	0.00
4100-0022	Final Dsn-Disposition PDR Chits	10	08JUN10A	08JUN10A	21JUN10A	21JUN10A	0		0.00	100	0.00	0.00
4100-0023	Final Dsn-Design Drawings	127*	01NOV10*	01NOV10A	31MAR11	06MAY11	-26	221	40,239.40	90	36,215.46	40,239.40
4100-0025	Final Dsn-Update Cost & Schedule Estimate	10	16MAY11*	09MAY11	27MAY11	20MAY11	5	227	20,159.60		0.00	0.00
4100-0026	Final Dsn-Prep Procurement Specs	16	06MAY11*	09MAY11	27MAY11	31MAY11	-1	221	10,079.80		0.00	0.00
4100-0027	Final Dsn-FDR Prep	13*	31MAY11	01JUN11	24JUN11	17JUN11	5	221	19,572.40		0.00	0.00
4100-0027A	CS Diagnostic - Peer review	0				18MAY11*	0	147	0.00		0.00	0.00
4100-0028	Final Dsn-CONDUCT FDR	3	27JUN11	22JUN11*	28JUN11*	24JUN11	2	219	1,324.40		0.00	0.00
4100-0032	Wire/Cables-Prep Requisition and procurement pac	15	02APR12*	02APR12*	20APR12	20APR12	0	14	32,627.60		0.00	0.00
4100-0033	Wire/Cables-SUBMIT REQ TO PROCUREMENT	5	23APR12	23APR12	27APR12	27APR12	0	14	7,261.60		0.00	0.00
4100-0034	Wire/Cables-Procurement lead time (1)	25	30APR12	30APR12	04JUN12	04JUN12	0	14	0.00		0.00	0.00
4100-0035	Wire/Cables-AWARD	1	05JUN12	05JUN12	05JUN12	05JUN12	0	14	7,261.60		0.00	0.00
4100-0036	Wire/Cables-Fabricate or delivery	130	06JUN12	06JUN12	10DEC12	10DEC12	0	14	71,643.14		0.00	0.00
4100-0038	Coils w/mandrels -Prep Requisition & procurement	15	02APR12*	02APR12*	20APR12	20APR12	0	14	24,764.10		0.00	0.00
4100-0039	Coils w/mandrels - SUBMIT REQ TO PROCUREMENT	5	23APR12	23APR12	27APR12	27APR12	0	14	3,630.80		0.00	0.00
4100-0040	Coils w/mandrels - Procurement lead time (1)	25	30APR12	30APR12	04JUN12	04JUN12	0	14	0.00		0.00	0.00
4100-0041	Coils w/mandrels - AWARD	1	05JUN12	05JUN12	05JUN12	05JUN12	0	14	0.00		0.00	0.00
4100-0042	Coils w/mandrels - Fabricate or delivery	130	06JUN12	06JUN12	10DEC12	10DEC12	0	14	120,564.54		0.00	0.00



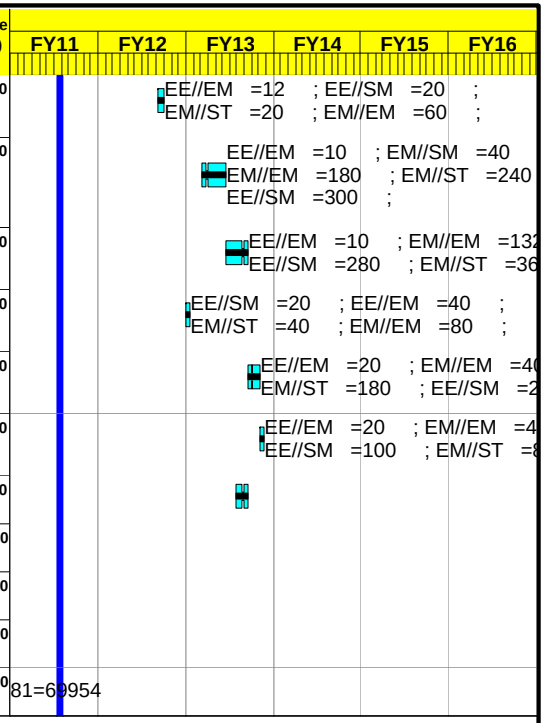
Data Date 30APR11
Run Date 20MAY11 11:00

1105

NSTX UPGRADES
RESOURCE LOADED SCHEDULE
CD-2 Schedule
April 2011

Early Bar
Progress Bar
Critical Activity

Activity ID	Activity Description	Work Days	BASELINE START	Forecast Start	BASELINE FINISH	Forecast Finish	Schedule Slip (Days)	Total Float	Budgeted Cost	PPCT	Earned value cost (BCWP)	Planned value cost (BCWS)
4100-0045	Fab/Assy Procedure	20	06JUN12	06JUN12	03JUL12	03JUL12	0	124	18,266.88		0.00	0.00
4100-0046	Shop Fabrication	65	11DEC12*	11DEC12*	20MAR13	20MAR13	0	14	119,716.30		0.00	0.00
4100-0047	Assembly	65	21MAR13	21MAR13	20JUN13	20JUN13	0	14	114,001.78		0.00	0.00
4100-0050	Installation Procedure (ex-vessel only)	15	01OCT12*	01OCT12*	19OCT12	19OCT12	0	178	29,835.40		0.00	0.00
4100-0051	Machine Installation (ex-vessel only)	30	21JUN13	21JUN13	05AUG13	05AUG13	0	14	65,733.40		0.00	0.00
4100-0052	PTP Testing	15	06AUG13	06AUG13	26AUG13	26AUG13	0	14	37,234.40		0.00	0.00
4100-0056	Mount Diagnostics in PFC Tiles	40	25APR13	25APR13	20JUN13	20JUN13	0	59	0.00		0.00	0.00
4100-FY09	FY09 Actual Cost	22*	23FEB09A	23FEB09A	30SEP09A	30SEP09A	0		11,000.00	100	11,000.00	11,000.00
FY104000	FY10 Actual Cost	40	01JAN10A	01JAN10A	26FEB10A	26FEB10A	0		-1,729.00	100	-1,729.00	-1,729.00
FY104100	FY10 Actual Cost	65	01FEB10A	01FEB10A	30APR10A	30APR10A	0		12,432.00	100	12,432.00	12,432.00
FY104100A	FY10 Actual Cost	110	03MAY10A	03MAY10A	30SEP10A	30SEP10A	0		69,954.00	100	69,954.00	69,954.00



4100 Center Stack Diagnostics (Kaita)	START	28FEB2009	31MAR2009	30APR2009	31MAY2009	30JUN2009	31JUL2009	31AUG2009	30SEP2009	31OCT2009	30NOV2009	31DEC2009
BCWS	0	0	2	2	1	2	2	1	1	0	0	0
CUM BCWS	0	0	2	3	5	6	8	10	11	11	11	11
BCWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM BCWP	0	0	0	0	0	0	0	0	0	0	0	0
ACWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM ACWP	0	0	0	0	0	0	0	0	0	0	0	0
CV	0	0	0	0	0	0	0	0	0	0	0	0
SV	.	.	-2.	-3.	-5.	-6.	-8.	-10.	-11.	-11.	-11.	-11.
CPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

4100 Center Stack Diagnostics (Kaita)		31JAN2010	28FEB2010	31MAR2010	30APR2010	31MAY2010	30JUN2010	31JUL2010	31AUG2010	30SEP2010	31OCT2010	30NOV2010	31DEC2010
	BCWS	-1	3	4	4	13	15	14	15	14	0	8	7
	CUM BCWS	10	13	17	22	35	49	63	78	92	92	100	106
	BCWP	0	0	0	0	0	0	0	0	0	0	0	118
	CUM BCWP	0	0	0	0	0	0	0	0	0	0	0	118
	ACWP	0	0	0	0	0	0	0	0	0	0	0	125
	CUM ACWP	0	0	0	0	0	0	0	0	0	0	0	125
	CV	0	0	0	0	0	0	0	0	0	0	0	-7
	SV	-10.	-13.	-17.	-22.	-35.	-49.	-63.	-78.	-92.	-92.	-100.	11.
	CPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	.95
	SPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.11

4100 Center Stack Diagnostics (Kaita)		31JAN2011	28FEB2011	31MAR2011	30APR2011	31MAY2011	30JUN2011	31JUL2011	31AUG2011	30SEP2011	31OCT2011	30NOV2011	31DEC2011
	BCWS	8	8	9	0	31	20	0	0	0	0	0	0
	CUM BCWS	115	123	132	132	163	183	183	183	183	183	183	183
	BCWP	4	4	2	0	0	0	0	0	0	0	0	0
	CUM BCWP	122	126	128	128	128	128	128	128	128	128	128	128
	ACWP	12	12	12	-41	0	0	0	0	0	0	0	0
	CUM ACWP	137	149	160	120	120	120	120	120	120	120	120	120
	CV	-15	-23	-32	8	8	8	8	8	8	8	8	8
	SV	7.	3.	-4.	-4.	-35.	-55.	-55.	-55.	-55.	-55.	-55.	-55.
	CPI	.89	.85	.8	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
	SPI	1.06	1.03	0.97	0.97	0.78	0.7	0.7	0.7	0.7	0.7	0.7	0.7

4100 Center Stack Diagnostics (Kaita)		31JAN2012	29FEB2012	31MAR2012	30APR2012	31MAY2012	30JUN2012	31JUL2012	31AUG2012	30SEP2012	31OCT2012	30NOV2012	31DEC2012
	BCWS	0	0	0	68	0	49	33	33	28	63	32	34
	CUM BCWS	183	183	183	251	251	301	334	366	395	458	490	524
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	128	128	128	128	128	128	128	128	128	128	128	128
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	120	120	120	120	120	120	120	120	120	120	120	120
	CV	8	8	8	8	8	8	8	8	8	8	8	8
	SV	-55.	-55.	-55.	-123.	-123.	-173.	-206.	-239.	-267.	-330.	-362.	-396.
	CPI	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
	SPI	0.7	0.7	0.7	0.51	0.51	0.43	0.38	0.35	0.32	0.28	0.26	0.24

4100 Center Stack Diagnostics (Kaita)		31JAN2013	28FEB2013	31MAR2013	30APR2013	31MAY2013	30JUN2013	31JUL2013	31AUG2013	30SEP2013	31OCT2013	30NOV2013	31DEC2013
	BCWS	38	33	35	38	40	37	47	43	0	0	0	0
	CUM BCWS	562	595	631	669	708	745	792	836	836	836	836	836
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	128	128	128	128	128	128	128	128	128	128	128	128
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	120	120	120	120	120	120	120	120	120	120	120	120
	CV	8	8	8	8	8	8	8	8	8	8	8	8
	SV	-434.	-467.	-503.	-541.	-581.	-617.	-664.	-708.	-708.	-708.	-708.	-708.
	CPI	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
	SPI	0.23	0.21	0.2	0.19	0.18	0.17	0.16	0.15	0.15	0.15	0.15	0.15

Annex I – WBS Dictionary

This Work Breakdown Structure (WBS) organizes and defines the scope of the NSTX Upgrade using the WBS as established by the original NSTX project and modified to accommodate the NSTX Upgrade.

WBS L1	L2	L3	Description
1			**NSTX UPGRADE PROJECT**
	1.1		**Torus Systems**
		1.1.0	Project Integrated Model
		1.1.1	Plasma Facing Components
		1.1.2	Vacuum Vessel and Support Structure
		1.1.3	Magnet Systems
	1.2		**Plasma Heating and Current Drive Systems**
		1.2.1	High Harmonic Fast Wave (HHFW)
		1.2.2	Coaxial Helicity Injection (CHI) Current Drive
		1.2.3	Electron Cyclotron Heating (ECH)
		1.2.4	Neutral Beam Injection (NBI)
	1.3		**Auxiliary Systems**
		1.3.1	Vacuum Pumping System
		1.3.2	Coolant Systems
		1.3.3	Bakeout Heating System
		1.3.4	Gas Delivery System
		1.3.5	Glow Discharge Cleaning System
	1.4		**Plasma Diagnostics**
		1.4.1	Plasma Diagnostics
	1.5		**Power Systems**
		1.5.1	AC Power Systems
		1.5.2	AC/DC Converters
		1.5.3	DC Systems
		1.5.4	Control and Protection System
		1.5.5	General Power Systems and Integration
	1.6		**Central Instrumentation and Controls (I&C)**
		1.6.1	Control System
		1.6.2	Data Acquisition System
	1.7		**Project Support & Integration**
		1.7.1	Project Management and Integration
		1.7.2	Project Physics
		1.7.3	Integrated Systems Tests
	1.8		**Site Preparation and Assembly**
		1.8.1	Site Preparation
		1.8.2	Torus Assembly and Construction

WBS Element: 1.4.1 **WBS Level: 3**
WBS Title: Plasma Diagnostics
Definition: The Plasma Diagnostics provide information on discharge parameters to characterize NSTX plasmas and guide its operation for optimized performance. The diagnostic subsystems included in this WBS are:

- Magnetic measurement diagnostics;
- Current density profile diagnostics;
- Laser and microwave diagnostics;
- Visible and total radiation diagnostics;
- Ultra violet and x-ray diagnostics;
- Particle measurement diagnostics;
- Divertor diagnostics; and
- Plasma Edge and vacuum diagnostics.

The NSTX Center Stack Upgrade will require new magnetics diagnostics to be installed This WBS element includes the design and fabrications of Center Stack magnetics diagnostics to replace units removed with the old Center Stack. Installation of these diagnostics is included in WBS element 1.1.3.3.4.
{Center Stack Upgrade Diagnostics (Job 4100)}

WBS Element: 1.5 **WBS Level: 2**
WBS Title: Power Systems
Definition: The Power Systems WBS element includes the engineering, design, prototyping, procurement and installation of all the systems and related elements that provide conditioned electrical power and energy to the NSTX systems. It includes the AC Power Systems, the AC/DC Convertors, the DC Systems, the Control and Protection System, and System Design and Integration.

WBS Element: 1.5.1 **WBS Level: 3**
WBS Title: AC Power Systems
Definition: The scope of the AC Power Systems WBS element is to provide the supply and distribution of all AC power to NSTX. This includes all the experimental and auxiliary loads.

WBS Element: 1.5.2 **WBS Level: 3**
WBS Title: AC/DC Converters
Definition: The scope of the AC/DC Converters WBS element is to reactivate existing AC/DC Converters that have not been used since the shutdown of TFTR for use by NSTX.

WBS Element: 1.5.3 **WBS Level: 3**
WBS Title: DC Systems
Definition: The scope of the DC Systems WBS element is to receive AC input power and deliver controlled DC output power to the NSTX coil systems. This

Work Approval Form (WAF)

Cost Center: 9417
Job Number: 4100
Job Title: Center Stack (CS) Upgrade Diagnostics
Job Manager: Robert Kaita/~~Jeff Abramson~~

Description:

Design and fabrications of CS magnetics diagnostics to replace units removed with old center stack. They consist of the following.
Internal (in vacuum):
Thermocouples
Mirnov/Pickup Coils
Halo Current Rogowski Coils
Tile-Mounted Langmuir Probes
External (in air):
Thermocouples
Flux Loops
Plasma Current Rogowski Coils

Schedule:

Refer to Primavera Data-Base

Approvals:

Robert Kaita 7/23/10
Job Manager

8/3/10
Project Manager

8/3/10
Engineering Department Head

	Cost Center:	9417																		
	Job Number:	4100																		
	Job Title:	Center Stack (CS) Upgrade Diagnostics																		
	Job Manager:	Robert Kaita/~~Jeff Abramson~~																		

Robert Kaita/Jeff Abramson

	USER INPUT TASKS AND DESCRIPTIONS		SCHEDULE *USER INPUT*			Estimate (user input) FY10$K					HOURS									
task numb	TASK DESCRIPTION	Responsible	Duration in WORK DAYS	*OPTIONAL Logical Pre-requisites (one task numbers in each column ,any order)*	actual= A	M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	EA** EM (analysis engr)	EA** SB (Designer)	EE** EM (Elctr Engr)	EE** SB (Electr Tech)	EM** EM (FO&M Engr)	EM** SB (FO&M Tech)	Other: Machinast	Cont	Basis of Estimate and Names of req'd skills if known	Category
						1.18	1.18	1.62	1.23	1.86	177.1	118.8	172.4	122.43	149.15	115.61	89.2			
~~1~~	~~**Physics Requirements**~~	~~Kaita~~																		
~~2~~	~~Similar coils and sensors used extensively for research on NSTX~~																			
~~3~~	~~**Conceptual Design**~~																			
~~4~~	~~PREPARE WORK PLANNING FORM~~	~~Abramson~~													~~20~~					~~2 & 4~~
~~5~~	~~Prep System Description~~	~~Abramson~~											~~40~~	~~10~~	~~40~~	~~10~~				~~2 & 4~~
~~6~~	~~Prep System Requirements~~	~~Abramson~~											~~40~~	~~10~~	~~40~~	~~10~~				~~2 & 4~~
~~7~~	~~R&D~~																			
~~8~~	~~Ananlysis~~																			
~~9~~	~~CDR~~	~~Kaita/Abramson~~											~~20~~	~~10~~	~~30~~	~~10~~				~~2 & 4~~
~~10~~	~~Similar coils and sensors used extensively for research on NSTX~~																			
11	**Preliminary Design**		35																	
16	Update Cost & Schedule Estimate	Kaita/Egebo											20		40			10%		2 & 4
17	Design Drawings	Kaita/Jariwala										120	80		40			10%		2 & 4
18	PDR Prep	Kaita/~~Abramson~~											20		40			10%		2 & 4
19	CONDUCT PDR	Kaita/~~Abramson~~											4		4			10%		2 & 4
20	Similar coils and sensors used extensively for research on NSTX																			
21	**Final Design**		180																	
22	Disposition PDR Chits	Kaita/~~Abramson~~											40		40			10%		2 & 4
23	Design Drawings	Kaita/Jariwala										120	80	20	40	20		10%		2 & 4
25	Update Cost & Schedule Estimate	Kaita/Egebo											80		40			10%		2 & 4
26	Prep Procurement Specs	Kaita/~~Abramson~~											40		20			10%		2 & 4
27	FDR Prep	Kaita/~~Abramson~~											40		80			10%		2 & 4
28	CONDUCT FDR	Kaita/~~Abramson~~											4		4			10%		2 & 4
29	Similar coils and sensors used extensively for research on NSTX																			
30	**Procurement**																			
31	Item 1: Wire & Cables		40			$19												20%		2 & 4
32	Prep Requisition and procurement package												40	40	80	40		20%		2 & 4
33	SUBMIT REQ TO PROCUREMENT												20		20			20%		2 & 4
34	**Procurement lead time (1)**																			
35	AWARD												20		20			20%		2 & 4
36	Fabricate or delivery													120		240		20%		2 & 4
37	Item 2:Coils w/ Mandrels		120			$40												20%		2 & 4
38	Prep Requisition and procurement package												10	40	80	20		20%		2 & 4
39	SUBMIT REQ TO PROCUREMENT												10		10			20%		2 & 4
40	**Procurement lead time (1)**																			

	Job Number:	4100																	
	Job Title:	**Center Stack (CS) Upgrade Diagnostics**																	
	Job Manager:	**Robert Kaita/~~Jeff Abramson~~**																	
					Estimate (user input)														
41		AWARD		[redacted]															
42		Fabricate or delivery											160	40	120	120		**20%**	2 & 4
43																			
44	**Fab/Assembly**																		
45	Fab/Assy Procedure											12	20	60	20			**20%**	2 & 4
46	Shop Fabrication											10	300	180	240	40		**20%**	2 & 4
47	Assembly											10	280	132	360			**20%**	2 & 4
48																			
49	**Installation**																		
50	Installation Procedure (ex-vessel only)											40	20	80	40			**10%**	2 & 4
51	Machine Installation (ex-vessel only)											20	200	40	180			**10%**	2 & 4
52	PTP Testing											20	100	40	80			**10%**	2 & 4
53																			
54	OTHER TASKS																		
55																			
	TOTALS		[redacted]	[redacted]	**$59**	**$0**	**$0**	**$0**	**$0**	**-**	**240**	**720**	**1,330**	**1,260**	**1,390**	**160**			
	TOTAL Preliminary Cost Estimate ($k)=		$748		$70	$0	$0	$0	$0	$0	$29	$124	$163	$188	$161	$14			

Notes:

(1) Procurement lead time:	Weeks
Purchase orders-Commercial, off-the-shelf items	**3**
Purchase orders-Noncommercial items	**5**
Subcontracts (non construction)	**8**
Construction subcontracts	**9**

CATEGORIZATION CODES:
1 - National Standards
2 - Engineering Judgement/Experience
3 - Estimates/Data from External Sources (e.g., W7X, ATF, etc.)
4 - Previous PPPL/ORNL Experience (e.g., TFTR, NSTX, PLT, etc.)
5 - Prototype Data/Test Results
6 - Catelogue Price/Vendor Quote
7 - Placed Contracts
8 - Actual experience for NCSX Work
9 - Other

Cost Center:	9417
Job Number:	4100
Job Title:	Center Stack (CS) Upgrade Diagnostics
Job Manager:	Robert Kaita/Jeff Abramson

Robert Kaita/Jeff Abramson

Uncertainty of the Estimate

	High	Medium	Low	Uncertainty Range (%)	Comments/Other Considerations
Design Maturity	X			10	Reuse of existing design with extensive operational experience and high design maturity level
Design Complexity			X	10	No new design required to replace any removed diagnostic equipment for CSU

Residual Impacts

	Risk Description	Likelihood of Occurring	Mitigation Plan	Basis of estimate	Cost Impact Low ($K)	Cost Impact High ($K)	Schedule Impact Low (weeks)	Schedule Impact High (Weeks)
1	Procurement Delay	VU	adjust schedule	similar previous work				
2	QA problem with received items	VU	return item to vendor, adjust schedule	similar previous work				
3								
4								
5								

Notes:

(1) Cost impacts should NOT include standing army costs which are separately calculated from the schedule impact

(2) The schedule impacts should be entered as the min and max impacts on the critical path.
If there is no critical path impact then the schedule entries should be zero.

(3) Likelihood of occurrence should be entered consistent with our risk classification methodology, i.e.
VL= Very Likely (P>80%), L=Likely (80%>P>40%), U=Unlikley (40%>P>10%), VU=Very Unlikely (P<10%), NC=Non-credible (P<1%)

Design Maturity	Design Complexity					
	Low		Medium		High	
Low	-15%	+25%	-20%	+40%	-30%	+60%
Medium	-10%	+15%	-15%	+25%	-20%	+40%
High	-5%	+10%	-10%	+15%	-15%	+25%

Design Maturity Definition

High

Final design available. All design features/requirements well known. No further design development or evolution expected that will impact estimate.

Medium

Preliminary design available. Some additional design evolution likely. Further developments can be somewhat expected or anticipated and reflected in estimate.

Low

No better than conceptual design basis currently available. Design details, procedures, etc. still need much development and evolution of requirements beyond estimate basis is likely and expected.

Design Complexity Definition

Low

Work is fairly well understood -- either standard construction or repetition of activities performed in past. Little likelihood of estimate not being well understood and requirements not being well defined.

Medium

More complex work requirements that have potential to impact cost and schedule estimates. Limited experience performing similar tasks, so ability to estimate accurately is somewhat suspect

High

Extremely challenging tasks and/or requirements. Unique or firstof-a-kind assembly or work tasks. No good basis for estimating work exists so there is a high degree of estimate uncertainty.

Based on standard industry and DOE estimate classifications (Per AACEI Recommende

USER INPUT TASKS AND DESCRIPTIONS		FY09$K					HOURS											
task numb	TASK DESCRIPTION	M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	EA** EM (analysis engr)	EA** DM (Designer)	EC** EM (computing Engr)	EC** SM/TB (Computing Tech)	EE** EM (Elctr Engr)	EE** SM/TB (Electr Tech)	EM** EM (FO&M Engr)	EM** SM/TB (FO&M Tech)	FC** AM (P&C Officer)	OP** SB/TB (HP Tech)	R*** RM (Researcher)	Other: Machining
	P3 cross ref (optinal)	1.22	1.22	1.63	1.10	1.63	185.5	125.1	143.5	144.4	175.9	151.07	165.37	145.35	150.8	142.8	180.2	150
	Internal:																	
	Thermocouples																	
	~~Design~~										~~20~~		~~20~~					
	~~CS Layout-Design~~							~~40~~			~~10~~		~~20~~					
	Procure Materials	$2,000									10		10					
	Fabricate													80				
	Attach to Tiles											80	10	10				
	Inst. Procedure review/~~update~~												20					
	~~CS Installation~~													~~80~~				
	~~CS Termination~~											~~100~~		~~20~~				
	CWD Update										40							
	Mirnov/Pickup Coils																	
	~~Design-Layout~~							~~60~~			~~40~~		~~60~~					
	~~CS Design Interface~~												~~40~~					
	Procure Materials; wire & Mandrels	$12,000											20					
	Wind Coils	$7,500											20					
	~~Testing~~											~~40~~						
	Mount in Tiles												20	120				
	Inst. Procedure review/~~update~~												~~20~~					
	~~CS Installation~~											~~80~~	~~40~~	~~120~~				
	~~CS Termination~~											~~120~~						
	CWD Update										20							
	Halo Current Rogowski Coils																	
	Drawing Update							40			20		20					
	ceramic wrap, foil, sleeving, cement	$6,000												40				
	Wind Coils	$6,000																
	Perform Coil Testing													40				
	Copper Foil Inst.and Wrap											80						
	Mandrel sizing for center stack											40						
	~~Testing Installed coils~~												~~40~~	~~40~~				
	Inst. Procedure review/~~update~~												20					
	~~Center Stack Installation~~										~~120~~							
	CWD Update										20							
	Tile-Mounted Langmuir Probes																	
	~~Design-Layout~~										~~20~~		~~20~~					
	~~CS Layout-Design~~										~~20~~		~~60~~					
	Procure Materials	$2,000																
	~~Fabricate~~													~~80~~				
	Inst. Procedure review/~~update~~												20					
	Install in Tile													120				
	~~CS Installation~~													~~80~~				
	~~CS Termination~~											~~160~~						
	CWD Update										20							
	External:																	
	Thermocouples																	
	Procure Materials	$1,500									20		20					
	Design-Layout							20			20		20					
	Fac TCs													40				
	Inst. Procedure review/update												20					
	CS Installation										120		40					
	CS Termination											20	20	40				
	Tokomak Installation										40		20					
	CWD Update										20							
	Flux Loops																	
	Design-Layout, Dwg update	$1,000						20			20		40					
	Procure Materials	$3,000											40					
	~~Fabricate Mandrels~~												~~40~~					~~80~~
	Inst. Procedure review/update												20					
	CS Installation										40	320	80					

USER INPUT TASKS AND DESCRIPTIONS			FY09$K					HOURS											
task numb	P3 cross ref (optinal)	TASK DESCRIPTION	M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	EA** EM (analysis engr)	EA** DM (Designer)	EC** EM (computing Engr)	EC** SM/TB (Computing Tech)	EE** EM (Elctr Engr)	EE** SM/TB (Electr Tech)	EM** EM (FO&M Engr)	EM** SM/TB (FO&M Tech)	FC** AM (P&C Officer)	DP** SB/TB (HP Tech)	R*** RM (Researcher)	Other: Machining
			1.22	1.22	1.63	1.10	1.63	185.5	125.1	143.5	144.4	175.9	151.07	165.37	145.35	150.8	142.8	180.2	150
		~~Tokomak Installation~~													~~120~~				
		Field Cable	$3,000									40		40	120				
		~~Testing~~										~~40~~			~~40~~				
		CWD Update												20					
		Plasma Current Rogowski Coils																	
		Design-Layout, Dwg update												40					
		Procure Materials	$3,000											40					
		Fabricate Mandrels												40	40				80
		Wind Rogowski Coils	$10,000											80					
		Temp tooling	$2,000																
		Copper Foil Insulation and Kapton Wrap											80						
		~~Testing~~												~~40~~	~~40~~				
		Inst. Procedure review/update												20					
		CS Installation										40	240	80					
		~~Tokomak Installation~~										~~20~~		~~60~~	~~120~~				
		TOTALS, $ & Hrs	$59,000					-	180	-	-	780	1,360	1,300	1,390	-	-	-	160