Work Authorization Document

NSTX Upgrade Project

Control Account #:	2425	**Title:**	BL Relocation
WBS	1.2.4	**Title:**	NB Injection
Period of Performance:	23 February 2009 through 11 August 2014		
Authorized Budget:	$1,860	**Control Account Manager:**	Denault
Revision #:	0	**Revision Date:**	July-11

Authorized Work Description:

This WBS element includes the efforts to provide services to the new neutral beam beamline and ancillary equipment in NSTX test cell. These services include water, cryogenic systems, gas supplies, and vacuum lines.

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.

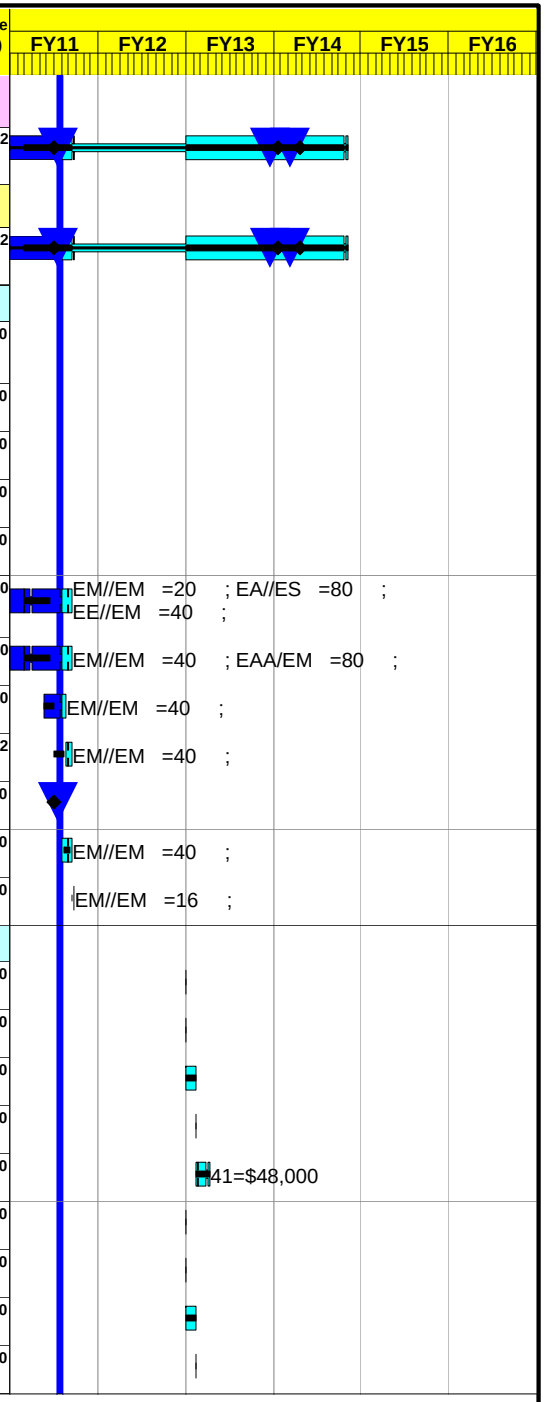
Control Account History

ECP#	Implement Date	Prior Budget	New Budget	Signature

Approvals	Name	Signature	Date
NSTX-U Project Manager	R. Strykowsky		
Control Account Manager	Denault		
Functional Manager	L. Dudek		

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		1,366	23FEB09A	23FEB09A	11AUG14	11AUG14	0	20	1,850,184.46		67,204.86	91,092.32
Job: 2425 - BL Relocation-DENAULT												
Subtotal		1,366	23FEB09A	23FEB09A	11AUG14	11AUG14	0	20	1,850,184.46		67,204.86	91,092.32
Design												
2425-0017	Design Drawings	24	03MAY10A	03MAY10A	04JUN10A	04JUN10A	0		0.00	100	0.00	0.00
2425-0018	PDR Prep	11	07JUN10A	07JUN10A	21JUN10A	21JUN10A	0		0.00	100	0.00	0.00
2425-0019	CONDUCT PDR	2	22JUN10A	22JUN10A	23JUN10A	23JUN10A	0		0.00	100	0.00	0.00
2425-0020	Layman Review	5	10AUG10A	10AUG10A	16AUG10A	16AUG10A	0		0.00	100	0.00	0.00
2425-0023	Disposition PDR Chits	2	24JUN10A	24JUN10A	25JUN10A	25JUN10A	0		0.00	100	0.00	0.00
2425-0024	Design Drawings	177*	01DEC10*	01OCT10A	16MAR11	17JUN11	-66	123	17,041.40	40	6,816.56	17,041.40
2425-0025	Update Analyses	177*	01DEC10*	01OCT10A	16MAR11	17JUN11	-66	123	21,742.80	75	16,307.10	21,742.80
2425-0026	Update Cost & Schedule Estimate	67*	15FEB11*	15FEB11A	28MAR11	18MAY11	-37	134	6,328.40	50	3,164.20	6,328.40
2425-0027	Prep Procurement Specs	20	29MAR11	20MAY11	09MAY11	17JUN11	-28	123	6,328.40		0.00	5,062.72
2425-0027A	Peer Review	0			31MAR11	14APR11A	-10		0.00		0.00	0.00
2425-0028	FDR Prep	30	10MAY11	06MAY11	10JUN11	17JUN11	-5	123	0.00		0.00	0.00
2425-0029	CONDUCT FDR 2425	3	13JUN11	22JUN11*	14JUN11	24JUN11	-8	121	2,531.36		0.00	0.00
Procure, Fab & Assembly												
2425-0033	Prep Requisitn and procuremt pckg-Steel & Parts	1	01OCT12*	01OCT12*	01OCT12	01OCT12	0	142	0.00		0.00	0.00
2425-0034	SUBMIT REQ TO PROCUREMENT - Steel and Parts	1	02OCT12	02OCT12	02OCT12	02OCT12	0	142	0.00		0.00	0.00
2425-0035	Procurement lead time (1) - Steel and Parts	30	03OCT12	03OCT12	13NOV12	13NOV12	0	142	0.00		0.00	0.00
2425-0036	AWARD - Steel and Parts	1	14NOV12	14NOV12	14NOV12	14NOV12	0	142	0.00		0.00	0.00
2425-0037	Fabricate or delivery - Steel and Parts	30	15NOV12	15NOV12	08JAN13	08JAN13	0	142	63,360.00		0.00	0.00
2425-0039	Prep Requisition and procurement pckg - Lifting	2	01OCT12*	01OCT12*	02OCT12	02OCT12	0	153	0.00		0.00	0.00
2425-0040	SUBMIT REQ TO PROCUREMENT - Lifting Equipment	1	03OCT12	03OCT12	03OCT12	03OCT12	0	153	0.00		0.00	0.00
2425-0041	Procurement lead time (1) - Lifting Equipment	30	04OCT12	04OCT12	14NOV12	14NOV12	0	153	0.00		0.00	0.00
2425-0042	AWARD - Lifting Equipment	1	15NOV12	15NOV12	15NOV12	15NOV12	0	153	0.00		0.00	0.00



Data Date 30APR11
Run Date 20MAY11 10:53

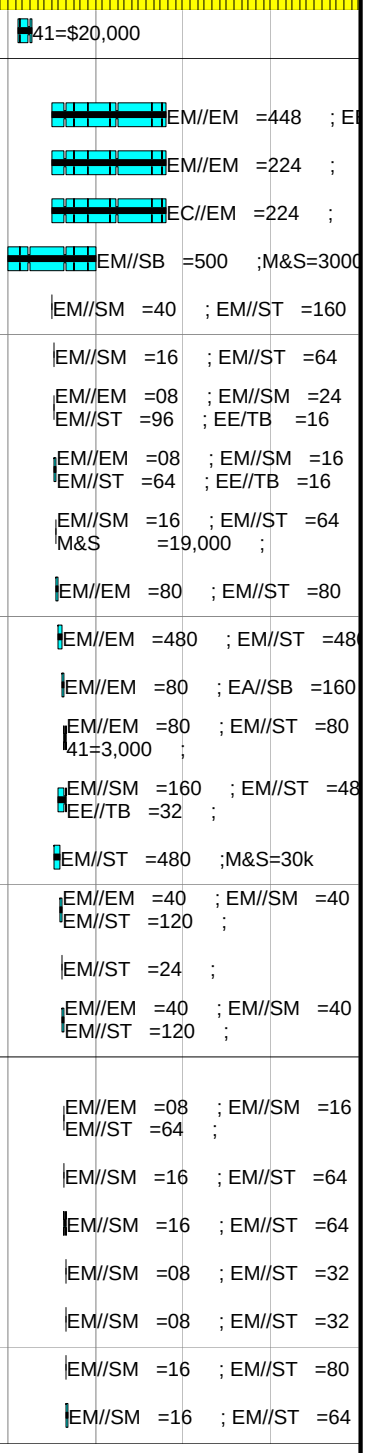
© Primavera Systems, Inc.

1105

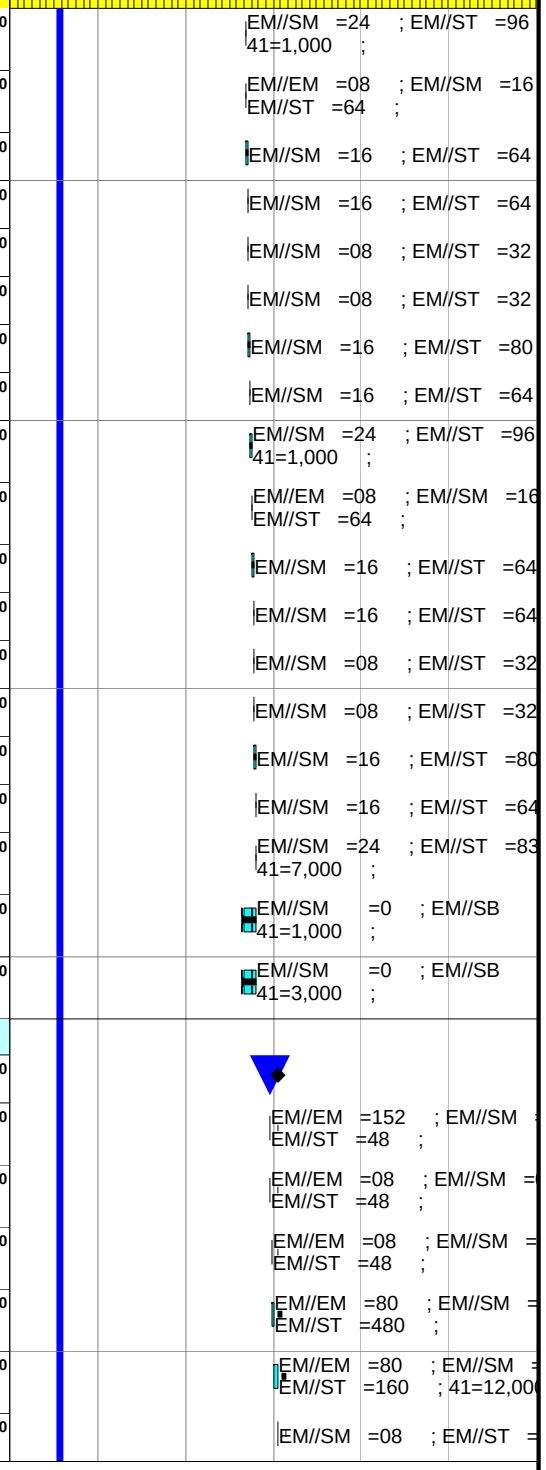
NSTX UPGRADES
RESOURCE LOADED SCHEDULE
CD-2 Schedule
April 2011

Early Bar
Progress Bar
Critical Activity

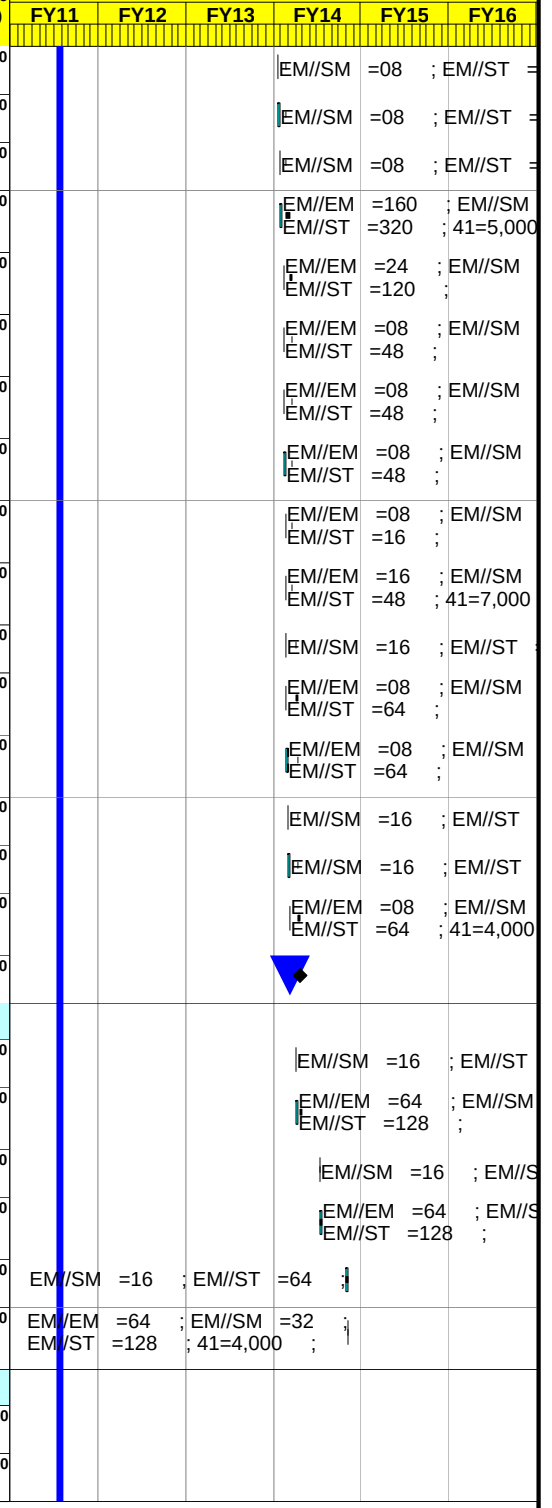
Activity ID	Activity Description	Work Days	BASELINE START	Forecast Start	BASELINE FINISH	Forecast Finish	Schedule Slip (Days)	Total Float	Budgeted Cost	PPCT	Earned value cost (BCWP)	Planned value cost (BCWS)
2425-0043	Fabricate or delivery - Lifting Equipment	30	16NOV12	16NOV12	09JAN13	09JAN13	0	153	26,400.00		0.00	0.00
Installation												
2425-0055	Engineering 1 Days Per Week title III	325	02APR13*	02APR13*	22JUL14	22JUL14	0	30	112,618.48		0.00	0.00
2425-0056	Engineering Support .Days Per Weektitle III	325	02APR13	02APR13	22JUL14	22JUL14	0	30	40,502.30		0.00	0.00
2425-0057	Drafting Support .5 day/week title III	325	02APR13	02APR13	22JUL14	22JUL14	0	30	34,285.56		0.00	0.00
2425-0058	Test Cell Maintenance	248	01OCT12*	01OCT12*	30SEP13	30SEP13	0	229	71,675.00		0.00	0.00
2425-0060	Road - Path	5	01APR13*	01APR13*	05APR13	05APR13	0	84	24,836.00		0.00	0.00
2425-0061	Duct Removal - Path	2	08APR13	08APR13	09APR13	09APR13	0	84	9,934.40		0.00	0.00
2425-0062	Lintel Removal - Path	3	10APR13	10APR13	12APR13	12APR13	0	84	17,822.56		0.00	0.00
2425-0063	Lintel Install - Path	2	15APR13	15APR13	16APR13	16APR13	0	84	12,855.36		0.00	0.00
2425-0064	Duct Install - Path	2	17APR13	17APR13	18APR13	18APR13	0	84	35,014.40		0.00	0.00
2425-0068	Setup - Metrology	5	19APR13	19APR13	25APR13	25APR13	0	84	23,057.60		0.00	0.00
2425-0069	Measure - Metrology	15	26APR13	26APR13	16MAY13	16MAY13	0	84	138,345.60		0.00	0.00
2425-0070	Model - Metrology	5	17MAY13	17MAY13	23MAY13	23MAY13	0	84	36,548.80		0.00	0.00
2425-0071	Lay out - Metrology	5	24MAY13	24MAY13	31MAY13	31MAY13	0	84	27,017.60		0.00	0.00
2425-0073	Labyrinth Removal	20	01MAY13*	01MAY13*	29MAY13	29MAY13	0	85	84,578.88		0.00	0.00
2425-0076	Construction - Lift Fixtures	20	09APR13*	09APR13*	06MAY13	06MAY13	0	90	92,918.40		0.00	0.00
2425-0077	Load Test - Lift Fixtures	5	07MAY13	07MAY13	13MAY13	13MAY13	0	90	27,478.40		0.00	0.00
2425-0078	Move - Lift Fixtures	1	14MAY13	14MAY13	14MAY13	14MAY13	0	90	2,665.92		0.00	0.00
2425-0079	Trial Runs - Lift Fixtures	5	15MAY13	15MAY13	21MAY13	21MAY13	0	90	27,478.40		0.00	0.00
Relocate HVE												
2425-0123	Move - HVE 1 Movement	2	20MAY13*	20MAY13*	21MAY13	21MAY13	0	48	11,351.52		0.00	0.00
2425-0124	Disassemble - HVE 1 Movement	2	22MAY13	22MAY13	23MAY13	23MAY13	0	48	9,934.40		0.00	0.00
2425-0125	Move to Crain Access - HVE 1 Movement	2	24MAY13	24MAY13	28MAY13	28MAY13	0	48	9,934.40		0.00	0.00
2425-0126	Lift into TFTR - HVE 1 Movement	1	29MAY13	29MAY13	29MAY13	29MAY13	0	48	4,967.20		0.00	0.00
2425-0127	Move In - HVE 1 Movement	1	30MAY13	30MAY13	30MAY13	30MAY13	0	48	4,967.20		0.00	0.00
2425-0128	Over Wall - HVE 1 Movement	2	31MAY13	31MAY13	03JUN13	03JUN13	0	48	11,711.68		0.00	0.00
2425-0129	Reassemble - HVE 1 Movement	2	04JUN13	04JUN13	05JUN13	05JUN13	0	48	9,934.40		0.00	0.00



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)
2425-0130	Placement - HVE 1 Movement	3	06JUN13	06JUN13	10JUN13	10JUN13	0	48	16,221.60		0.00	0.00
2425-0133	Move - HVE 2 Movement	2	11JUN13	11JUN13	12JUN13	12JUN13	0	48	11,351.52		0.00	0.00
2425-0134	Disassemble - HVE 2 Movement	2	13JUN13	13JUN13	14JUN13	14JUN13	0	48	9,934.40		0.00	0.00
2425-0135	Move to Crain Access - HVE 2 Movement	2	17JUN13	17JUN13	18JUN13	18JUN13	0	48	9,934.40		0.00	0.00
2425-0136	Lift into TFTR - HVE 2 Movement	1	19JUN13	19JUN13	19JUN13	19JUN13	0	48	4,967.20		0.00	0.00
2425-0137	Move In - HVE 2 Movement	1	20JUN13	20JUN13	20JUN13	20JUN13	0	48	4,967.20		0.00	0.00
2425-0138	Over Wall - HVE 2 Movement	2	21JUN13	21JUN13	24JUN13	24JUN13	0	48	11,711.68		0.00	0.00
2425-0139	Reassemble - HVE 2 Movement	2	25JUN13	25JUN13	26JUN13	26JUN13	0	48	9,934.40		0.00	0.00
2425-0140	Placement - HVE 2 Movement	3	27JUN13	27JUN13	01JUL13	01JUL13	0	48	16,221.60		0.00	0.00
2425-0143	Move - HVE 3 Movement	2	02JUL13	02JUL13	03JUL13	03JUL13	0	48	11,351.52		0.00	0.00
2425-0144	Disassemble - HVE 3 Movement	2	08JUL13	08JUL13	09JUL13	09JUL13	0	48	9,934.40		0.00	0.00
2425-0145	Move to Crain Access - HVE 3 Movement	2	10JUL13	10JUL13	11JUL13	11JUL13	0	48	9,934.40		0.00	0.00
2425-0146	Lift into TFTR - HVE 3 Movement	1	12JUL13	12JUL13	12JUL13	12JUL13	0	48	4,967.20		0.00	0.00
2425-0147	Move In - HVE 3 Movement	1	15JUL13	15JUL13	15JUL13	15JUL13	0	48	4,967.20		0.00	0.00
2425-0148	Over Wall - HVE 3 Movement	2	16JUL13	16JUL13	17JUL13	17JUL13	0	48	11,711.68		0.00	0.00
2425-0149	Reassemble - HVE 3 Movement	2	18JUL13	18JUL13	19JUL13	19JUL13	0	48	9,934.40		0.00	0.00
2425-0150	Placement - HVE 3 Movement	3	22JUL13	22JUL13	24JUL13	24JUL13	0	48	14,901.60		0.00	0.00
2425-0155	Install HVE Hilti	45	20MAY13	20MAY13	24JUL13	24JUL13	0	48	5,763.20		0.00	0.00
2425-0160	Remove / Reinstall Floor Plug	45	20MAY13	20MAY13	24JUL13	24JUL13	0	48	26,176.00		0.00	0.00
Relocate Beamline **TC LIMITED ACCESS**												
2425-0081	BEGIN BEAMLINE RELOCATION TO NTC	0	17OCT13	19SEP13			20	8	0.00		0.00	0.00
2425-0082	Lift onto Rollers - Box Movements	1	17OCT13	19SEP13	17OCT13	19SEP13	20	8	33,669.76		0.00	0.00
2425-0083	Move IN - Box Movements	1	18OCT13	20SEP13	18OCT13	20SEP13	20	8	8,161.60		0.00	0.00
2425-0084	Over Wall - Box Movements	1	21OCT13	23SEP13	21OCT13	23SEP13	20	8	8,161.60		0.00	0.00
2425-0085	Placement - Box Movements	10	22OCT13	24SEP13	04NOV13	07OCT13	20	8	82,982.40		0.00	0.00
2425-0086	Metrology - Box Movements	10	05NOV13	08OCT13	18NOV13	21OCT13	20	8	63,800.00		0.00	0.00
2425-0089	Off - Source Platform	1	19NOV13*	22OCT13*	19NOV13	22OCT13	20	8	4,213.60		0.00	0.00



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)
2425-0090	Move - Source Platform	1	20NOV13	23OCT13	20NOV13	23OCT13	20	8	3,294.88		0.00	0.00
2425-0091	Lift - Source Platform	1	21NOV13	24OCT13	21NOV13	24OCT13	20	8	5,132.32		0.00	0.00
2425-0092	On - Source Platform	1	22NOV13	25OCT13	22NOV13	25OCT13	20	8	5,132.32		0.00	0.00
2425-0093	Metrology - Source Platform	10	25NOV13	28OCT13	10DEC13	08NOV13	20	8	87,375.60		0.00	0.00
2425-0097	Stabilize - Lid Movement	3	11DEC13	11NOV13	13DEC13	13NOV13	20	8	22,548.48		0.00	0.00
2425-0098	Lift onto Rollers - Lid Movement	1	16DEC13	14NOV13	16DEC13	14NOV13	20	8	8,434.88		0.00	0.00
2425-0099	Move IN - Lid Movement	1	17DEC13	15NOV13	17DEC13	15NOV13	20	8	8,434.88		0.00	0.00
2425-0100	Over Wall - Lid Movement	1	18DEC13	18NOV13	18DEC13	18NOV13	20	8	8,434.88		0.00	0.00
2425-0101	Placement - Lid Movement	1	19DEC13	19NOV13	19DEC13	19NOV13	20	8	4,760.00		0.00	0.00
2425-0102	Metrology - Lid Movement	1	20DEC13	20NOV13	20DEC13	20NOV13	20	8	19,350.00		0.00	0.00
2425-0106	90in Flange - Component Movement	2	02JAN14	21NOV13	03JAN14	22NOV13	20	8	10,264.64		0.00	0.00
2425-0107	Magnet - Component Movement	2	06JAN14	25NOV13	07JAN14	26NOV13	20	8	11,729.76		0.00	0.00
2425-0108	Ion Dump - Component Movement	2	08JAN14	27NOV13	09JAN14	02DEC13	20	8	11,729.76		0.00	0.00
2425-0109	Exit Spool - Component Movement	2	10JAN14	03DEC13	13JAN14	04DEC13	20	8	10,264.64		0.00	0.00
2425-0110	TIV - Component Movement	2	14JAN14	05DEC13	15JAN14	06DEC13	20	8	10,264.64		0.00	0.00
2425-0111	Calorimeter - Component Movement	2	16JAN14	09DEC13	17JAN14	10DEC13	20	8	17,129.76		0.00	0.00
2425-0112	BEAMLINE AND COMPONENTS INSTALLED IN NTC	0			17JAN14	10DEC13	20	8	0.00		0.00	0.00
Relocate Sources												
2425-0115	Move 1 - Source Movement	2	20JAN14	02JAN14	21JAN14	03JAN14	12	158	10,264.64		0.00	0.00
2425-0116	Align 1 - Source Movement	4	22JAN14	06JAN14	27JAN14	09JAN14	12	158	32,250.24		0.00	0.00
2425-0117	Move 2 - Source Movement	2	10APR14	10APR14	11APR14	11APR14	0	94	10,264.64		0.00	0.00
2425-0118	Align 2 - Source Movement	4	14APR14	14APR14	17APR14	17APR14	0	94	32,250.24		0.00	0.00
2425-0119	Move 3 - Source Movement	2	04AUG14	04AUG14	05AUG14	05AUG14	0	20	10,264.64		0.00	0.00
2425-0120	Align 3 - Source Movement	4	06AUG14	06AUG14	11AUG14	11AUG14	0	20	37,650.24		0.00	0.00
FY092425	FY09 Actual Cost	22*	23FEB09A	23FEB09A	30SEP09A	30SEP09A	0		15,023.00	100	15,023.00	15,023.00
FY102425	FY10 Actual Cost	143	01OCT09A	01OCT09A	30APR10A	30APR10A	0		19,729.00	100	19,729.00	19,729.00



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)	FY11	FY12	FY13	FY14	FY15	FY16
FY102435A	FY10 Actual Cost	110	03MAY10A	03MAY10A	30SEP10A	30SEP10A	0		6,165.00	100	6,165.00	6,165.00	81=8583					

2425 BL Relocation (Denault)	START	28FEB2009	31MAR2009	30APR2009	31MAY2009	30JUN2009	31JUL2009	31AUG2009	30SEP2009	31OCT2009	30NOV2009	31DEC2009
BCWS	0	0	2	2	2	2	2	2	2	3	3	2
CUM BCWS	0	0	3	5	7	9	11	13	15	18	21	23
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	.	.	-3.	-5.	-7.	-9.	-11.	-13.	-15.	-18.	-21.	-23.
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

2425 BL Relocation (Denault)		31JAN2010	28FEB2010	31MAR2010	30APR2010	31MAY2010	30JUN2010	31JUL2010	31AUG2010	30SEP2010	31OCT2010	30NOV2010	31DEC2010
	BCWS	3	3	3	3	1	1	1	1	1	0	0	9
	CUM BCWS	26	29	32	35	36	37	38	40	41	41	41	50
	BCWP	0	0	0	0	0	0	0	0	0	0	0	47
	CUM BCWP	0	0	0	0	0	0	0	0	0	0	0	47
	ACWP	0	0	0	0	0	0	0	0	0	0	0	46
	CUM ACWP	0	0	0	0	0	0	0	0	0	0	0	46
	CV	0	0	0	0	0	0	0	0	0	0	0	0
	SV	-26.	-29.	-32.	-35.	-36.	-37.	-38.	-40.	-41.	-41.	-41.	-4.
	CPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.01
	SPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.93

2425 BL Relocation (Denault)		31JAN2011	28FEB2011	31MAR2011	30APR2011	31MAY2011	30JUN2011	31JUL2011	31AUG2011	30SEP2011	31OCT2011	30NOV2011	31DEC2011
	BCWS	12	13	12	4	5	5	0	0	0	0	0	0
	CUM BCWS	62	75	87	91	96	101	101	101	101	101	101	101
	BCWP	0	9	9	3	0	0	0	0	0	0	0	0
	CUM BCWP	47	56	65	67	67	67	67	67	67	67	67	67
	ACWP	0	1	1	1	0	0	0	0	0	0	0	0
	CUM ACWP	47	47	48	49	49	49	49	49	49	49	49	49
	CV	0	9	17	18	18	18	18	18	18	18	18	18
	SV	-15.	-19.	-22.	-24.	-29.	-34.	-34.	-34.	-34.	-34.	-34.	-34.
	CPI	1.	1.19	1.35	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
	SPI	0.75	0.74	0.75	0.74	0.7	0.66	0.66	0.66	0.66	0.66	0.66	0.66

2425 BL Relocation (Denault)		31JAN2012	29FEB2012	31MAR2012	30APR2012	31MAY2012	30JUN2012	31JUL2012	31AUG2012	30SEP2012	31OCT2012	30NOV2012	31DEC2012
	BCWS	0	0	0	0	0	0	0	0	0	6	33	54
	CUM BCWS	101	101	101	101	101	101	101	101	101	108	141	195
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	67	67	67	67	67	67	67	67	67	67	67	67
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	49	49	49	49	49	49	49	49	49	49	49	49
	CV	18	18	18	18	18	18	18	18	18	18	18	18
	SV	-34.	-34.	-34.	-34.	-34.	-34.	-34.	-34.	-34.	-40.	-73.	-127.
	CPI	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
	SPI	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.62	0.48	0.35

2425 BL Relocation (Denault)		31JAN2013	28FEB2013	31MAR2013	30APR2013	31MAY2013	30JUN2013	31JUL2013	31AUG2013	30SEP2013	31OCT2013	30NOV2013	31DEC2013
	BCWS	21	5	6	243	407	135	114	18	17	132	147	135
	CUM BCWS	215	221	227	470	877	1,012	1,126	1,144	1,161	1,293	1,439	1,575
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	67	67	67	67	67	67	67	67	67	67	67	67
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	49	49	49	49	49	49	49	49	49	49	49	49
	CV	18	18	18	18	18	18	18	18	18	18	18	18
	SV	-148.	-154.	-159.	-402.	-810.	-945.	-1059.	-1077.	-1094.	-1226.	-1372.	-1507.
	CPI	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
	SPI	0.31	0.3	0.3	0.14	0.08	0.07	0.06	0.06	0.06	0.05	0.05	0.04

2425 BL Relocation (Denault)		31JAN2014	28FEB2014	31MAR2014	30APR2014	31MAY2014	30JUN2014	31JUL2014	31AUG2014	30SEP2014	31OCT2014	30NOV2014	31DEC2014
	BCWS	127	11	12	55	12	12	9	48	0	0	0	0
	CUM BCWS	1,701	1,712	1,724	1,779	1,791	1,803	1,812	1,860	1,860	1,860	1,860	1,860
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	67	67	67	67	67	67	67	67	67	67	67	67
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	49	49	49	49	49	49	49	49	49	49	49	49
	CV	18	18	18	18	18	18	18	18	18	18	18	18
	SV	-1634.	-1645.	-1657.	-1712.	-1724.	-1736.	-1744.	-1792.	-1792.	-1792.	-1792.	-1792.
	CPI	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37
	SPI	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

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

thermal loading. Disruption loads on the ECH waveguide will be evaluated for the Center Stack Upgrade Fields and field transients. Discussions with heating system experts regarding the performance of the ECH system for the higher Center Stack Upgrade fields indicate that no modification to the resonant frequency or other operational characteristic for the system will require upgrade. Only disruption qualification is planned. No previous qualification has been identified, so the resources include creation of a new calculation – not a review of an existing calculation as is the case for ICRH.
{Electron Cyclotron Heating (Job 2300)}

WBS Element: 1.2.4 **WBS Level: 3**
WBS Title: Neutral Beam Injection (NBI)
Definition: The Neutral Beam Injection System Upgrade provides a second Neutral Beam as part of the NSTX Upgrade Project. The second NBI is identical to the one already installed on NSTX. An existing TFTR beam will be decontaminated, refurbished, and installed on NSTX. This WBS element includes the NBI source refurbishment; the TFTR beamline decontamination, refurbishment and relocation to the NSTX Test Cell; the 2nd NBI Services; the NBI armor modifications; the 2nd NBI Power, Controls and Instrumentation; the 2nd NBI Duct and vacuum vessel modifications; and the NSTX Test Cell equipment removals and relocations necessary to accommodate the 2nd NBI. Vacuum Pumping System Modifications necessary to accommodate the 2nd NBI are included in WBS element 1.3. NBI Management and Health Physics support are included in element WBS 1.7.

WBS Element: 1.2.4.2 **WBS Level: 4**
WBS Title: NBI Source Refurbishment
Definition: This WBS element includes the activities to refurbish three neutral beam ion sources for the 2nd Neutral beamline, as currently being performed for the installed Neutral beamline 1.
{Source Refurbishment (Job 2420)}

WBS Element: 1.2.4.3 **WBS Level: 4**
WBS Title: NSTX Beamline 2 Decontamination
Definition: This WBS element includes the disassembly and decontamination activities of a TFTR Neutral Beam beamline in preparation for beamline refurbishment and reuse as an NSTX upgrade.
{NSTX Beamline 2 Decontamination (Job 2430)}

WBS Element: 1.2.4.4 **WBS Level: 4**
WBS Title: NBI Beamline Refurbishment and Relocation
Definition: This WBS element includes refurbishment of a TFTR NBI and its relocation to the NSTX test cell.

Included in this WBS element are the activities necessary to refurbish a TFTR Neutral Beam beamline for use on NSTX. This scope includes

replacing copper impinged parts as required and refurbishment of the seals, thermocouple wiring, and bellows (cal and spool) as needed.
{NSTX Beamline 2 Refurbishment (Job 2440)}

Also included in this WBS element are the efforts necessary to relocate a TFTR neutral beam line and ancillary equipment into the NSTX test cell. This includes High Voltage Enclosures (HVEs) and the complete beam box.
{NSTX Beamline 2 Relocation (Job 2425)}

WBS Element: 1.2.4.5 **WBS Level: 4**
WBS Title: NSTX Beamline 2 Services
Definition: This WBS element includes the efforts to provide services to the new neutral beam beamline and ancillary equipment in NSTX test cell. These services include water, cryogenic systems, gas supplies, and vacuum lines.
{NSTX Beamline 2 Services (Job 2450)}

WBS Element: 1.2.4.6 **WBS Level: 4**
WBS Title: NBI Armor
Definition: This WBS element includes the design, fabrication, and installation of upgraded and relocated neutral beam armor including cooling and instrumentation work.
{NBI Armor (Job 2460)}

WBS Element: 1.2.4.7 **WBS Level: 4**
WBS Title: NBI Beamline 2 Power and Controls
Definition: This WBS element includes providing power, controls and instrumentation for the 2nd Neutral beamline.

Included in this WBS element is providing power for the NBI beamline 2. NB2 is planned to be powered from the TFTR NB4 A, B, & C line ups. The electrical equipment in these line ups will be reactivated. The TFTR NB4 HVEs will be relocated to the NSTX Test Cell as part of WBS element 1.2.4.4. New triax cables will be installed with terminations from the Modregs to the HVEs. New Decel coaxial cables will be installed from the Decel supplies to the Sources. The Arc, Filament, Magnet, and the 208 feeds, to HVEs cables, will be spliced in the TFTR Test Cell basement to new cabling designed and installed from the TFTR Basement to the NSTX Test Cell. The fiber cables also will be spliced with additional lengths recovered from other TFTR line ups. The AC auxiliaries and Grounding for the NB2 will be designed and installed.
{NBI Power System (Job 2470)}

Also included in this WBS element are the controls and instrumentation for the NB2. The work covers PLC, programming, control racks, new thermocouples, TC scanner, miscellaneous controls, and control cabling. The work also includes the gradient grid upgrade. System integration and testing will also be performed as part of this effort.

Work Approval Form (WAF)

Cost Center: 9418
Job Number: 2425
Job Title: NSTX Beamline 2 Relocation
Job Manager: Martin Denault

Description:

This job includes the efforts to relocate a TFTR neutral beam line and ancillary equipment into the NSTX test cell. This includes the High Voltage Enclosures (HVEs) and the complete beam box.

Schedule:

Refer to Primavera Data-Base

Approvals:

7-20-10
Job Manager

8/3/10
Project Manager

8/3/10
Engineering Department Head

Cost Center: 9418
Job Number: 2425
Job Title: NSTX Beamline 2 Relocation
Job Manager: Martin Denault

USER INPUT TASKS AND DESCRIPTIONS

SCHEDULE — ***USER INPUT***

Estimate (user input) — **FY10$K** — **HOURS (priced at FY10 rates)**

task numb	P3 cross ref (optinal)	TASK DESCRIPTION	Responsible	DURATION in WORK DAYS	Logical Pre-requisites (one task numbers in each column ,any order)	User Input Start Date (optional)	actual=A	M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	EA** EM (analysis engr)	EA** (Designer)	EC** EM (computing Engr)	EE** EM (Elctr Engr)	EE** SM (Senior Electr Tech)	EE** SB (Electr Tech)	EE** TB (Electr Tech)	EM** EM (FO&M Engr)	EM** SM Senior Tech)	EM** SB (FO&M Tech)	EM** TB (FO&M Tech)	FC** AM (P&C Officer)	Contingency	Names of req'd skills if known	Basis of Estimate Category
1																											
2																											
3																											
4		**Preliminary Design**	Denault																								
5		PDR Prep		5	17															40					10%		4- Experience
6		CONDUCT PDR		2	18															16					10%		4- Experience
7		Lehman Review		5		12/15/10														40							4- Experience
8																											
9		**Final Design**	Denault																								
10		Disposition PDR Chits		2	21	1/28/11														16					10%		4- Experience
11		Design Drawings		10	22									80		40				20					10%		4- Experience
12		Update Analyses		5	23								80							40					10%		4- Experience
13		Update Cost & Schedule Estimate		5	24															40				40	10%		4- Experience
14		Prep Procurement Specs		5	25															40					10%		4- Experience
15		FDR Prep		5	26															40					10%		4- Experience
16		CONDUCT FDR		2	27															16					10%		4- Experience
17																											
36																											
37		**Installation**	Denault																								
38		Installation Procedure																									
39		Machine Installation																									
40		PTP Testing																									
41																											
42		Engineering 1 Days Per Week title III	1	280		2/1/11										160				448					10%		4- Experience
43		Engineering Support 1/2 Days Per Week title III	0.5	280		2/2/11														224					25%		4- Experience
44		Drafting Support 1/2 day/week title III	0.5	280		2/3/11									224										10%		4- Experience
45																											
46		Path						$15																			
47		Road		5		1/1/12															40	160			25%		4- Experience
48		Duct Removal		2	59	1/1/12															16	64			25%		4- Experience
49		Lintel Removal		3	60														16	8	24	96			25%		4- Experience
50		Lintel Install		2	107														16	8	16	64			25%		4- Experience
51		Duct Install		2	62																16	64			25%		4- Experience
		[redacted]						[redacted]																			
52																											
53																											
54		Metrology						$3																			
55		Setup		5		10/1/09														80		80			10%		4- Experience
56		Measure		15	67															240		240			10%		4- Experience
57		Model		5	68									80						80					10%		4- Experience
58		Lay out		5	69															80		80			10%		4- Experience
		[redacted]						[redacted]																			
59																											
60		Labyrinth Removal		[redacted]		6/1/10		[redacted]											32		[redacted]				20%		4- Experience
61																											
62		Lift Fixtures						[redacted]																			
63		Construction		20		1/10/10																480			10%		4- Experience

Cost Center:	9418
Job Number:	2425
Job Title:	NSTX Beamline 2 Relocation
Job Manager:	Martin Denault

Estimate (user input)

task	TASK DESCRIPTION	Responsible	DURATION in WORK DAYS	Logical Pre-requisites (one task numbers in each column ,any order)			User Input Start Date (optional)	actual= A	M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	EA** EM (analysis engr)	EA** (Designer)	EC** EM (computing Engr)	EE** EM (Electr Engr)	EE** SM (Senior Electr Tech)	EE** SB (Electr Tech)	EE** TB (Electr Tech)	EM** EM (FO&M Engr)	EM** SM Senior Tech)	EM** SB (FO&M Tech)	EM** TB (FO&M Tech)	FC** AM (P&C Officer)	Contingency	Names of req'd skills if known	Basis of Estimate Category
	USER INPUT TASKS AND DESCRIPTIONS		SCHEDULE USER INPUT						FY10$K					HOURS (priced at FY10 rates)														
64	Load Test		5	75																	40	40	120			10%		4- Experience
65	Move		1	76																			24			10%		4- Experience
66	Trial Runs		5	77																	40	40	120			10%		4- Experience
67																												
68	Box Movement								$2																			
69	Lift onto Rollers		1	95	#	#	1/1/12														152	8	48			20%		4- Experience
70	Move IN		1	88																	8	8	48			20%		4- Experience
71	Over Wall		1	89																	8	8	48			20%		4- Experience
72	Placement		10	90																	80	80	480			20%		4- Experience
73	Metrology		10	91																	80	80	160			20%		4- Experience
74																												
75	Source Platform								$1																			
76	Off		1				1/1/10															8	24			10%		4- Experience
77	Move		1	95																		8	16			10%		4- Experience
78	Lift		1	96																		8	32			10%		4- Experience
79	On		1	97																		8	32			10%		4- Experience
80	Metrology		10	98																	160	80	320			10%		4- Experience
81																												
82																												
83	Lid Movement								$5																			
84	Stabilize		3	99																	24	24	120			20%		4- Experience
85	Lift onto Rollers		1	103																	8	8	48			20%		4- Experience
86	Move IN		1	104																	8	8	48			20%		4- Experience
87	Over Wall		1	105																	8	8	48			20%		4- Experience
88	Placement		1	106																	8	8	16			20%		4- Experience
89	Metrology		1	107																	16	8	48			20%		4- Experience
90																												
91																												
92	Component Movement								$2																			
93	90in Flange		2	108																		16	64			10%		4- Experience
94	Magnet		2	112																	8	16	64			10%		4- Experience
95	Ion Dump		2	113																	8	16	64			10%		4- Experience
96	Exit Spool		2	114																		16	64			10%		4- Experience
97	TIV		2	115																		16	64			10%		4- Experience
98	Calorimeter		2	116																	8	16	64			10%		4- Experience
99																												
100																												
101	Source Movement																											
102	Move 1		2	99																		16	64			10%		4- Experience
103	Align 1		4	121																	64	32	128			10%		4- Experience
104	Move 2		2	122																		16	64			10%		4- Experience
105	Align 2		4	123																	64	32	128			10%		4- Experience
106	Move 3		2	124																		16	64			10%		4- Experience
107	Align 3		4	125																	64	32	128			10%		4- Experience
108																												
109	HVE 1 Movement								$1																			
110	Move		2		#		6/1/11														8	16	64			10%		4- Experience

Cost Center:	9418			
Job Number:	2425			
Job Title:	NSTX Beamline 2 Relocation			
Job Manager:	Martin Denault			

Estimate (user input)

task	TASK DESCRIPTION	Responsible	DURATION in WORK DAYS	Logical Pre-requisites (one task numbers in each column ,any order)	User Input Start Date (optional)	actual= A	M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	EA** EM (analysis engr)	EA** (Designer)	EC** EM (computing Engr)	EE** EM (Elctr Engr)	EE** SM (Senior Electr Tech)	EE** SB (Electr Tech)	EE** TB (Electr Tech)	EM** EM (FO&M Engr)	EM** SM Senior Tech)	EM** SB (FO&M Tech)	EM** TB (FO&M Tech)	FC** AM (P&C Officer)	Contingency	Names of req'd skills if known	Basis of Estimate Category
	USER INPUT TASKS AND DESCRIPTIONS		SCHEDULE – USER INPUT				FY10$K					HOURS (priced at FY10 rates)														
111	Disassemble		2	129																16	64			10%		4- Experience
112	Move to Crain Access		2	130																16	64			10%		4- Experience
113	Lift into TFTR		1	131																8	32			10%		4- Experience
114	Move In		1	132																8	32			10%		4- Experience
115	Over Wall		2	133																16	80			10%		4- Experience
116	Reassemble		2	134																16	64			10%		4- Experience
117	Placement		3	135																24	96			10%		4- Experience
118																										
119	HVE 2 Movement						$1																			
120	Move		2																8	16	64			10%		4- Experience
121	Disassemble		2	139																16	64			10%		4- Experience
122	Move to Crain Access		2	140																16	64			10%		4- Experience
123	Lift into TFTR		1	141																8	32			10%		4- Experience
124	Move In		1	142																8	32			10%		4- Experience
125	Over Wall		2	143																16	80			10%		4- Experience
126	Reassemble		2	144																16	64			10%		4- Experience
127	Placement		3	145																24	96			10%		4- Experience
128																										
129	HVE 3 Movement						$1																			
130	Move		2																8	16	64			10%		4- Experience
131	Disassemble		2	149																16	64			10%		4- Experience
132	Move to Crain Access		2	150																16	64			10%		4- Experience
133	Lift into TFTR		1	151																8	32			10%		4- Experience
134	Move In		1	152																8	32			10%		4- Experience
135	Over Wall		2	153																16	80			10%		4- Experience
136	Reassemble		2	154																16	64			10%		4- Experience
137	Placement		3	155																24	96			10%		4- Experience
																								10%		
																								10%		
	TOTALS						106.0	$0	$0	$0	$0	80	160	224	200	0	0	64	2356	1312	6296	0	40			
							127.2	0.0	0.0	0.0	0.0	14.2	19.0	30.3	34.5	0.0	0.0	5.3	351.4	195.3	727.9	0.0	6.3			

TOTAL Preliminary Cost Estimate ($k)= $1,511

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 Experieince (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:	9418
Job Number:	2425
Job Title:	NSTX Beamline 2 Relocation
Job Manager:	Martin Denault

Uncertainty of the Estimate

	High	Medium	Low	Uncertainty Range (%)	Comments/Other Considerations
Design Maturity		X			
Design Complexity			X		

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								
2								
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

Cost Center:	9418						
Job Number:	2425						
Job Title:	NSTX Beamline 2 Relocation						
Job Manager:	Martin Denault						
Materials and Subcontracts (M&S)				**Basis of Estimate**			
Description:							
Pipe				Vendor Pricing			
Parts				Vendor Pricing			
MISC				Experience			

CATEGORIZATION CODES:
1 - National Standards
2 - Engineering Judgement/Experience
3 - Estimates/Data from External Sources (e.g., W7X, ATF, etc.)
4 - Previous PPPL/ORNL Experieince (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

TOTALS