Work Authorization Document

NSTX Upgrade Project

Control Account #:	2470	**Title:**	2nd NBI Power
WBS	1.2.4	**Title:**	NB Injection
Period of Performance:	23 February 2009 through 30 September 2014		
Authorized Budget:	$3,335	**Control Account Manager:**	Raki
Revision #:	0	**Revision Date:**	July-11

Authorized Work Description:

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.

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	Raki		
Functional Manager	A. vonHalle		

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		1,401	23FEB09A	23FEB09A	30SEP14	30SEP14	0	1,487	3,333,994.03		239,282.36	240,032.53

Job: 2470 - 2nd NBI Power-RAKI

Subtotal		1,401	23FEB09A	23FEB09A	30SEP14	30SEP14	0	1,487	3,333,994.03		239,282.36	240,032.53

21-AC Aux.

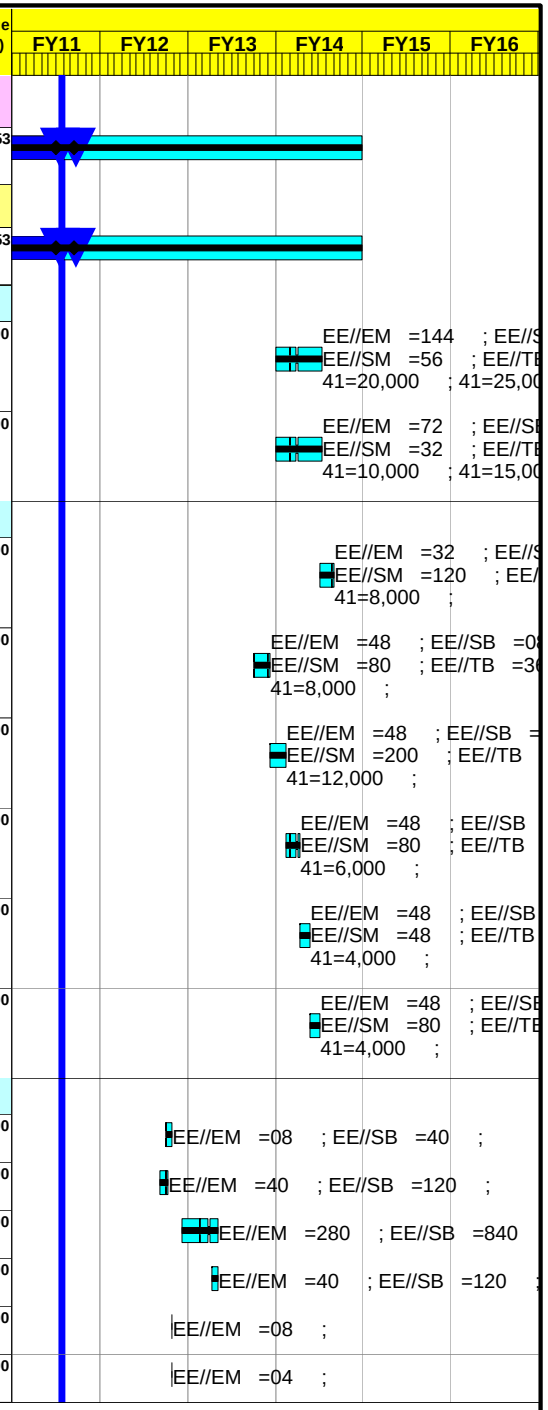
247000245	ip211-AC Auxiliaries PP's etc	130	01OCT13*	01OCT13*	14APR14	14APR14	0	63	174,685.04		0.00	0.00
247000250	212 grounding	130	01OCT13*	01OCT13*	14APR14	14APR14	0	63	109,645.28		0.00	0.00

22-Reactivation

247000254	Power Testing of Reactivated Equipment	45	03APR14	03APR14	05JUN14	05JUN14	0	26	51,300.96		0.00	0.00
247000255	Switchyard- Reactivation	45	01JUL13*	01JUL13*	04SEP13	04SEP13	0	26	68,716.88		0.00	0.00
247000256	Surge Room- Reactivation	50	05SEP13	05SEP13	13NOV13	13NOV13	0	26	103,722.63		0.00	0.00
247000257	Mod- reg- Reactivation	30	14NOV13	14NOV13	08JAN14	08JAN14	0	26	48,791.60		0.00	0.00
247000258	Arc/Filament/magnet- Reactivation	30	09JAN14	09JAN14	19FEB14	19FEB14	0	26	38,783.28		0.00	0.00
247000259	LCC- Reactivation	30	20FEB14	20FEB14	02APR14	02APR14	0	26	46,091.60		0.00	0.00

24-Cabling

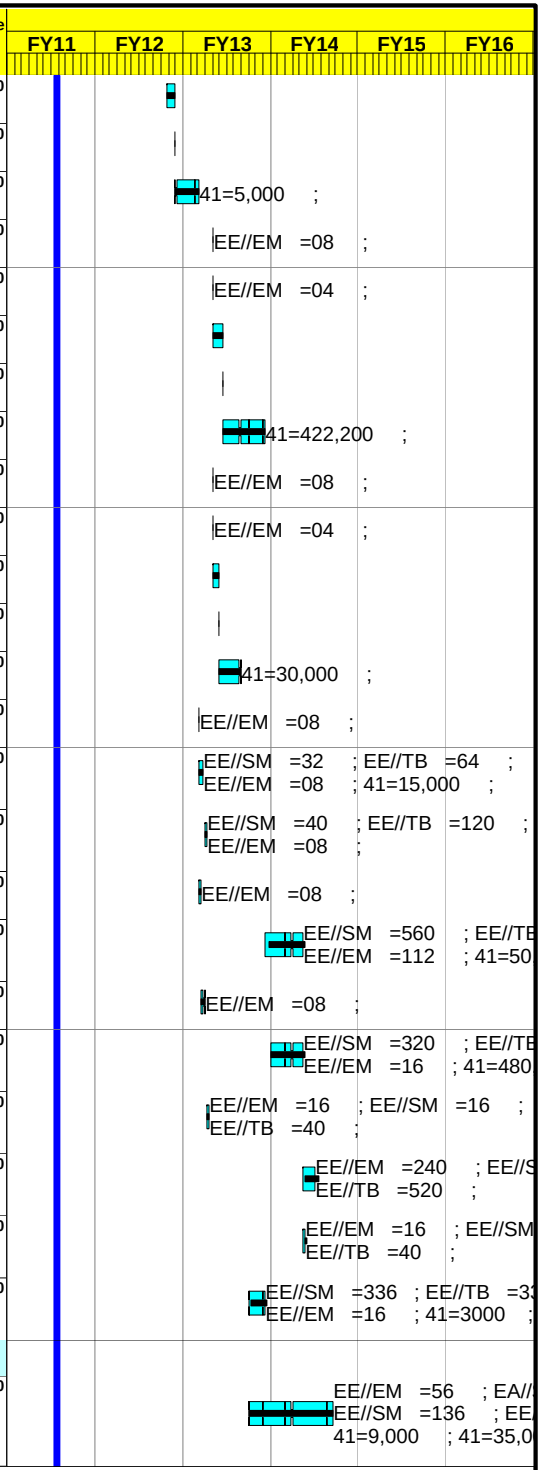
247000260	Design - Penetrations	15	02JUL12*	02JUL12*	23JUL12	23JUL12	0	190	6,983.52		0.00	0.00
247000270	Design Removal of Cable	25	08JUN12*	08JUN12*	13JUL12	13JUL12	0	182	23,984.00		0.00	0.00
247000275	Design - Cables	100	04SEP12*	04SEP12*	01FEB13	01FEB13	0	47	170,743.41		0.00	0.00
247000280	Prep Procurement Spec - Raceway	15	14JAN13*	14JAN13*	01FEB13	01FEB13	0	160	24,487.60		0.00	0.00
247000420	Prep Req & Procurement Pckg - Penetrations	1	24JUL12	24JUL12	24JUL12	24JUL12	0	190	1,516.72		0.00	0.00
247000430	Submit Req to Procurement - Penetrations	1	25JUL12	25JUL12	25JUL12	25JUL12	0	190	758.36		0.00	0.00



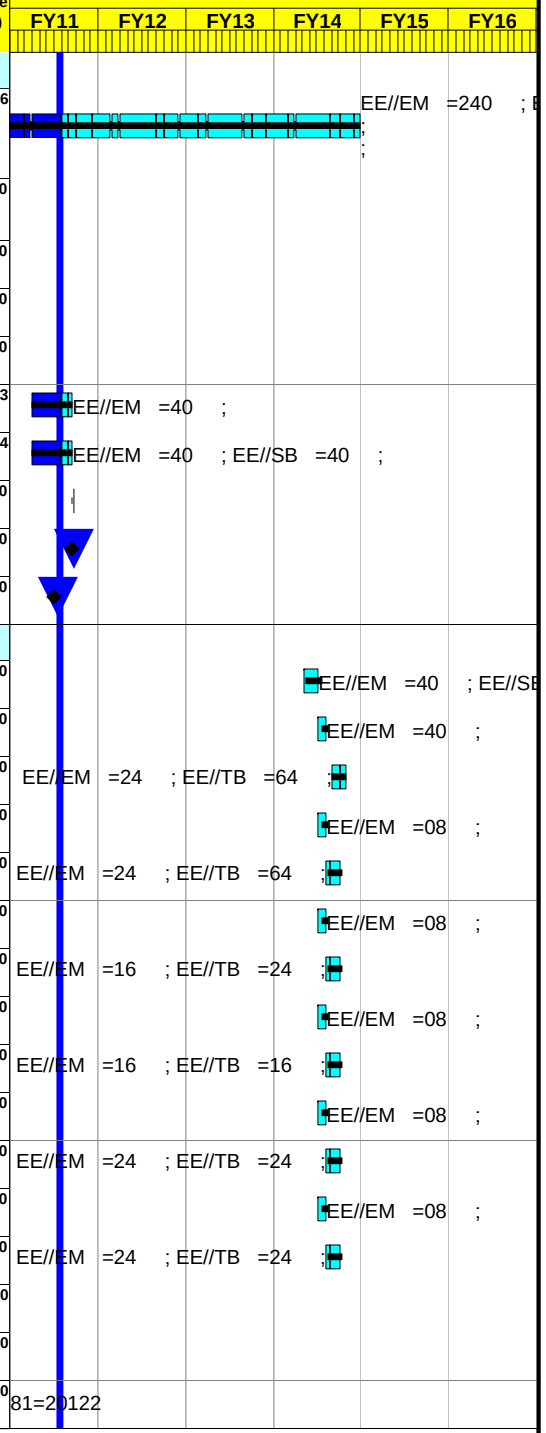
Data Date	**30APR11**	**1105**	**NSTX UPGRADES** **RESOURCE LOADED SCHEDULE** **CD-2 Schedule** **April 2011**	**Sheet 1 of 3**
Run Date	**20MAY11 10:55**			

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)
247000440	Procurement Lead Time - Penetrations	25	26JUL12	26JUL12	29AUG12	29AUG12	0	190	0.00		0.00	0.00
247000450	Award - Penetrations	1	30AUG12	30AUG12	30AUG12	30AUG12	0	190	0.00		0.00	0.00
247000460	Procurement/Fab/Assembly - Penetrations	65	31AUG12	31AUG12	04DEC12	04DEC12	0	190	6,553.85		0.00	0.00
247000470	Prep Req & Procurement Pckg - Cables	1	04FEB13	04FEB13	04FEB13	04FEB13	0	47	1,548.56		0.00	0.00
247000480	Submit Req to Procurement - Cables	1	05FEB13	05FEB13	05FEB13	05FEB13	0	47	774.28		0.00	0.00
247000490	Procurement Lead Time - Cables	30	06FEB13	06FEB13	19MAR13	19MAR13	0	47	0.00		0.00	0.00
247000500	Award - Cables	1	20MAR13	20MAR13	20MAR13	20MAR13	0	47	0.00		0.00	0.00
247000510	Procurement - NBI Cables	120	21MAR13	21MAR13	10SEP13	10SEP13	0	47	557,304.00		0.00	0.00
247000520	Prep Req & Procurement Pckg - Raceway	1	05FEB13	05FEB13	05FEB13	05FEB13	0	161	1,548.56		0.00	0.00
247000530	Submit Req to Procurement - Raceway	1	06FEB13	06FEB13	06FEB13	06FEB13	0	161	774.28		0.00	0.00
247000540	Procurement Lead Time - Raceway	15	07FEB13	07FEB13	27FEB13	27FEB13	0	161	0.00		0.00	0.00
247000550	Award - Raceway	1	28FEB13	28FEB13	28FEB13	28FEB13	0	161	0.00		0.00	0.00
247000560	Procurement/Fab/Assembly - Raceway	65	01MAR13	01MAR13	31MAY13	31MAY13	0	161	39,600.00		0.00	0.00
247000690	Installation Procedure - Penetrations	5	05DEC12	05DEC12	11DEC12	11DEC12	0	190	1,548.56		0.00	0.00
247000700	Installation - Penetrations	8	12DEC12	12DEC12	21DEC12	21DEC12	0	190	32,929.04		0.00	0.00
247000710	Removal - Cable	8	02JAN13	02JAN13	11JAN13	11JAN13	0	215	19,783.76		0.00	0.00
247000720	Installation Procedure - Cable	5	12DEC12	12DEC12	18DEC12	18DEC12	0	226	1,548.56		0.00	0.00
247000730	Installation - Cable	100	23SEP13*	11SEP13*	21FEB14	11FEB14	8	47	271,076.75		0.00	0.00
247000740	Installation Procedure - Raceway	5	19DEC12	19DEC12	03JAN13	03JAN13	0	266	1,548.56		0.00	0.00
247000750	Installation - 2nd NBI Raceway	90	07OCT13*	01OCT13*	21FEB14	17FEB14	4	78	739,832.48		0.00	0.00
247000780	Commissioning - Removal of Cable	5	14JAN13	14JAN13	18JAN13	18JAN13	0	310	9,639.28		0.00	0.00
247000790	Commissioning - Cable	40	24FEB14	12FEB14	18APR14	08APR14	8	47	141,711.60		0.00	0.00
247000795	Commissioning - Raceway	5	24FEB14	18FEB14	28FEB14	24FEB14	4	78	9,965.68		0.00	0.00
2470000729	decontmination of east wall	48	16JUL13	02JUL13	20SEP13	10SEP13	8	47	97,071.52		0.00	0.00
25-Transmission Line												
247000285	Design & Install Transmission Line	240	01JUL13*	01JUL13*	19JUN14	19JUN14	0	56	133,959.36		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)
28-System Design & Integration												
247000090	Design dwgs, changes,as-builts (LOE)	1,101*	03MAY10A	03MAY10A	30SEP14	30SEP14	0	1,487	87,822.51	LOE	19,847.88	19,861.76
247000100	CDR Complete Power System	20	01OCT09A	01OCT09A	28OCT09A	28OCT09A	0		0.00	100	0.00	0.00
247000180	PDR Preparation	37	03MAY10A	03MAY10A	23JUN10A	23JUN10A	0		0.00	100	0.00	0.00
247000190	Conduct PDR	1	24JUN10A	24JUN10A	24JUN10A	24JUN10A	0		0.00	100	0.00	0.00
247000200	PDR Complete	0			24JUN10A	24JUN10A	0		0.00	100	0.00	0.00
247000235	Calculations - Final Dsgn	115*	03JAN11*	03JAN11A	13JUN11	13JUN11	0	127	6,915.60	70	4,840.92	5,111.53
247000295	FDR Cabling	115*	03JAN11	03JAN11A	13JUN11	13JUN11	0	127	11,900.80	70	8,330.56	8,796.24
247000300	Conduct FDR	3	14JUN11	22JUN11*	14JUN11	24JUN11	-8	121	0.00		0.00	0.00
247000305	FDR Complete	0			14JUN11	24JUN11	-8	121	0.00		0.00	0.00
2470PEER	Peer Review	0			31MAR11	14APR11A	-10		0.00		0.00	0.00
System Testing												
247000890	New Procedures, PTP's, ISTP's	44	18FEB14*	06FEB14*	18APR14	08APR14	8	47	19,546.80		0.00	0.00
247000900	DC Hipots Engineering	20	21APR14	09APR14	16MAY14	06MAY14	8	47	8,005.20		0.00	0.00
247000910	DC Hipots Commissioning	40	06JUN14	06JUN14	01AUG14	01AUG14	0	26	11,022.00		0.00	0.00
247000920	Elect Interlock Testing Eng	20	21APR14	09APR14	16MAY14	06MAY14	8	47	1,601.04		0.00	0.00
247000930	Elect Interlock Testg Commissioning	40	19MAY14	07MAY14	15JUL14	02JUL14	8	47	11,022.00		0.00	0.00
247000940	Kirk Key Testing Eng	20	21APR14	09APR14	16MAY14	06MAY14	8	47	1,601.04		0.00	0.00
247000941	Kirk Key Testg Commissioning	40	19MAY14	07MAY14	15JUL14	02JUL14	8	47	5,534.16		0.00	0.00
247000945	Instrumentation Testing Engr	20	21APR14	09APR14	16MAY14	06MAY14	8	47	1,601.04		0.00	0.00
247000946	Instrumentation Commissioning	40	19MAY14	07MAY14	15JUL14	02JUL14	8	47	4,756.80		0.00	0.00
247000950	Control Sys Engr	20	21APR14	09APR14	16MAY14	06MAY14	8	47	1,601.04		0.00	0.00
247000951	Control Sys Commissioning	40	19MAY14	07MAY14	15JUL14	02JUL14	8	47	7,135.20		0.00	0.00
247000960	Coil Protection Engr	20	21APR14	09APR14	16MAY14	06MAY14	8	47	1,601.04		0.00	0.00
247000971	Coil Protection Commissioning	40	19MAY14	07MAY14	15JUL14	02JUL14	8	47	7,135.20		0.00	0.00
FY092470	FY09 Actual Cost	22*	23FEB09A	23FEB09A	30SEP09A	30SEP09A	0		115,170.00	100	115,170.00	115,170.00
FY102470	FY10 Actual Cost	143	01OCT09A	01OCT09A	30APR10A	30APR10A	0		78,528.00	100	78,528.00	78,528.00
FY102470A	FY10 Actual Cost	110	03MAY10A	03MAY10A	30SEP10A	30SEP10A	0		12,565.00	100	12,565.00	12,565.00



2470 2nd NBI Power (Raki)	START	28FEB2009	31MAR2009	30APR2009	31MAY2009	30JUN2009	31JUL2009	31AUG2009	30SEP2009	31OCT2009	30NOV2009	31DEC2009
BCWS	0	4	16	16	15	16	16	16	16	12	10	9
CUM BCWS	0	4	20	36	51	68	84	100	115	127	138	147
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	.	-4.	-20.	-36.	-51.	-68.	-84.	-100.	-115.	-127.	-138.	-147.
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

2470 2nd NBI Power (Raki)		31JAN2010	28FEB2010	31MAR2010	30APR2010	31MAY2010	30JUN2010	31JUL2010	31AUG2010	30SEP2010	31OCT2010	30NOV2010	31DEC2010
	BCWS	11	11	13	12	4	4	4	4	4	2	1	1
	CUM BCWS	158	169	182	194	197	201	205	209	213	215	216	217
	BCWP	0	0	0	0	0	0	0	0	0	0	0	217
	CUM BCWP	0	0	0	0	0	0	0	0	0	0	0	217
	ACWP	0	0	0	0	0	0	0	0	0	0	0	215
	CUM ACWP	0	0	0	0	0	0	0	0	0	0	0	215
	CV	0	0	0	0	0	0	0	0	0	0	0	3
	SV	-158.	-169.	-182.	-194.	-197.	-201.	-205.	-209.	-213.	-215.	-216.	.
	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	1

2470 2nd NBI Power (Raki)		31JAN2011	28FEB2011	31MAR2011	30APR2011	31MAY2011	30JUN2011	31JUL2011	31AUG2011	30SEP2011	31OCT2011	30NOV2011	31DEC2011
	BCWS	5	5	5	5	5	3	2	2	2	2	2	2
	CUM BCWS	222	227	233	237	242	245	247	249	250	252	254	255
	BCWP	3	3	7	5	0	0	0	0	0	0	0	0
	CUM BCWP	221	224	231	237	237	237	237	237	237	237	237	237
	ACWP	1	3	7	11	0	0	0	0	0	0	0	0
	CUM ACWP	216	219	226	237	237	237	237	237	237	237	237	237
	CV	5	5	5	-1	-1	-1	-1	-1	-1	-1	-1	-1
	SV	-2.	-3.	-1.	-1.	-6.	-9.	-10.	-12.	-13.	-15.	-17.	-19.
	CPI	1.02	1.02	1.02	1.	1.	1.	1.	1.	1.	1.	1.	1.
	SPI	0.99	0.99	1	1	0.98	0.96	0.96	0.95	0.95	0.94	0.93	0.93

2470 2nd NBI Power (Raki)		31JAN2012	29FEB2012	31MAR2012	30APR2012	31MAY2012	30JUN2012	31JUL2012	31AUG2012	30SEP2012	31OCT2012	30NOV2012	31DEC2012
	BCWS	2	2	2	2	2	16	20	2	33	40	38	72
	CUM BCWS	257	259	260	262	264	280	300	302	335	375	414	486
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	237	237	237	237	237	237	237	237	237	237	237	237
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	237	237	237	237	237	237	237	237	237	237	237	237
	CV	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	SV	-20.	-22.	-24.	-25.	-27.	-43.	-64.	-66.	-98.	-139.	-177.	-249.
	CPI	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
	SPI	0.92	0.92	0.91	0.9	0.9	0.84	0.79	0.78	0.71	0.63	0.57	0.49

2470 2nd NBI Power (Raki)		31JAN2013	28FEB2013	31MAR2013	30APR2013	31MAY2013	30JUN2013	31JUL2013	31AUG2013	30SEP2013	31OCT2013	30NOV2013	31DEC2013
	BCWS	91	9	46	114	119	91	174	187	129	307	296	302
	CUM BCWS	577	586	632	746	865	956	1,130	1,317	1,446	1,752	2,049	2,351
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	237	237	237	237	237	237	237	237	237	237	237	237
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	237	237	237	237	237	237	237	237	237	237	237	237
	CV	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	SV	-340.	-349.	-395.	-509.	-628.	-719.	-893.	-1080.	-1209.	-1516.	-1812.	-2114.
	CPI	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
	SPI	0.41	0.4	0.37	0.32	0.27	0.25	0.21	0.18	0.16	0.14	0.12	0.1

2470 2nd NBI Power (Raki)		31JAN2014	28FEB2014	31MAR2014	30APR2014	31MAY2014	30JUN2014	31JUL2014	31AUG2014	30SEP2014	31OCT2014	30NOV2014	31DEC2014
	BCWS	317	260	172	121	56	36	17	2	2	0	0	0
	CUM BCWS	2,668	2,929	3,100	3,222	3,278	3,314	3,331	3,333	3,335	3,335	3,335	3,335
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	237	237	237	237	237	237	237	237	237	237	237	237
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	237	237	237	237	237	237	237	237	237	237	237	237
	CV	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
	SV	-2432.	-2692.	-2863.	-2985.	-3041.	-3077.	-3094.	-3096.	-3098.	-3098.	-3098.	-3098.
	CPI	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
	SPI	0.09	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07

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

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: 2470
Job Title: NBI Power Systems
Job Manager: S. Ramakrishnan
Rev 1 6/7/2010

Description:

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 Job 2425 NSTX Beamline 2 Relocation.* 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.

Schedule:

Refer to Primavera Data-Base

Approvals:

7/21/10
Job Manager

8/3/10
Project Manager

8/3/10
Engineering Department Head

NBI Power System (all Values ... ...'s unless noted otherwise)

Cost Center:	9418																												
Job Number:	2470																												
Job Title:	NBI Power Systems																												
Job Manager:	S. Ramakrishnan																												
NSTX NB2 Power System 060710 with decontamination effort													M&S				Design/ Procurement		Installation				Commissioning			Line Total	Cont.		
						Mult	Qt y	excl factor	Qnt y	Units	Qty	Units	Unit Cost (k$/unit)	Cost ($K)	Spare Units	Spare Cost ($K)	EEEM (md)	DM (md)	EEEM (md)	EESM (md)	EETB (md)	SC ($K)	EEEM (md)	EESM (md)	EETB (md)	($K)		Names of req'd skills if known	Basis of Estimate Category
21 - AC Auxiliaries	$246.643	$246.6																											
		$246.6	$246.6																										
	211 - AC Aux		PPs,etc.			1		1			1	lot	$20.00	$20.00		1	12	30	5	5	50	$25	1	2	2	$152	10%		4
	212 - Grounding		Misc. grounding			1		1			1	lot	$10.00	$10.00			5	20	3	2	40	$15	1	2	2	$95	10%		4
22 - Reactivation	$236.299	$236.3																											
	Reactivation of Equipment	$236.3	$236.3			1		1																					
			Switchyard	Maintenance	Reactivation	1		1			3		$2.00	$6.00	1.000	2.000	1	1					5	10	45	$58	10%		4
			Surge Room	Maintenance	Reactivation	1		1			3		$3.00	$9.00	1.000	3.000	1	1		10	24		5	10	15	$70	10%		4
			Mod-Reg	Maintenance	Reactivation	1		1			3		$1.50	$4.50	1.000	1.500	1	1					5	10	20	$39	10%		4
			Arc/Filament/Magnet	Maintenance	Reactivation	1		1			3		$1.00	$3.00	1.000	1.000	1	1					5	6	18	$31	10%		4
			LCC	Maintenance	Reactivation	1		1			3		$1.00	$3.00	1.000	1.000	1	1					5	10	20	$38	10%		4
24 - Cabling	$1,966.238	$1,966.2																											
		$1,966.2	$1,966.2																										
		Penetrations	Misc			1		1	5		5		$1.00	$5.00			1	5	1	4	8	$15				$42	10%		2,4
		Removing cabling	Misc			1		1									5	15	1	5	15		2	2	5	$47	10%		2,4
		4/C-500mcm Arc/ Fil. cables *	Six (6) Cables			1		1	3		1800	ft	$0.03	$162.00			5	15	2	10	15		2	2	5	$253	15%		4,6
		4/C- 500 mcm Magnet cables*	Three (3) Cables			1		1	3		900	ft	$0.03	$81.00			5	15	2	10	15		2	2	5	$154	15%		4,6
		HVDC Triax cables**	Three (3) Cables			1		1	3		310	ft	$0.11	$102.30			5	15	2	10	15	$5	10	10	20	$217	15%		4,6
		HVDC Triax cables terminations	Six (6) terminations			1		1	1		6	unit	$5.00	$30.00			5	15	2	10	15	$20	10	10	20	$146	15%		4,6
		4-C #8 ,208V Cables for NB *	Three (3) Cables			1		1	3		900	ft	$0.01	$27.00			5	15	2	10	15		2	2	5	$88	10%		4,6
		RG 218U Decel Cables*	Three (3) cables			1		1	3		550	ft	$0.01	$9.90			5	15	2	10	15		2	2	5	$67	10%		2,4
		8 channel Fiber Cables	Eighteen (18) Cables			1		1						$10.00			5	15	2	40	40		2	2	5	$120	15%		2,4
		decontamination effort on TFTR cast wall surface	1 lot			1		1						$3.00			1			40	40		1	2	2	$84			4&7
		Fiber Cables	Prototype test of fusion splices			1		1						$0.30			1	1	1	5	5		1	1	2	$17	10%		2,4
		Raceways/ installation/pulling/termintation	1 lot			1		1						$30.00			5	15	2	40	40	$480	2	2	5	$733	30%		2,4
25 - Transmission Line	$117.715	$117.7																											
		$117.7	$117.7																										
			Install transmission line			1		1			3		$3.00	$9.00			3	15	2	15	25	$35	2	2	4	$118	10%		2,4
26- System Design and Integration	$261.849	$261.8																											
		$191.5	$191.5																										
			Design Drawings & Drawings changes , as-builts	New drawings & Misc. updates		1		1									30.00	40.00								$79	10%		2,4
			CDR Power system	power system		1		1									5.00	5.00								$12	10%		2,4
			PDR Power system	power system		1		1									5.00	5.00								$12	10%		2,4
			FDR Cabling	power system		1		1									5.00	5.00								$12	10%		2,4
			Calculations	calculations - documentation		1		1									5.00									$7	10%		2,4
	System Testing	$70.3	$70.3																										
			Procedures PTPs, ISTPs	New Procedures		1		1									5.00	10.00								$16	10%		2,4
				DC Hipots		1		1									5						3		8	$16	10%		2,4
				Electrical Interlock Testing		1		1									1						3		8	$11	10%		2,4
				Kirk Key Interlock Testing		1		1									1						2		3	$6	10%		2,4
				Instrumentation Test & Calibration		1		1									1						2		2	$5	10%		2,4
				Control System Testing		1		1									1						3		3	$8	10%		2,4
				Coil Protection System Testing		1		1									1						3		3	$8	10%		2,4
			TOTALS											$525.00		10	135	276	29	226	377	$595	80	89	232	$2,758			
IN MAN HOURS																	1080	2208	232	1808	3016		640	712	1856				
RATES FY10													M&S -->	525	Spares-->	9.500					SC -->	729							
		FY2010 Hourly Rates																								ΣMD			
EEEM	1.3794	172.4	1.3794	1.3680										643.650			449		564			729	373	cross check	EEEM	244			
EESM	1.2049	150.6	1.2049	1.1600																					EESM	315			
EETB	0.6682	83.5	0.6682	0.6400													2758								EETB	609			
G&A (MHX)	1.2260	1.178		1.2260										2758.441											EADM	276			
DM	0.9504	118.8	0.9504	0.9900																					[illegible]	525			

NBI Power System (all Values in K$'s unless noted otherwise)

Cost Center:	9418
Job Number:	2470
Job Title:	NBI Power Systems
Job Manager:	S. Ramakrishnan

NSTX NB2 Power System 060710 with decontamination effort

	Mult	Qty	excl factor	Qnty	Units	M&S Qty	M&S Units	M&S Unit Cost (k$/unit)	M&S Cost ($K)	Spare Units	Spare Cost ($K)	Design/ Procurement EEEM (md)	Design/ Procurement DM (md)	Installation EEEM (md)	Installation EESM (md)	Installation EETB (md)	SC ($K)	Commissioning EEEM (md)	Commissioning EESM (md)	Commissioning EETB (md)	Line Total ($K)	Cont.	Names of req'd skills if known	Basis of Estimate Category
																				Subcon	595			
																				Total				

Notes:
SCOPE COVERED
2 Sub-contract estimates based on bids and a projected increase of costs
4. Cost in 2010 Dollars
5. SCHEDULE WILL AFFECT COST

CATEGORIZATION CODES:
1 - National Standards
2 - Engineering Judgement/Experience
3 - Estimates/Data from External Sources (e.g., W7X, ATF, etc.)
4 - Previous PPPL/ORNL Experielnce (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:	2470
Job Title:	NBI Power Systems
Job Manager:	S. Ramakrishnan

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	Old Varian tubes are being used and may need tune up	U	Based on further assessment this risk has been retied since we have enough spares.	Budgetary quotes received for Triax and other cables and used in estimate				
2	Old 100 micron fiber cables that are proposed to be used may not be in good condition	U	Test a prototype with a 62.5 micron cable fused to 100 micron cable	Past experience in installing the NB1 line up for NSTX		50		
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 Recommended