Work Authorization Document

NSTX Upgrade Project

Control Account #:	5200	**Title:**	DCPS
WBS	1.5	**Title:**	Power System
Period of Performance:	03 May 2010 through 20 August 2014		
Authorized Budget:	$2,493	**Control Account Manager:**	Hatcher
Revision #:	0	**Revision Date:**	July-11

Authorized Work Description:

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

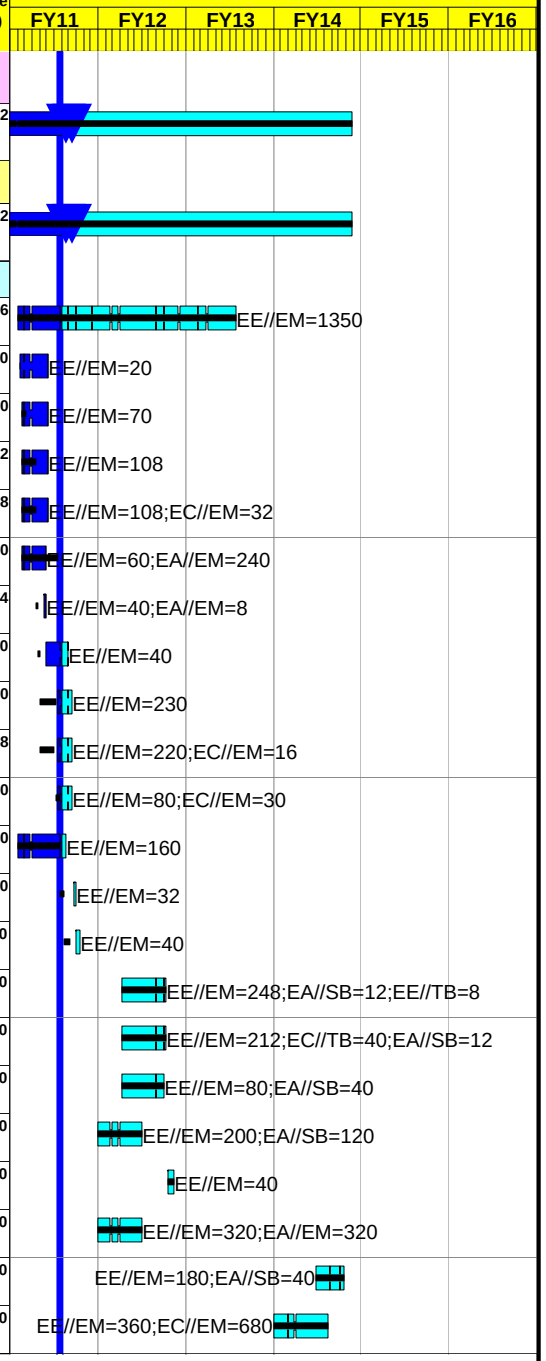
Approvals	Name	Signature	Date
NSTX-U Project Manager	R. Strykowsky		
Control Account Manager	Hatcher		
Functional Manager	A. vonHalle		

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		1,073	03MAY10A	03MAY10A	20AUG14	20AUG14	0	1,515	2,486,219.29		316,296.49	392,605.12

Job: 5200 - Digital Coil Protection-HATCHER

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		1,073	03MAY10A	03MAY10A	20AUG14	20AUG14	0	1,515	2,486,219.29		316,296.49	392,605.12
04	Project Oversigt	620*	01NOV10*	01NOV10A	29APR13	29APR13	0	126	248,849.99	LOE	49,023.45	48,967.26
08	Prep System Description	142*	08NOV10*	08NOV10A	12NOV10	03MAR11A	-71		3,457.80	100	3,457.80	3,457.80
09	Prep System Requirements	137*	15NOV10	15NOV10A	07DEC10	03MAR11A	-56		12,102.30	100	12,102.30	12,102.30
10	Analog Conceptual Design	137*	15NOV10	15NOV10A	19JAN11	03MAR11A	-31		18,672.12	100	18,672.12	18,672.12
11	Digital Conceptual Design	137*	15NOV10	15NOV10A	19JAN11	03MAR11A	-31		22,957.88	100	22,957.88	22,957.88
12	Conceptual Design Analysis & Alg. Prep.	100*	15NOV10	15NOV10A	13APR11	28FEB11A	32		56,616.60	100	56,616.60	56,616.60
13	CDR Prep. & Review	5	20JAN11	22FEB11A	26JAN11	28FEB11A	-23		8,457.04	100	8,457.04	8,457.04
16	CDR Chit Resolution	65*	27JAN11*	01MAR11A	02FEB11	31MAY11	-83	126	6,915.60	30	2,074.68	6,915.60
17	Analog Preliminary Design	40*	03FEB11	22APR11A	06APR11	17JUN11	-51	126	39,764.70	30	11,929.41	39,764.70
18	Digital Preliminary Design	40*	03FEB11	22APR11A	30MAR11	17JUN11	-56	126	40,178.68	30	12,053.60	40,178.68
19	PDR Prep. & Review	44*	07APR11	18APR11A	27APR11	17JUN11	-36	107	17,849.10	50	8,924.55	17,849.10
20	Systems Code Development	135*	01NOV10*	01NOV10A	27APR11	18MAY11	-15	128	27,662.40	80	22,129.92	27,662.40
23	PDR Chit Resolution	10	28APR11	20JUN11	11MAY11	01JUL11	-36	107	5,532.48		0.00	1,106.50
24	CSU FDR Prep	9	12MAY11	05JUL11	02JUN11	15JUL11	-30	107	0.00		0.00	0.00
25	Analog Design - Pt. I	130	12JAN12*	12JAN12*	13JUL12	13JUL12	0	255	49,398.48		0.00	0.00
26	Digital Design - Pt. I	130	12JAN12*	12JAN12*	13JUL12	13JUL12	0	255	44,816.44		0.00	0.00
27	Hardware Interface	120	12JAN12*	12JAN12*	28JUN12	28JUN12	0	265	20,646.40		0.00	0.00
28	Systems Code - A	120	03OCT11*	03OCT11*	28MAR12	28MAR12	0	330	54,355.60		0.00	0.00
29	Final Design Review	20	16JUL12	16JUL12	10AUG12	10AUG12	0	255	7,583.60		0.00	0.00
30	DCPS Algorithms	120	03OCT11*	03OCT11*	28MAR12	28MAR12	0	330	128,281.60		0.00	0.00
31	External Interface & Response	80	01APR14	01APR14	23JUL14	23JUL14	0	13	41,807.40		0.00	0.00
32	Real Time Programming	150	01OCT13*	01OCT13*	12MAY14	12MAY14	0	63	177,467.20		0.00	0.00



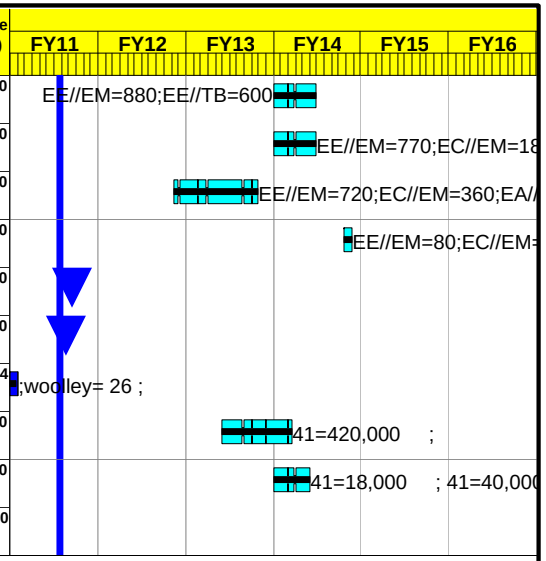
Data Date 30APR11
Run Date 20MAY11 11:02

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)
33	Analog Design - Pt. II	120	01OCT13*	01OCT13*	31MAR14	31MAR14	0	93	234,416.40		0.00	0.00
34	Digital Design - Pt. II	120	01OCT13*	01OCT13*	31MAR14	31MAR14	0	13	225,380.42		0.00	0.00
35	Systems Code - B	240	13AUG12	13AUG12	31JUL13	31JUL13	0	255	227,205.52		0.00	0.00
36	Systems Integration & Testing	20	24JUL14*	24JUL14*	20AUG14	20AUG14	0	13	41,970.40		0.00	0.00
19A	PDR	0				17JUN11*	0	2,305	0.00		0.00	0.00
5200-0024A	DCP - Peer Review	0				18MAY11*	0	147	0.00		0.00	0.00
5200-010	Woolley October Budget	20	01OCT10*	01OCT10A	28OCT10	29OCT10A	-1		4,495.14	100	4,495.14	4,495.14
5200013M	DCP -Hardware (procure & Install)	200	01MAR13*	01MAR13*	13DEC13	13DEC13	0	161	557,676.00		0.00	0.00
5200013N	DCP -Cabling and Raceways	100	01OCT13*	01OCT13*	03MAR14	03MAR14	0	113	78,300.00		0.00	0.00
FY105200A	FY10 Actual Cost	110	03MAY10A	03MAY10A	30SEP10A	30SEP10A	0		83,402.00	100	83,402.00	83,402.00



5200 DCPS (Hatcher)	START	28FEB2009	31MAR2009	30APR2009	31MAY2009	30JUN2009	31JUL2009	31AUG2009	30SEP2009	31OCT2009	30NOV2009	31DEC2009
BCWS	0	0	0	0	0	0	0	0	0	0	0	0
CUM BCWS	0	0	0	0	0	0	0	0	0	0	0	0
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	.	.	.	.	.	.	.	.	.	.	.	.
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

5200 DCPS (Hatcher)	31JAN2010	28FEB2010	31MAR2010	30APR2010	31MAY2010	30JUN2010	31JUL2010	31AUG2010	30SEP2010	31OCT2010	30NOV2010	31DEC2010
BCWS	0	0	0	0	16	17	17	17	17	4	39	41
CUM BCWS	0	0	0	0	16	33	50	67	83	88	127	169
BCWP	0	0	0	0	0	0	0	0	0	0	0	167
CUM BCWP	0	0	0	0	0	0	0	0	0	0	0	167
ACWP	0	0	0	0	0	0	0	0	0	0	0	146
CUM ACWP	0	0	0	0	0	0	0	0	0	0	0	146
CV	0	0	0	0	0	0	0	0	0	0	0	21
SV	.	.	.	.	-16.	-33.	-50.	-67.	-83.	-88.	-127.	-2.
CPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.15
SPI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.99

5200 DCPS (Hatcher)	31JAN2011	28FEB2011	31MAR2011	30APR2011	31MAY2011	30JUN2011	31JUL2011	31AUG2011	30SEP2011	31OCT2011	30NOV2011	31DEC2011
BCWS	51	60	69	40	18	9	8	8	8	38	40	40
CUM BCWS	219	279	348	388	406	415	423	431	439	477	517	558
BCWP	12	58	33	41	0	0	0	0	0	0	0	0
CUM BCWP	179	237	270	312	312	312	312	312	312	312	312	312
ACWP	13	27	31	28	0	0	0	0	0	0	0	0
CUM ACWP	158	185	217	245	245	245	245	245	245	245	245	245
CV	20	52	54	67	67	67	67	67	67	67	67	67
SV	-41.	-42.	-78.	-76.	-94.	-103.	-111.	-119.	-127.	-166.	-206.	-246.
CPI	1.13	1.28	1.25	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
SPI	0.82	0.85	0.78	0.8	0.77	0.75	0.74	0.72	0.71	0.65	0.6	0.56

5200 DCPS (Hatcher)	31JAN2012	29FEB2012	31MAR2012	30APR2012	31MAY2012	30JUN2012	31JUL2012	31AUG2012	30SEP2012	31OCT2012	30NOV2012	31DEC2012
BCWS	53	57	57	27	30	27	20	25	26	30	29	27
CUM BCWS	610	667	724	751	780	807	828	853	879	909	937	965
BCWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM BCWP	312	312	312	312	312	312	312	312	312	312	312	312
ACWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM ACWP	245	245	245	245	245	245	245	245	245	245	245	245
CV	67	67	67	67	67	67	67	67	67	67	67	67
SV	-299.	-355.	-412.	-439.	-469.	-495.	-516.	-541.	-567.	-597.	-626.	-653.
CPI	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
SPI	0.51	0.47	0.43	0.42	0.4	0.39	0.38	0.37	0.35	0.34	0.33	0.32

5200 DCPS (Hatcher)		31JAN2013	28FEB2013	31MAR2013	30APR2013	31MAY2013	30JUN2013	31JUL2013	31AUG2013	30SEP2013	31OCT2013	30NOV2013	31DEC2013
	BCWS	30	26	84	88	83	72	83	59	57	187	170	145
	CUM BCWS	995	1,021	1,105	1,193	1,275	1,347	1,430	1,489	1,545	1,732	1,902	2,048
	BCWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM BCWP	312	312	312	312	312	312	312	312	312	312	312	312
	ACWP	0	0	0	0	0	0	0	0	0	0	0	0
	CUM ACWP	245	245	245	245	245	245	245	245	245	245	245	245
	CV	67	67	67	67	67	67	67	67	67	67	67	67
	SV	-683.	-709.	-793.	-881.	-964.	-1035.	-1118.	-1177.	-1234.	-1420.	-1591.	-1736.
	CPI	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
	SPI	0.31	0.31	0.28	0.26	0.24	0.23	0.22	0.21	0.2	0.18	0.16	0.15

5200 DCPS (Hatcher)	31JAN2014	28FEB2014	31MAR2014	30APR2014	31MAY2014	30JUN2014	31JUL2014	31AUG2014	30SEP2014	31OCT2014	30NOV2014	31DEC2014
BCWS	123	107	98	36	20	11	21	29	0	0	0	0
CUM BCWS	2,171	2,278	2,376	2,412	2,432	2,443	2,464	2,493	2,493	2,493	2,493	2,493
BCWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM BCWP	312	312	312	312	312	312	312	312	312	312	312	312
ACWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM ACWP	245	245	245	245	245	245	245	245	245	245	245	245
CV	67	67	67	67	67	67	67	67	67	67	67	67
SV	-1859.	-1966.	-2065.	-2100.	-2120.	-2131.	-2152.	-2182.	-2182.	-2182.	-2182.	-2182.
CPI	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
SPI	0.14	0.14	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12

Work Approval Form (WAF)

Cost Center:	**9417**
Job Number:	**5200**
Job Title:	**DCPS**
Job Manager:	**R.E. Hatcher**

Description:

Digital Coil Protection System (DCPS) development

Schedule:

See Tab B or attached

Approvals:

_____

Job Manager

_____

Project Manager

_____

Engineering Department Head

Cost Center: 9417
Job Number: 5200
Job Title: DCPS
Job Manager: R.E. Hatcher

Estimate (user input)

task numb	TASK DESCRIPTION	Responsible	SCHEDULE: USER INPUT: DURATION in WORK DAYS	Logical Pre-requisites (one task numbers in each column ,any order)	User Input Start Date (optional)	Calculated: START DATE	Calculated: FINISH DATE
1	**Physics Requirements**						
2							
3	**Project Oversight**						
4	Project Oversigt	Hatcher	650		11/1/10	11/1/10	**4/29/2013**
5							
6	**Conceptual Design**						
7	PREPARE WORK PLANNING FORM						
8	Prep System Description	Hatcher	5		11/8/10	11/8/10	**11/15/2010**
9	Prep System Requirements	Hatcher	15	8		11/15/10	**12/6/2010**
10	Analog Conceptual Design	Mozulay	40	8		11/15/10	**1/10/2011**
11	Digital Conceptual Design	Lawson	40	8		11/15/10	**1/10/2011**
12	Conceptual Design Analysis & Alg. Prep.	Titus	100	8		11/15/10	**4/4/2011**
13	CDR Prep. & Review	Hatcher	5	11		1/10/11	**1/17/2011**
14							
15	**Preliminary Design**						
16	CDR Chit Resolution	Hatcher	5	13	1/24/11	1/24/11	**1/31/2011**
17	Analog Preliminary Design	Mozulay	45	16		1/31/11	**4/4/2011**
18	Digital Preliminary Design	Lawson	40	16		1/31/11	**3/28/2011**
19	PDR Prep. & Review	Hatcher	15	18		3/28/11	**4/18/2011**
20	Systems Code Development	Woolley	120		11/1/10	11/1/10	**4/18/2011**
21							
22	**Final Design**						
23	PDR Chit Resolution	Hatcher	10	19		4/18/11	**5/2/2011**
24	CSU FDR Prep	Hatcher	15	23		5/2/11	**5/23/2011**
25	Analog Design - Pt. I	Mozulay	130	23	1/1/12	1/1/12	**7/1/2012**
26	Digital Design - Pt. I	Lawson	130	23	1/1/12	1/1/12	**7/1/2012**
27	Hardware Interface	Mozulay	120	23	1/1/12	1/1/12	**6/17/2012**
28	Systems Code - A	Woolley	120	24	10/1/11	10/1/11	**3/17/2012**
29	Final Design Review	Hatcher	20	27		6/17/12	**7/15/2012**
30	DCPS Algorithms	Titus	120	23	10/1/11	10/1/11	**3/17/2012**
31	External Interface & Response	Ramakrishnan	80	34		3/18/14	**7/8/2014**
32	Real Time Programming	Sichta	150	29	10/1/13	10/1/13	**4/29/2014**
33	Analog Design - Pt. II	Mozulay	120	29	10/1/13	10/1/13	**3/18/2014**
34	Digital Design - Pt. II	Lawson	120	29	10/1/13	10/1/13	**3/18/2014**
35	Systems Code - B	Woolley	240	29		7/15/12	**6/16/2013**
36	Systems Integration & Testing	Hatcher	20	34	4/1/13	3/18/14	**4/15/2014**
37							
38							

actual= A	FY11$K: M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	HOURS (priced at FY11 rates): EA** EM (analysis engr)	EA** SB (Designer)	TD* 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)	LP** TB (HP Tech)	R** RM (Researcher)	FC** AM (P&C Officer)	Computer Div. Engr	% COST CONTIGNECY %	% SCHED CONTIGNECY %	Names of req'd skills if known	Basis of Estimate Category
	1.23	1.23	1.79	1.28	2.06	207.700	134.650	139.160	186.380	167.100	134.360	90.560	170.620	169.640	130.480	100.350	132.620	188.880	175.4					
									1,350															
									20															
									70															
									108															
								32	108															
						240			60															
						8			40															
									230															
								16	220															
								30	80															
									160															
									32															
									40															
							12		248			8												
							12	40	212															
							40		80															
							120		200															
									40															
						320			320															
							40		180															
								680	360															
									880			600												
								184	770			440												
						160		360	720															
							40	80	80			80												
	$0	$0	$0	$0	$0	728	264	1,422	6,608	-	-	1,128	-	-	-	-	-	-	-	-	-	-		
	$0	$0	$0	$0	$0	$151	$36	$198	$1,232	$0	$0	$102	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0		

TOTALS

TOTAL Preliminary Cost Estimate ($k)= $1,718

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

FY11: Oct-08 Nov-08 Dec-08 Jan-09 Feb-09 Mar-09 Apr-09 May-09 Jun-09 Jul-09 Aug-09 Sep-09
FY12: Oct-09 Nov-09 Dec-09 Jan-10 Feb-10 Mar-10 Apr-10 May-10 Jun-10 Jul-10 Aug-10 Sep-10

Cost Center:	9417
Job Number:	5200
Job Title:	DCPS
Job Manager:	R.E. Hatcher

Uncertainty of the Estimate

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

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 Recommended

Cost Center: 9417
Job Number: 5200
Job Title: DCPS
Job Manager: R.E. Hatcher

Materials and Subcontracts (M&S)

Basis of Estimate

Description:

$420 K was allocated for M&S in a previous estimate. We will mos likely not need that much, but as there was no detail in the previou estimate, I'd like to leave that amount there until I can get better number from the hardware engineers.

$420 K

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

Cost Center: 9417
Job Number: 5200
Job Title: DCPS
Job Manager: R.E. Hatcher

Materials and Subcontracts (M&S)

Basis of Estimate

Description:

$420 K was allocated for M&S in a previous estimate. We will mos likely not need that much, but as there was no detail in the previou estimate, I'd like to leave that amount there until I can get better number from the hardware engineers.

$420 K

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

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