

Work Authorization Document

NSTX Upgrade Project

Control Account #:	2450	Title:	2nd NBI Services
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WBS	1.2.4	Title:	NB Injection
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Period of Performance: 23 February 2009 through 18 August 2014

Authorized Budget:	\$4,516	Control Account Manager:	Denault
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Revision #:	0	Revision Date:	July-11
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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. Strykowski		
Control Account Manager	Denault		
Functional Manager	L. Dudek		

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
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NSTX Upgrade Project

Subtotal		1,371	23FEB09A	23FEB09A	18AUG14	18AUG14	0	1,517	4,512,165.60		311,515.86	337,013.40						
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Job: 2450 - 2nd NBI Services-DENAULT

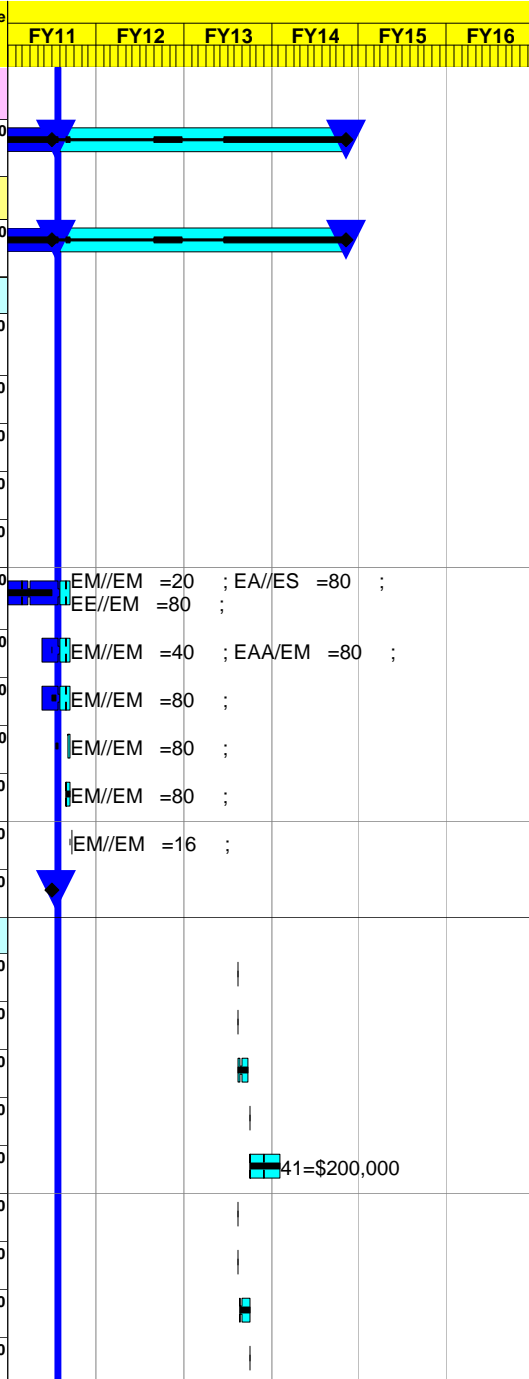
Subtotal		1,371	23FEB09A	23FEB09A	18AUG14	18AUG14	0	1,517	4,512,165.60		311,515.86	337,013.40						
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Design

2450-0017	Design Drawings	25	03MAY10A	03MAY10A	07JUN10A	07JUN10A	0		0.00	100	0.00	0.00						
2450-0018	PDR Prep	10	23JUN10A	23JUN10A	24JUN10A	24JUN10A	0		0.00	100	0.00	0.00						
2450-0019	CONDUCT PDR	2	22JUN10A	22JUN10A	23JUN10A	23JUN10A	0		0.00	100	0.00	0.00						
2450-0020	Lehman Review	5	10AUG10A	10AUG10A	16AUG10A	16AUG10A	0		0.00	100	0.00	0.00						
2450-0022	Disposition PDR Chits	2	24JUN10A	24JUN10A	25JUN10A	25JUN10A	0		0.00	100	0.00	0.00						
2450-0023	Design Drawings	177*	01OCT10A	01OCT10A	28MAR11	17JUN11	-58	30	23,957.00	80	19,165.60	23,957.00						
2450-0024	Update Analyses	84*	29MAR11	21FEB11A	04APR11	17JUN11	-53	123	21,742.80	60	13,045.68	21,742.80						
2450-0025	Update Cost & Schedule Estimate	84*	05APR11	21FEB11A	13APR11	17JUN11	-46	123	12,656.80	60	7,594.08	12,656.80						
2450-0026	Prep Procurement Specs	10	14APR11	06JUN11	27APR11	17JUN11	-36	123	12,656.80		0.00	12,656.80						
2450-0027	FDR Prep	15	31MAY11	27MAY11	13JUN11	17JUN11	-4	123	12,656.80		0.00	0.00						
2450-0028	CONDUCT FDR 2450	3	14JUN11	22JUN11*	15JUN11	24JUN11	-7	121	2,531.36		0.00	0.00						
2450-PEER	Peer Review	0			31MAR11	14APR11A	-10		0.00		0.00	0.00						

Procure, Fab & Assembly

2450-0032	Prep Requisition & procurement pkg - Cyro parts	1	15MAY13*	15MAY13*	15MAY13	15MAY13	0	24	0.00		0.00	0.00						
2450-0033	SUBMIT REQ TO PROCUREMENT - Cyro parts	1	16MAY13	16MAY13	16MAY13	16MAY13	0	45	0.00		0.00	0.00						
2450-0034	Procurement lead time (1) - Cyro parts	30	17MAY13	17MAY13	28JUN13	28JUN13	0	45	0.00		0.00	0.00						
2450-0035	AWARD - Cyro parts	1	01JUL13	01JUL13	01JUL13	01JUL13	0	45	0.00		0.00	0.00						
2450-0036	Fabricate or delivery - Cyro parts	90	02JUL13	02JUL13	07NOV13	07NOV13	0	45	265,866.67		0.00	0.00						
2450-0038	Prep Requisitn & procuremnt pkg - Pipe & misc.	2	15MAY13*	15MAY13*	16MAY13	16MAY13	0	24	0.00		0.00	0.00						
2450-0039	SUBMIT REQ TO PROCUREMENT - Pipe & misc.	1	17MAY13	17MAY13	17MAY13	17MAY13	0	24	0.00		0.00	0.00						
2450-0040	Procurement lead time (1) - Pipe & misc.	30	20MAY13	20MAY13	01JUL13	01JUL13	0	24	0.00		0.00	0.00						
2450-0041	AWARD - Pipe & misc.	1	02JUL13	02JUL13	02JUL13	02JUL13	0	24	0.00		0.00	0.00						

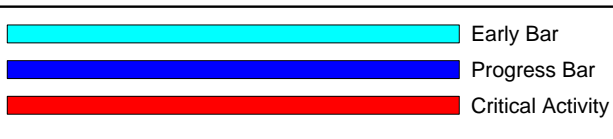


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**NSTX UPGRADES
 RESOURCE LOADED SCHEDULE
 CD-2 Schedule
 April 2011**

Sheet 1 of 2



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																		
2450-0042	Fabricate or delivery - Pipe & misc.	65	03JUL13	03JUL13	04OCT13	04OCT13	0	24	641,095.38		0.00	0.00							41=\$485,000												
2450-0053A	Engineering for 2nd NBI Services	356	15MAR13*	15MAR13*	18AUG14	18AUG14	0	1,517	457,664.43		0.00	0.00							EM//EM =2,400 ;												
2450-0053B	Engineering Support for 2nd NBI Services	356	15MAR13	15MAR13	18AUG14	18AUG14	0	1,517	107,069.66		0.00	0.00							41=80,000 ;												
2450-0053C	Drafting Support for 2nd NBI Services	863*	15MAR13	04MAR11A	18AUG14	18AUG14	0	30	110,130.04	5	5,710.50	0.00							EA//SB =800 ;												
2450-0056	Install Penetrations	80	01JUN12*	01JUN12*	24SEP12	24SEP12	0	245	119,385.00		0.00	0.00							EM//ST =900												
2450-0057	Helium Transfer Lines	160	01AUG13*	01AUG13*	27MAR14	27MAR14	0	35	462,686.30		0.00	0.00							EM//ST =3,000 ; EE//												
2450-0059	Nitrogen Transfer Lines	120	31JAN14*	31JAN14*	21JUL14	21JUL14	0	35	188,429.70		0.00	0.00							EM//ST =1,200 ;												
2450-0061	SF6 Transfer Lines	30	31JAN14*	31JAN14*	13MAR14	13MAR14	0	125	71,074.11		0.00	0.00							EM//ST =450 ; EE//TB =83 ;												
2450-0063	HVE Water Lines	65	31JAN14*	31JAN14*	01MAY14	01MAY14	0	90	186,972.15		0.00	0.00							EM//ST =1,200 ; EE//TB =195 ;												
2450-0065	Ion Dump Water Lines	175	07OCT13*	07OCT13*	23JUN14	23JUN14	0	24	434,324.95		0.00	0.00							EM//ST =2,800 ; ; EE//TB =435 ;												
2450-0067	Ion Source Water Lines	130	07OCT13*	07OCT13*	18APR14	18APR14	0	69	310,648.55		0.00	0.00							EM//ST =2,000 ; EE//TB =315 ;												
2450-0074	Vacuum Lines	30	24JUN14*	24JUN14*	05AUG14	05AUG14	0	24	88,868.12		0.00	0.00							EM//ST =575 ; EE//TB =86 ;												
2450-0085	Stack 8 Vacuum Lines	30	07OCT13*	07OCT13*	15NOV13	15NOV13	0	199	54,837.20		0.00	0.00							EM//ST =350 ; EE//TB =60 ;												
2450-0093	Gas System	23	07OCT13*	07OCT13*	06NOV13	06NOV13	0	206	50,948.02		0.00	0.00							EM//ST =325 ; EE//TB =56 ;												
2450-0097	Legs	12	01OCT13*	01OCT13*	16OCT13	16OCT13	0	221	58,947.46		0.00	0.00							EM//ST =250 ; 41=15,000 ; EE//TB =38 ;												
2450-0099	HVAC	70	01OCT13*	01OCT13*	20JAN14	20JAN14	0	163	31,818.00		0.00	0.00							EA//SB =80 41=15000												
2450-0102	Platform Mods	70	20JAN14*	11DEC13*	25APR14	28MAR14	20	34	519,198.30		0.00	0.00							EA//SB =200 ; EE//E EE//TB =230 ; EM//E												
2450-0103	NBI SERVICES COMPLETE	0			05AUG14	05AUG14	0	24	0.00		0.00	0.00							▼												
FY092450	FY09 Actual Cost	22*	23FEB09A	23FEB09A	30SEP09A	30SEP09A	0		76,722.00	100	76,722.00	76,722.00																			
FY102450	FY10 Actual Cost	143	01OCT09A	01OCT09A	30APR10A	30APR10A	0		122,550.00	100	122,550.00	122,550.00																			
FY102450A	FY10 Actual Cost	110	03MAY10A	03MAY10A	30SEP10A	30SEP10A	0		66,728.00	100	66,728.00	66,728.00	81=66768																		

2450 2nd NBI Services (Denault)	31JAN2012	29FEB2012	31MAR2012	30APR2012	31MAY2012	30JUN2012	31JUL2012	31AUG2012	30SEP2012	31OCT2012	30NOV2012	31DEC2012
BCWS	0	0	0	0	0	31	32	33	23	0	0	0
CUM BCWS	352	352	352	352	352	383	415	448	472	472	472	472
BCWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM BCWP	306	306	306	306	306	306	306	306	306	306	306	306
ACWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM ACWP	309	309	309	309	309	309	309	309	309	309	309	309
CV	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
SV	-46.	-46.	-46.	-46.	-46.	-77.	-109.	-142.	-166.	-166.	-166.	-166.
CPI	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
SPI	0.87	0.87	0.87	0.87	0.87	0.8	0.74	0.68	0.65	0.65	0.65	0.65

2450 2nd NBI Services (Denault)	31JAN2013	28FEB2013	31MAR2013	30APR2013	31MAY2013	30JUN2013	31JUL2013	31AUG2013	30SEP2013	31OCT2013	30NOV2013	31DEC2013
BCWS	0	0	20	39	41	36	301	367	350	442	244	210
CUM BCWS	472	472	491	531	572	608	909	1,276	1,626	2,068	2,312	2,522
BCWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM BCWP	306	306	306	306	306	306	306	306	306	306	306	306
ACWP	0	0	0	0	0	0	0	0	0	0	0	0
CUM ACWP	309	309	309	309	309	309	309	309	309	309	309	309
CV	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
SV	-166.	-166.	-185.	-225.	-266.	-302.	-603.	-970.	-1321.	-1763.	-2006.	-2216.
CPI	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99	.99
SPI	0.65	0.65	0.62	0.58	0.53	0.5	0.34	0.24	0.19	0.15	0.13	0.12

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.

<u>WBS</u>			
<u>L1</u>	<u>L2</u>	<u>L3</u>	<u>Description</u>
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

Annex I – WBS Dictionary

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: 2450
Job Title: NSTX Beamline 2 Services
Job Manager: Martin Denault
Rev 2 7/14/2010

Description:

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


Schedule:

Refer to Primavera Data-Base

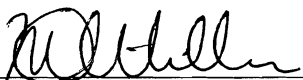
Approvals:

 7-29-10

Job Manager

 8/3/10

Project Manager

 8/3/10

Engineering Department Head

Cost Center:	9418
Job Number:	2450
Job Title:	NSTX Beamline 2 Services
Job Manager:	Martin Denaut

SCHEDULE	
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 (opt)
1	Conceptual Design	Denaut	1		9/24/09
2	PREPARE WORK PLANNING FORM		2	4	
3	Prep System Description		3	5	
4	Prep System Requirements		10	6	
5	R&D		20	7	
6	Analysis		2	8	1/11/09
7	CDR				
8					
9					
10					
11	Preliminary Design	Denaut	10	9	
12	Thermal Analysis		10	12	
13	Seismic Analysis		5	13	
14	FMEA Analysis		2	14	
15	Prepare NEPA Form		10	15	
16	Update Cost & Schedule Estimate		60	16	
17	Design Drawings		10	17	
18	PDR Prep		2	18	5/1/10
19	CONDUCT PDR		5	19	
20	Lehman Review				
21					
22	Final Design	Denaut	2	20	
23	Disposition PDR Chits		10	22	
24	Design Drawings		5	23	
25	Update Analyses		10	24	
26	Update Cost & Schedule Estimate		10	25	
27	Prep Procurement Specs		10	26	
28	FDR Prep		2		10/1/10
29	CONDUCT FDR				
30					
31	Procurement				
32	Cryo parts		1	28	
33	Prep Requisition and procurement package		1	32	1/1/11
34	SUBMIT REQ TO PROCUREMENT		30	33	
35	Procurement lead time (1)		1	34	
36	AWARD		90	35	
37	Fabricate or delivery				
38	Pipe and misc.		2	28	1/1/11
39	Prep Requisition and procurement package		1	38	
	SUBMIT REQ TO PROCUREMENT				

Estimate (user input)	
FY09\$K	HOURS (priced at FY09 rates)

task	M&S (41)	CREDIT CARD (43)	OTHER (39)	TRAVEL (35)	OVERTIME (31)	EA** EM (analysis engr)	EA** (Designer)	EE** EM (Eltr Engr)	EE** SM (Senior Electr Tech)	EE** SB (Electr Tech)	EE** TB (Electr Tech)	EM** EM (F&M Eng)	EM** SM Senior Tech	EM** SB (F&M Tech)	EM** AM (P&C Officer)	Contingency	Names of req'd skills if known	Basis of Estimate Category
1																		4-Experience
2																		4-Experience
3																		4-Experience
4																		4-Experience
5																		4-Experience
6																		4-Experience
7																		4-Experience
8						80		80										4-Experience
9																		4-Experience
10																		4-Experience
11																		4-Experience
12						40		80										4-Experience
13						40		80										4-Experience
14						40		40										4-Experience
15																		4-Experience
16																		4-Experience
17																		4-Experience
18							480	160										4-Experience
19																		4-Experience
20																		4-Experience
21																		4-Experience
22																		4-Experience
23																		4-Experience
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35																		4-Experience
36																		4-Experience
37																		4-Experience
38																		4-Experience
39																		4-Experience

Cost Center: 9418
Job Number: 2450
Job Title: NSTX Beamline 2 Services
Job Manager: Martin Denault

SCHEDULE

USER INPUT TASKS AND DESCRIPTIONS

Task	TASK DESCRIPTION	Responsible	Duration in WORK DAYS	Logical Pre-requisites (one task numbers in each column, any order)	User Input Start Date (opt)	HOURS (priced at FY09 rates)												Contingency	Names of req'd skills if known	Basis of Estimate Category
						FY09\$K	EA (analysis eng)	EA (Designer)	EE EM (Eltr 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)	FC AM (P&C Officer)				
92	Gas System		25		6/1/10	\$15												15%	See Tab E for SB breakdown	
97	Leads		12		6/1/11	\$15												15%	See Tab E for SB breakdown	
102	HVAC Platform mods					\$75	200	40										15%		

TOTALS
 870 0 0 0 0 280 1640 480 0 0 2053 3908 0 15350 160
 \$1,067 \$0 \$0 \$0 \$0 \$53 \$205 \$83 \$0 \$0 \$173 \$625 \$0 \$1,830 \$24

Notes:
 (1) Procurement lead time:
 Purchase orders-Commercial, off-the-shelf items 3 Weeks
 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 - Catalogue Price/Vendor Quote
 7 - Placed Contracts
 8 - Actual experience for NCSX Work

