NCSX Project Work Breakdown Structure (WBS) Dictionary
Ancillary Systems (WBS 2)
NCSX-WBS-02-02
June 22, 2007

Prepared by:	
R. Simmons	
Reviewed by:	
WBS 21 & WBS 22 (Fueling Systems & Vacuum Pumping Systems)	Bill Blanchard Digitally signed by Bill Blanchard DN: CN = Bill Blanchard, C = US, O = PPPL, OU = Eng and Tech Infrastructure Date: 2007.06.22 11:37:37 -04'00' W. Blanchard (WBS Manager)
WBS 23 (Wall Conditioning Systems)	**No Longer in MIE Project**
WBS 24 & WBS 26 (ICH & ECH Systems)	**No Longer in MIE Project**
WBS 25 (Neutral Beam Systems)	**No Longer in MIE Project**
WBS 25 (Neutral Beam Systems)	**No Longer in MIE Project**
Other WBS 2 Systems	Lawrence E. Dudek Digitally signed by Lawrence E. Dudek DN: cn=Lawrence E. Dudek, c=US Date: 2007.06.22 13:02:40 -06'00' L. Dudek (RLM)
Approved by:	
Hutch Neilson Digitally signed by Hutch Neilson DN: CN = Hutch Neilson, C = US, O = PPPL Date: 2007.06.22 15:47:57 -04'00' H. Neilson	

Work Breakdown Structure (WBS) Dictionary
Ancillary Systems (WBS 2)

Record of Revisions

Revision	Date	Author	Description
0	**9/8/2003**	**Simmons**	**Initial issue**
1	**1/21/2004**	**Simmons**	**Updated WBS dictionary to delete technical requirements and reflect CD-2 milestone scope.**
2	**6/22/2007**	**Simmons**	**Updated WBS to Reflect Scope for 2007 Rebaseline.**

Work Breakdown Structure (WBS) Dictionary
Ancillary Systems (WBS 2)

WBS Element: 2	**WBS Level: 2**
WBS Title:	**Ancillary Systems**
Description:	The Ancillary Systems includes several subsystems, which are critical to plasma performance. Auxiliary Systems include: • Fueling Systems (WBS 21); • Vacuum Pumping Systems (WBS 22); • Wall Conditioning Systems (WBS 23); • ICH System (WBS 24); • Neutral Beams (WBS 25); and • ECH Systems (WBS 26) Typical Ancillary Systems work scope includes design, R&D to support the design effort, component fabrication, assembly, installation, system level commissioning and testing. **MIE Project Scope:** Includes Ancillary Systems work needed to meet CD-4 objectives as defined in lower-level WBS elements. The following lower level elements are included in the MIE Project: • Fueling Systems – only the Gas Fueling Systems (WBS 211); • Vacuum Pumping Systems (WBS 22); and • Neutral Beam Injection Systems (WBS 25). All other WBS elements are **excluded** from the MIE Project, but may be considered for future upgrades.

WBS Element: 21	**WBS Level: 3**
WBS Title:	**Fueling Systems**
Description:	This WBS element consists of all the effort and systems to provide operational plasma fueling systems for the NCSX device. **MIE Project Scope**: Only parts of the Gas Fueling Systems (WBS 211) are included in the MIE Project. The Pellet Injection System (WBS 212) will be installed as **future** upgrade.

Work Breakdown Structure (WBS) Dictionary
Ancillary Systems (WBS 2)

WBS Element: 211	WBS Level: 4
WBS Title:	**Gas Fueling Systems**
Description:	The MIE project scope is limited to a single gas injector system capable of injecting any one of the species of interest, H_2, D_2, or He gas, into the plasma at a time. **MIE Project Scope:** • Design, fabrication, refurbishment (as appropriate), installation, and system testing of gas fueling equipment capable of injecting H_2, D_2, or He gas into the plasma. • Equipment includes gas injector, the gas delivery line, and pulse valve control. **Future Scope:** In its final configuration, the system will have 2 to 4 injectors capable of injecting H_2, D_2, or He gas into the plasma. The controls will be upgraded with a modern PLC controlling this and other systems.
WBS Element: 212	**WBS Level: 4**
WBS Title:	**Pellet Injection Fueling Systems**
Description:	A pellet injector will be installed as a **future** upgrade. **MIE Project Scope:** None.

WBS Element: 22	WBS Level: 3
WBS Title:	**Vacuum Pumping System (VPS)**
Description:	The MIE project scope is limited to one TMP backed by an existing mechanical/booster pump system. **MIE Project Scope:** Design, fabrication, installation, and system testing of equipment needed to implement the vacuum pumping system. **Future Scope:** In the future, NCSX Vacuum Pumping System will use as much as possible of the existing PBX-M vacuum pumping system hardware where it is cost effective to implement. The PBX-M Torus Vacuum Pumping System consists of: • Four (4) Leybold Heraeus TMP 1500 turbo-molecular pumps (TMPs) • Four (4) Model 1398 belt driven backing pumps • One (1) Kinney KT 500 belt driven roughing pump • Gate valves, flanges, and instrumentation In its final configuration, up to four TMPs will be implemented, including associated ducting and valves.. A new Residual Gas Analyzer (RGA) will be provided. In addition, the VPS will be controlled with a PLC based system, which will also be used to control other systems.

Work Breakdown Structure (WBS) Dictionary
Ancillary Systems (WBS 2)

WBS Element: 23		WBS Level: 3
WBS Title:	**Wall Conditioning Systems**	
Description:	This WBS element consists of the effort and systems to provide wall conditioning and impurity control. Included are the Glow Discharge Cleaning (WBS 231), Boronization Systems (WBS 232) and Lithiumization Systems (WBS 233). All these systems will be installed as **future** upgrades as needed. **MIE Project Scope:** None. **Future Scope:** Defined in lower-level WBS elements.	
WBS Element: 231		**WBS Level: 4**
WBS Title:	**Glow Discharge Cleaning System**	
Description:	A glow discharge cleaning (GDC) system will be installed on NCSX as a **future** upgrade. **MIE Project Scope:** None.	
WBS Element: 232		**WBS Level: 4**
WBS Title:	**Boronization System**	
Description:	A boronization system will be installed on NCSX as a **future** upgrade if required by the project. **MIE Project Scope:** None.	
WBS Element: 233		**WBS Level: 4**
WBS Title:	**Lithiumization System**	
Description:	A lithium wall conditioning system will be installed as a **future** upgrade if required by the project. **MIE Project Scope:** None.	

WBS Element: 24		WBS Level: 3
WBS Title:	**ICH System**	
Description:	The NCSX device has been designed to accommodate up to 6 MW of Ion Cyclotron Heating (ICH) as a **future** upgrade. **MIE Project Scope:** None.	

Work Breakdown Structure (WBS) Dictionary
Ancillary Systems (WBS 2)

WBS Element: 25	**WBS Level: 3**
WBS Title:	**Neutral Beam Injection System**
Description:	A Neutral Beam Injection system based on the existing C-site NBI system will be implemented on NCSX. **MIE Project Scope:** Evaluation of legacy equipment including one beamline, power systems, ac power, and controls. **Completed.** **Future Scope:** • Installation and commissioning of the first beamline. • Evaluation, testing, refurbishment, repair, or replacement of existing equipment for remaining beamlines as required. • All installation, system testing, and commissioning of remaining beamlines.

WBS Element: 26	**WBS Level: 3**
WBS Title:	**ECH System**
Description:	The NCSX device has been designed to accommodate up to 3 MW of Electron Cyclotron Heating (ICH) as a **future** upgrade. **MIE Project Scope:** None.