

NCSX Project Work Breakdown Structure (WBS) Dictionary
Facility Systems (WBS 6)
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Prepared by:	
R. Simmons	
Reviewed by:	
WBS 61, WBS 63, & WBS 65 (Water Cooling Systems, Utility Systems, & Facility Systems Integration)	L. Dudek (WBS Manager and RLM)
WBS 62 (Cryogenic Systems)	G. Gettelfinger (WBS Manager)
WBS 64 (Bakeout Systems)	M. Kalish (WBS Manager)
WBS 61 & 63 (Water Cooling Systems & Utility Systems)	W Reiersen (RLM)
Approved by:	
H. Neilson	

**Work Breakdown Structure (WBS) Dictionary
Facility Systems (WBS 6)**

Record of Revisions

Revision	Date	Author	Description
0	9/9/2003	Simmons	Initial issue
1	12/1/2003	Simmons	Deleted WBS 66.
2	1/21/2004	Simmons	Updated WBS dictionary to remove correct WBS 615, updated WBS 62 & 64, deleted WBS 66 and technical requirements, and updated to CD-2 scope.
3	3/30/2004	Simmons	Updated to correct references to partial installation of cryostat in WBS 623.
4	7/2/2007	Simmons	Updated WBS to Reflect Scope for 2007 Rebaseline.

Work Breakdown Structure (WBS) Dictionary Facility Systems (WBS 6)

WBS Element: 6		WBS Level: 2
WBS Title:	Facility Systems	
Description:	<p>Facility Systems consists of several subsystems which support operation. This WBS element includes:</p> <ul style="list-style-type: none"> • Water Cooling Systems (WBS 61) ; • Cryogenic Systems (WBS 62); • Utility Systems (WBS 63); • Vacuum Vessel Heating and Cooling Systems (WBS 64) Systems; and • Facility Systems Integration (WBS 65) –No longer in use <p>Typical Facility Systems work scope includes design, R&D to support the design effort, component fabrication, assembly, installation, system level commissioning and testing.</p> <p>MIE Project Scope: Includes the facility systems work needed to meet CD-4 objectives. Defined in lower-level WBS elements.</p> <p>Future Scope: Additional facility systems capabilities will be added as the NCSX Project capabilities are expanded.</p>	

WBS Element: 61		WBS Level: 3
WBS Title:	Water Cooling Systems	
Description:	<p>This WBS element includes all the effort required to add cooling loops to the existing C-site (CS) and HVAC Water Systems as required for NCSX subsystems. This WBS element consists of the following sub-elements:</p> <ul style="list-style-type: none"> • C-Site Water Cooling (WBS 611) • Neutral Beam Water Cooling (WBS 612); • Vacuum Pumping Water Cooling (WBS 613); • Bakeout Water Cooling (WBS 614); and • Diagnostics Water Cooling (WBS 615). <p>MIE Project Scope: Includes the facility systems work needed to meet CD-4 objectives. Defined in lower-level WBS elements.</p> <p>Future Scope: Additional facility systems capabilities will be added as the NCSX Project capabilities are expanded.</p>	

Work Breakdown Structure (WBS) Dictionary Facility Systems (WBS 6)

WBS Element: 611		WBS Level: 4
WBS Title:	C-Site Water Cooling System	
Description:	<p>The CS Water System is a demineralized water cooling system that originally supplied the cooling water for the PBX and PLT experiments. This system removes heat from the NCSX water cooling subsystems and transfers it to the atmospheric cooling tower via the flat plate heat exchanger in the C-Site pump room basement. The system currently is inactive.</p> <p>MIE Project Scope:: None.</p> <p>Future Scope: Refurbish and re-commission system as necessary.</p>	

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WBS Element: 612		WBS Level: 4
WBS Title:	Neutral Beam Water Cooling Systems	
Description:	<p>This WBS element consists of the effort to provide cooling water capability for the neutral beams. This system transfers heat from the internal beamline enclosure components and power supplies to the CS Water System. This system was operational for PBX but is currently inactive.</p> <p>MIE Project Scope: None.</p> <p>Future Scope: Refurbish and re-commission system as necessary.</p>	
WBS Element: 613		WBS Level: 4
WBS Title:	Vacuum Pumping Water Cooling System	
Description:	<p>The Vacuum Pumping Water Cooling System (VPWCS) provides a cooling water loop to reject heat produced by the Torus Vacuum Pumping System (TVPS) and the NB Vacuum Pumping System to the HVAC Water System. The system used on PBX-M will be re-used where practical. The equipment to be cooled includes the turbomolecular pumps (TMPs) and backing pumps for the TVPS and NB enclosures. The existing HVAC chilled water system will be used as the ultimate heat sink.</p> <p>MIE Project Scope: Limited to the supply cooling water to in-scope TVPS (WBS 22).</p> <p>Future Scope: Supply cooling water to upgrade vacuum systems as they are brought on line.</p>	
WBS Element: 614		WBS Level: 4
WBS Title:	Bakeout Water System	
Description:	<p>The WBS element consists of the effort to provide a cooling water loop to reject waste heat from the VV Heating and Cooling System (WBS 64). The cooling loop will be connected to the CS cooling water system.</p> <p>MIE Project Scope: None.</p> <p>Future Scope: Supply cooling water to upgrade heating and cooling systems as they are brought on line.</p>	
WBS Element: 615		WBS Level: 4
WBS Title:	Diagnostic Water Cooling System	
Description:	<p>The Diagnostics Water Cooling System (DWCS) will provide a cooling manifold around NCSX to cool various diagnostics components to be installed on or near the vacuum vessel. The cooling loop will be connected to the CS cooling water system.</p> <p>MIE Project Scope: None.</p> <p>Future Scope: Supply cooling water to upgrade diagnostic systems as they are brought on line.</p>	

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WBS Element: 62		WBS Level: 3
WBS Title:	Cryogenic Systems	
Description:	<p>This WBS element consists of the following subsystems:</p> <ul style="list-style-type: none"> • LN₂-LHe Supply System (WBS 621); • LN₂ Coil Cooling (WBS 622); and • GN₂ Cryostat Cooling System (WBS 623). <p>MIE Project Scope: Provide cryogenic systems consistent with CD-4 requirements. Defined in lower level WBS elements.</p> <p>Future Scope: Upgrade cryogenic systems consistent with NCS Project upgrades and increased capabilities. Defined in lower level WBS elements.</p>	
WBS Element: 621		WBS Level: 4
WBS Title:	LN₂-LHe Supply System	
Description:	<p>The Liquid Nitrogen (LN₂) and Liquid Helium (LHe) Supply System (WBS 621) will be used to receive, store, and deliver cryogenics to the LN₂ Coil Cooling System (WBS 622), to the GN₂ Cryostat Cooling System (WBS 623), and to the Neutral Beam Injection System (WBS 25). This WBS element also includes connection to the existing LN₂ storage tank.</p> <p>MIE Project Scope: Provide liquid nitrogen supply for coil and cryostat cooling consistent with CD-4 requirements.</p> <p>Future Scope: Upgrade liquid nitrogen supply system to support higher field or longer pulses as required. Provide liquid helium supply for neutral beams as required.</p>	
WBS Element: 622		WBS Level: 4
WBS Title:	LN₂ Coil Cooling Supply System	
Description:	<p>This WBS element consists of the effort to provide a LN₂ system for the cooling of the modular coils (WBS 14), and conventional coils (WBS 13). This system will:</p> <ul style="list-style-type: none"> • Distribute liquid nitrogen to the stellarator core with a supply/return differential sufficient to move fluid through the field coils at an acceptable rate. Does not include the distribution system <i>within</i> the cryostat for cooling the coil systems, which is the responsibility of WBS 1. • Remove the energy gained by the recirculating loop from the field coils in a manner that results in a stable supply temperature to the coils. <p>MIE Project Scope: Establish requirements and system architecture for entire LN₂ feed system including in-cryostat LN₂ distribution system (WBS 161). Provide liquid nitrogen cooling system based on that constructed for the coil test facility (CTF). Provide piping run to connect the CTF system to the cryostat system.</p> <p>Future Scope: Upgrade liquid nitrogen cooling system to support higher field or longer pulses as required.</p>	

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WBS Element: 623		WBS Level: 4
WBS Title:	GN₂ Cryostat Cooling System	
Description:	<p>The GN₂ Cryostat Cooling System (WBS 623) will be used to circulate nitrogen gas of a controlled temperature through the NCSX cryostat and, consequently, around the exposed surfaces of the structures within the cryostat during cooldown from room temperature and also during operation. This WBS element provides heating to bring the equipment within the cryostat up from the operating temperature of 80K back to room temperature. The cryostat cooling system is vented to the outside environment through a stack that is also part of this WBS element.</p> <p>MIE Project Scope: Development activities necessary to optimize performance and system consistent with CD-4 requirements.</p> <p>Future Scope: Upgrade system to support higher field or longer pulses as required.</p>	

WBS Element: 63		WBS Level: 3
WBS Title:	Utility Systems	
Description:	<p>Utility Systems consist of three (3) service manifolds around the NCSX vacuum vessel: one for vacuum venting; one for GN₂ service; and one for compressed air. The vacuum pump venting system shall provide a system to vent the vacuum pumps in the CS basement and the diagnostic vacuum pumps in the NCSX test cell to the outside.</p> <p>MIE Project Scope: Provide a vent for the vacuum vessel pumping system.</p> <p>Future Scope: upgrades to support upgraded systems as they come on line.</p>	

WBS Element: 64		WBS Level: 3
WBS Title:	Vacuum Vessel Heating and Cooling	
Description:	<p>The WBS element consists of the effort to provide heating and cooling to the vacuum vessel. The system supports high-temperature bakeout of the vessel and control of the vacuum vessel temperature under heat loading from plasma losses and heat losses to surrounding cold structure.</p> <p>MIE Project Scope: Provide a system to force 150 C heated air through the vacuum vessel heating and cooling tubes.</p> <p>Future Scope: Upgrades as necessary to support 350 C bakeout capability and increased plasma losses as upgraded plasma heating systems come on line.</p>	

WBS Element: 65		WBS Level: 3
WBS Title:	Facility Systems Integration	
Description:	<p>MIE Project Scope: Planning and interface definition for Facility systems.</p> <p><i>No longer in use and now closed.</i></p>	