INTERFACE CONTROL DOCUMENT TITLE AND APPROVAL PAGE

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ICD Number: ICD-12-14-3-0001 VV Insulation	**Primary Author:** P. Goranson
Impacted WBS Elements: WBS-121, WBS-123, WBS-14, WBS 3	**Type of Interface:** Mechanical/Envelope Interface

Description of Interface: The Vacuum Vessel (VV) includes a layer of insulation over all its external surfaces inside the Cryostat, including port extensions. This layer maintains the VV temperature during bake out and operation when the Cryostat is cooled down and protect the Modular Coils (MC) from excessive thermal loading. This ICD defines the requirements for mounting this insulation and the clearances required between the VV and the MC.

Record of Revisions

Revision Numb	Description	Date
0	Initial issue	12/16/2004

Approvals

WBS Manager:	**WBS Manager:**
WBS Manager	**Project Engineer**
Project Engineer:	**Project Engineer:**
Systems Engineering Support Manager:	

ICD DETAIL SHEET

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(Use Continuation Sheets as Necessary to Include the Following Applicable Information)

Scope of Interface:
This interface impacts the design of the Vacuum Vessel, the Heating and Cooling Distribution System, Diagnostics, and the Modular Coil design.

Equipment and Responsibility List:
Vacuum Vessel (WBS 121 Goranson
Vacuum Vessel Insulation (WBS 122) Goranson
Heating and Cooling Distribution System (WBS123) Goranson
Modular Coil (WBS14) Williamson
Diagnostics (WBS 3): Johnson

Related ICDs:
ICD-1203-361-01

Notes and Abbreviations:

Interface Block Diagrams:

Installation/Operation Information:
Insulation is installed on the vacuum vessel body before installation of the vessel inside of the MC structure. The insulation must lie within a nominal contour 1.0 inch from the surface of the vessel, the goal being to permit maneuvering of the vessel into the MC structure without damage to the insulation. The insulation is installed in layers, the first layers being installed on studs, between the coolant tubes, the second layers covering the tubes as well as the first layers. The second layers must be attached to the first layers as well as to each other.
The port extensions extending out through the MC structure are covered by a layer of insulation which is nominally 1.5 inches thick. Regions outside the MC structure are covered by layers which are nominally 2 inches thick. The port extensions must maintain a clearance of 1.0 inches to the MC structure during bakeout when the VV is at 350 C and the MC structure is cooled to 80 K. The insulation mounting must be done after installation of electrical heaters and thermocouples onto the port extensions, and before welding of the extensions onto the VV which is installed inside the MC.
The vertical ports (Port 12) insulation is installed before installation of the VV inside the MC and starts with a 1.0 inch layer of insulation installed under and between the coolant tubes, followed by a 0.5 inch layer installed over the tubes and first layer of insulation. The goal is to thermally isolate the tubes from the vertical port and prevent undue heating of its flange during bake out. Diagnostics and thermocouples must be installed first. The mounting is similar to the insulation on the VV body using studs for the first layer and tying the second layer to itself and the previous layer.

<u>VV thermal loads through insulation:</u>

Load to MC cooling system during bakeout	11.3 kW
Load to cryostat cooling system during bakeout	10.1 kW
Load to MC cooling system during standby	4.5 kW
Load to cryostat cooling system during standby	4.8 kW

Other Pertinent Information:

Reference documents:

VV Local Thermal Analysis	NCSX-CALC-121-001-00
NCSX Vacuum Vessel Heat Balance Analysis	NCSX-CALC-123-003-00
NCSX Vacuum Vessel Heating/Cooling Distribution System Thermo-hydraulic Analysis	NCSX-CALC-123-002-00