FERMILAB
Technical Division

SMTA at MDB

DESY SCRF Cavity Type II (C22) Cryogenic Safety Documents

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1.0 – SYSTEM DESIGN DOCUMENTS

1.1 – System Description

At the Meson Detector Building, a cave called the Single Module Test Area (SMTA) has been constructed for housing a Horizontal Test Cryostat (HTC). The Cryogenic Test Facility (CTF) supplies liquid helium and liquid nitrogen to the HTC. The HTC will test single Superconducting Radio Frequency (SCRF) dressed cavities. Currently, the cryogenic commissioning of the HTC is successfully complete. The plan is to test the RF system of the HTC using a test dressed cavity. A DESY SCRF Type II Cavity called C22 will be used for RF commissioning.

This document includes the Cryogenic Safety Documents, as specified in FESHM 5032, for the C22 cavity. Safety documents and engineering notes pertaining to the Horizontal Test Cryostat and the Cryogenic Test Facility are separate and have been approved previous to the start of the cryogenic commissioning. Since the C22 cavity becomes part of the HTC and the CTF, many components of the safety documents are part of the HTC and CTF documents.

1.2 – Piping and Instrumentation Diagram (Flow Schematic)

Figure 1 shows a reduced copy of drawing 4906.320-ME-442771. The electronic version of the drawing can be located in the FERMILAB I-DEAS TDM.

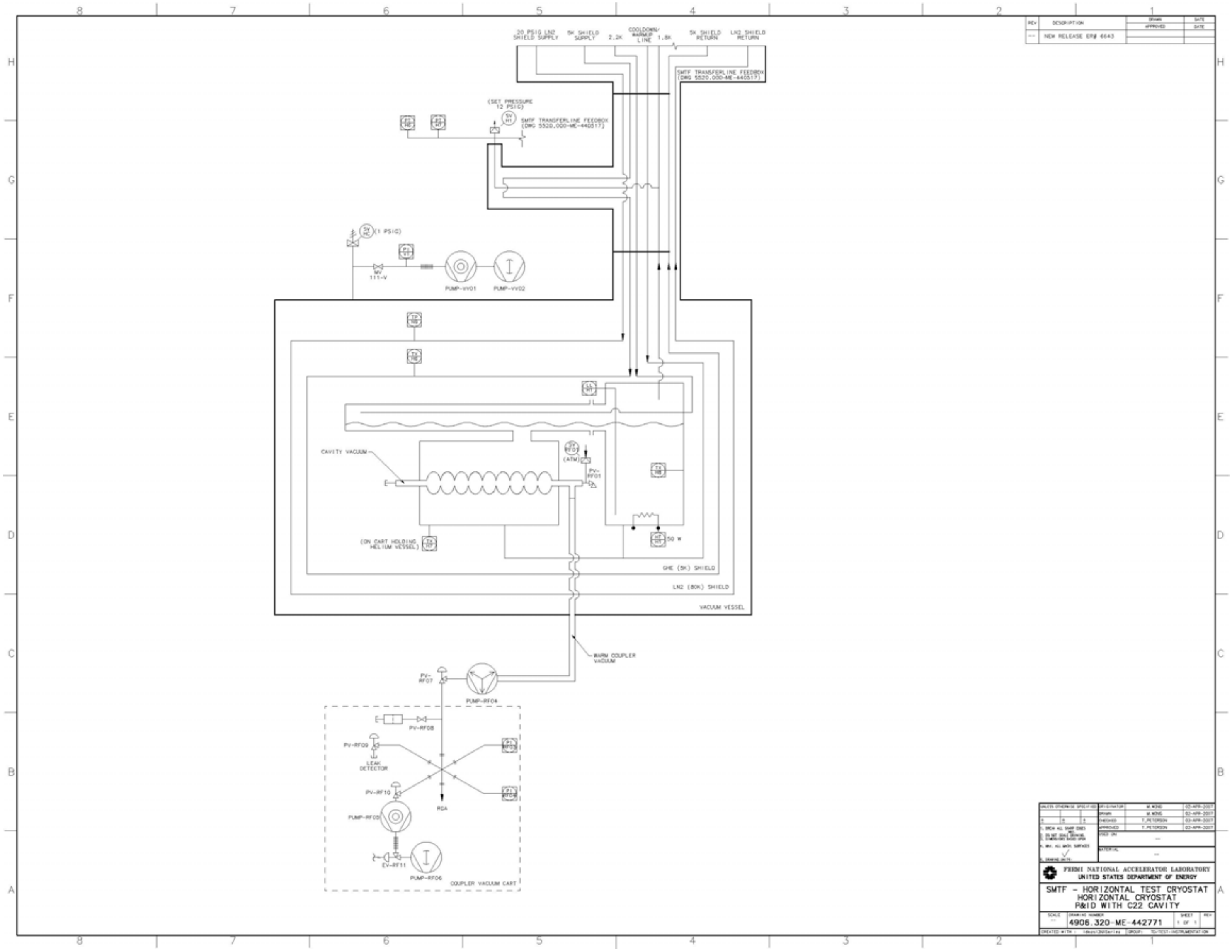

Figure 1 – Piping and Instrumentation Diagram of HTC with C22 Cavity (drawing 4906.320-ME-442771)

1.3 – Valve and Instrumentation List

Instrumentation	Location	Model	Company	Range	Comment
PI-RF03	Warm side of input coupler - low vacuum range	KJL902050 diaphragm monometer	Kurt Lesker	0.75-1,500 Torr	
PI-RF04	Warm side of input coupler - high vacuum range	ITR90 Ionivac with display	Leybold	3.75E-10 - 750 torr	

Valve	Description / Location	Model	Company	Range	Comment
PV-RF01	RF Cavity vacuum, Isolation valve within cryostat	Right angle manual valve 54032-GE02	VAT	--	1.5-inch valve
PV-RF07	Warm coupler vacuum, isolation valve to pump cart	Right angle UHV all-metal valve 9515027	Varian	--	1.5-inch valve with 2.75-inch CFF
PV-RF08	Warm coupler vacuum, valve leading to filter for letup procedure			--	Manual valve
PV-RF09	Warm coupler vacuum, valve leading to leak detector			--	Manual valve
PV-RF10	Warm coupler vacuum, isolation valve to turbo pump			--	Manual valve
EV-RF11	Warm coupler vacuum, isolation valve to roots pump			--	Manual valve
SV-RF01	RF Cavity vacuum, safety device	Pressure burst disk with 1-1/3" CFF	MDC Vacuum	Set pressure: Positive Pressure	0.75-inch
SV-H1	Helium pumping line, rupture disk	LRP	BS&B	Set point 12 psig @ 72 deg F	3-inch

Vacuum Pumps	Description / Location	Model	Company	Pump Speed	Comment
PUMP-RF04	Warm coupler cavity pump - ion pump	VacIon Plus 40 Starcell	Varian	34 L/sec	Controller: Varian 120V
PUMP-RF05	Warm coupler cavity pump - turbo pump	V70LP DN63	Varian	68 L/sec	Controller: Varian Turbo-V70 120V #9699505
PUMP-RF06	Warm coupler cavity pump - dry roots pump	ACP 28	Alcatel	16 cfm	

1.4 – Operating Control Loops

The C22 vessel does not add items to the HTC control system.

2.0 – SYSTEM OPERATING DOCUMENTS

As of the writing this document, the HTC is operated in the same way with the C22 vessel as without the vessel during cryogenic commissioning. Thus, a new operating procedure, qualification and training requirements, and startup checklist are not required.

3.0 – SAFETY ANALYSIS DOCUMENTS

3.1 - FMEA

Device	Description Reliefs & Valves	Failure Mode	Hazard / Effect	Comments / Remarks
SV-RF01	Loss of cavity vacuum (positive pressure)	Closed	No hazard. Possible rupture of cavity.	Replace or Repair.
		Open	No hazard. No additional gasses are added to the cryogenic system. Warm insulating vacuum will warm the helium bath, causing a rupture of SV-H1.	Replace or Repair.
SV-H1	Loss of helium (set pressure)	Closed	No hazard. Possible rupture of piping.	Replace or Repair.
		Open	No hazard. Loss of helium gas.	Replace or Repair.
PV-RF01	Cavity (beam line) vacuum valve	Closed	No hazard. Operational problem.	Replace or Repair.
		Open	No hazard. No additional gasses are added to the cryogenic system. Warm insulating vacuum will warm the helium bath, causing a rupture of SV-H1.	Replace or Repair.
PV-RF07	Warm coupler vacuum valve	Closed	No hazard. Operational problem.	Replace or Repair.
		Open	No hazard. Warm coupler vacuum is not attached to the vacuum spaces within the HTC.	Replace or Repair.
PV-RF08	Valve leading to filter for let-up procedure	Closed	No hazard. Operational problem.	Replace or Repair.
		Open	No hazard. Warm coupler vacuum is not attached to the vacuum spaces within the HTC.	Replace or Repair.

Device	Description Reliefs & Valves	Failure Mode	Hazard / Effect	Comments / Remarks
PV-RF09	Valve leading to leak detector	Closed	No hazard. Operational problem.	Replace or Repair.
		Open	No hazard. Warm coupler vacuum is not attached to the vacuum spaces within the HTC.	Replace or Repair.
PV-RF10	Isolation valve to turbo pump	Closed	No hazard. Operational problem.	Replace or Repair.
		Open	No hazard. Warm coupler vacuum is not attached to the vacuum spaces within the HTC.	Replace or Repair.
EV-RF11	Isolation valve to roots pump	Closed	No hazard. Operational problem.	Replace or Repair.
		Open	No hazard. Warm coupler vacuum is not attached to the vacuum spaces within the HTC.	Replace or Repair.

3.2 – What-If Analysis

Event	Consequence / Hazard	Conclusion.
Loss of cavity vacuum	Warm temperature will call liquid helium to vaporize.	Safe. Helium system in HTC is adequately protected by relief system.
Loss of warm coupler vacuum	Warm coupler vacuum is a trapped volume but temperatures will never be cold enough to condense air. Tuning position of cavity will change.	Safe. Operations problem only – test would be invalid.
Leaks into the subatmospheric helium circuit.	Possible introduction of contamination into helium system. Contamination could freeze out in the test stand or in the helium system.	Safe. Operations problem only. Relief valves exist for overpressure of the system due to plugs from freeze-up.
Warm coupler vacuum is left open to air for an extended time, then PV-RF-07 is closed, then warm coupler vacuum is warmed up.	When opened, the warm coupler vacuum would fill with water. When sealed and warmed, the water in the vacuum would never rise above the saturation pressure of water (<1 atm).	Safe. Operations problems only.

3.3 – Hazard Analysis

As of the writing this document, the HTC is operated and maintained in the same way with the C22 vessel as without the vessel during cryogenic commissioning. An additional Hazard Analysis is not required.

3.4 – Other ES&H Section Compliance

The C22 vessel does not introduce additional cryogens to the SMTA. Thus, an additional ODH analysis is not required.

4.0 – ENGINEERING DOCUMENTS

The Pressure Vessel Engineering Note for the DESY SCRF Cavity Type II (C22) [M. Wong – Rev 0: 11 April 2007] has been completed as a separate document.