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Magnet Division Procurement Specification

Superconducting Magnet Division

Specification Number: SMD-ELENS-2002

Revision: A

Procurement Specification: 4k Cryogenic Control Valve, Liquid Helium Supply, E-Lens Magnet

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Revision History
Rev. A: Initial Release 1/10/12

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1. Introduction

   This specification defines a cryogenic control valve for installation on the vacuum jacket liquid helium supply line for superconducting magnets.

2. Process Design Requirements

   2.1. The process design requirements are given in Table 1. The valve shall be able to meet the requirements of 4 different operational modes:

   1. JT Operation Mode A
   2. JT Operation Mode B
   3. Liquid He Dewar Test Mode
   4. Fill Mode from Dewar. (Valve can be full open in this mode)

   2.2. All valves shall be designed for minimum heat leak to process without heat station. Max heat leak to process shall be 0.5W

   2.3. All valves are required to operate between 4K and 400K.

   2.4. Pressure rating of the valve is 20 bar (~300 psig).

   2.5. Design pressure shall be vacuum to full pressure rating.

   2.6. Depending on the control function, the vendor shall propose either equal percentage, linear plug or plug with some combination profile for BNL to choose.

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Table 1 - Valve Specifications

Service:	Helium
Function:	Liquid Helium Fill / JT
Valve Type:	Globe Straight Through Pattern With Butt Weld End
Jacket:	2” IPS Vacuum Jacket
End Connections:	½” Tube Butt Weld
Control :	Maintain Liquid Level
Operator:	Normally Closed
Control Type:	Continuous Control Throttling
Actuator:	Diaphragm/ Spring Or Piston/ Spring
Positioner:	Vendor To Propose
Pressure Rating [Bar]:	20
Design Pressure:	Vacuum To Full Pressure Rating
Design Temperature [K]:	4 – 400
Seat Leakage:	Bubble Tight At Max. Pressure Differential
Valve Leakage To Vacuum:	1 X 10^{-9} Atm-CC/S At Max. Pressure Differential
Seal Type:	Bellow Sealed With Back Up Sealing
Vacuum Boundary Interface:	Vacuum Jacketed Transfer Line
Max. heat leak to 4.5 K [W]:	0.5W
Max. valve size [in]:	½” OD
Length of Valve Inside Vac. Jacket:	600mm
Maximum Overall Height :	980mm

	JT Operation Mode A	JT Operation Mode B	Liquid He Dewar Test Mode	Liquid He Dewar Fill Mode
Mass flow [g/s]	1.59	1.71	1.0	3.0
Inlet				
Pressure [bar]	4.0	4.0	1.2	1.45
Temperature [K]	5.98	6.0	4.422	4.60
Phase	Supercritical	Supercritical	2-phase	2-Phase
h [j/g]	23.73	24.2	20.01	15.3
Outlet				
Pressure [bar]	1.32	1.32	1.18	1.18
Temperature [K]	4.531	4.531	4.403	4.403
Density [g/L]				
Phase	Two-Phase	Two-Phase	Two-Phase	Two-Phase
Vapor fraction [%]	~ 64%	~ 67%	up to ~ 46%	up to ~ 22%

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3. Construction Materials

3.1. All material shall be new and proven for 4 K application.

3.2. Selection of materials used shall prevent the occurrence of galling between mating parts.

3.3. Selection of materials used shall prevent the occurrence of galvanic corrosion.

3.4. Epoxy or other similar materials shall not be used

3.5. All piping shall be seamless or welded austenitic stainless steel

4. Mechanical Design Requirements

4.1. All fixed permanent joints shall be welded

4.2. No mechanical joints are allowed to the vacuum space and suitable for cold box installation.

4.3. All seals, joints and welds shall be suitable for design temperature, pressure and full vacuum

4.4. The valve will be subjected to temperature cycle and shall be capable of withstanding 10,000 cycles from 400K to 4K without loss of leak tight integrity

4.5. The valve shall be helium mass spectrometer leak tested for external leakage and shall have a leak rate less than $1x10^{-9}$ atm. cc/s at 1 ATM differential pressure

4.6. The valve shall be designed for helium bubble tight closure at a differential pressure equal to the design pressure across the valve seat in either direction

4.7. The valve shall incorporate soft seating with easily replaceable plugs and seats

4.8. Special tools for installation and maintenance along with price shall be given in the proposal

4.9. The valve and all internal surfaces shall be clean for helium refrigeration application

5. Type of Valves to be furnished:

5.1. Valve operators shall be instrument air actuated. Instrument air provided by the buyer is regulated between 60 to 80 PSIG. All the mounting brackets and attachment to valve shall be provided.

5.2. Control valves shall be equipped with air-operated pneumatic diaphragm actuators, positioners, filter/regulator sets, and I/P (current to pneumatic) transducers, fail to closed. These devices shall be tubed and assembled on the valve actuator by the valve supplier. The instrument air supply connection to the valve assembly shall be 1/4 FNPT. I/P transducers shall be 4-20 MA with load impedance less than 350 ohms. The electrical enclosure for the solenoid connections shall be NEMA 1 and provided with provision for flexible conduit connection.

6. Documentation

6.1. Calculations to show how the proposed valve is to meet the specification, including % opening of valve at the specified conditions.

6.2. Data sheets with valve and the interface dimensions and outline drawings including the operator shall be furnished with the proposed submittal offer.

6.3. Max. allowable forces, moments and deflections induced by piping at the valve body.

6.4. The proposed valve data

6.5. The proposed actuator data

7. QA deliverables

1) Certified Material Test Reports (CMTR's) for pressure boundary materials
2) Pressure Test report
3) Seat test report
4) Leak check test report
5) Certificate of Conformance

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Minimum Data To Be Provided By The Vendor

5.3 Proposed Valve Data

Tag Name: _____
Model N0.: _____
Valve Size: _____
CV: _____
Heat Leak: _____
Design Max. Press. _____
Design Max. Temp. _____

Type (Globe / Angle): _____
Body End Conn. _____
(IN/OUT) IPS
Body Matl. _____
Packing Matl. _____
Packing Type _____

Plug Matl. _____
Seat Matl. _____
Stem Matl. _____
Recommended Spare Parts _____

5.4 Proposed Actuator Data

Tag Name: _____
Model N0.: _____
Type: _____
Size: _____
Actuator Dia _____
Stroke _____
Seating Force _____
Recommended Spare Parts _____

Please provide the above requested technical data including dimensional, price and delivery data The vendor submittal cannot be evaluated without the above data.