SPECIAL SPECIFICATION

SECTION 15074S

LIQUID NITROGEN DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section covers materials, installation, decommissioning, cleaning and inspection of the Liquid Nitrogen (LN_2) system.

B. The intent of this specification is not to limit contractor(s) expertise, exercise of professional experience, judgement or responsibility. Alternates to methods described shall be submitted in writing to Engineer, for approval, prior to commencement of work. Explanation of benefits of alternates shall also be submitted.

C. The scope of work includes decomissioning the existing 13000 gal liquid nitrogen tank, the existing 12.5 KSCFH vaporizor and associated liquid nitrogen piping; disconnecting the associated piping; relocating the 13000 gal liquid nitrogen tank and the 12.5 KSCFH vaporizor; reconnecting the liquid nitrogen piping from the liquid nitrogen tank to the 12.5 KSCFH vaporizor, installing liquid nitrogen pressure regulators and pressure gauges with associated isolation valves, connecting the liquid nitrogen regulator station with liquid nitrogen distribution piping (vacuum jacketed) to the MicroFab, providing and installing piping, isolation valve, safety valves, point of use valves, vents, mechanical keep colds..

D. The Vacuum Jacketed Piping is designed to provide low pressure liquid nitrogen from nitrogen tank to cryogenic equipment.

E. The equipment that is provided is manufactured for use with extremely low temperatures (-320ºF). Any material coming in contact with liquid nitrogen must be austentic stainless steels, copper and brass. Any material coming in contact with cold vapors must be appropriate for extremely low temperatures.

F. Related Codes and Standards:

1. Vacuum Jacketed Pipe – ASME Section B31.3 – “Process Piping”.

2. Section 13085S –“Seismic Protection”

3. Section 150**60 – Hanger and Supports**

1.02 SUBMITTALS

A. Provide submittals as required in this specification. Submittals shall include, but are not limited to piping diagrams at minimum ¼” = 1’-0” scale detailed schedules, decomissioning procedure, cleaning procedures, test procedure and test results, and cut sheet for pipe, valve and equipment.

1.03 DELIVERY, STORAGE AND HANDLING

A. Store piping, valves and fittings separately by type. The materials shall be stored and handled in a clean, sheltered location.

B. Any material damaged or contaminated must be recleaned. Contaminated material must be stored separate from clean material. Cost for recleaning materials shall be paid by the Contractor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Vacuum Jacketed Piping: Quality Cryogenics

B. **Foam Insulated Piping: The Manufacturer Inc.**

C. Mechanical Keep Cold: Quality Cryogenics

D. Vacuum Jacketed Cryogenic Valve: ACME Cryogenics, Inc

E. **Phase Separator: ACME Cryogenics, Inc**

F. Pressure Relief Valve: Rego Cryo-Flow Products

G. Liquid Nitrogen Pressure Regulator: Cashco, Inc.

H. Vacuum Evacuation and Pressure Relief Valve: ACME Cryogenic, Inc

I. Pressure gauge: Ashcroft

2.02 VACUUM JACKETED PIPING (VJP) SYSTEM:

A. The Vacuum Jacketed Piping (VJP) system is designed for the efficient transfer of liquid nitrogen at pressures up to standard 150 psig. The normal operating pressure for liquid nitrogen supply is set as 30 psig. The flow requirements for the MicroFab is 2.6 GPM maximum.

B. The Vacuum Jacketed Piping system is made up of individual components. These components include VJP sections, vacuum jackted cryogenic valves, bayonet connection, relief valve, fittings, and phase separator and mechanical keep cold.

C. VJP shall be double-walled construction that has an inner pipe for the transfer of liquid nitrogen and an outer pipe to support and retain the vacuum insulation. The inner and outer pipe is constructed with a SCH5 300 series stainless steel.

D. The insulation is a low static vacuum with multiple layers of paper and foil applied in such a way as to reflect back radiant heat. Molecular sieves and getters are used with the insulation to maintain low vacuum levels over a minimum of 10 years.

E. VJP system is accommodated by the inner pipe, so the outer jacket of the pipe system does not require special roller hangers.

F. The VJP pipe sections are designed and built with a factory sealed vacuum through a evacuation valve and super insulated system or piping system connected to redundant vacuum pumps. The pipe sections may be connected together with either a mechanical bayonet coupling or a welded field joint coupling. The evacuation valve will act as emergency pressure relief valve for the secondary contaiment.

2.03 ADDITIONAL EQUIPMENT

A. Mechanical Keep-Cold (Vapor Vent) – The mechanical keep-cold uses a mechanical float valve to maintain liquid in the VJ pipe line and vent the excess gas created by normal heat leak. The mechanical keep-cold helps provide liquid on demand to the equipment.

B. Pressure Relief Valve – Relief valves are required to protect the line in the event an isolation valve is shut off with liquid in the line. All reliefs should be less than or equal to 150 psi.

C. Phase separator – Separate the liquid and gas phase to ensure the continous liquid supply

D. Vacuum Jacketed Flex shall be furnished as per drawings and owner request.

E. Vacuum Jacketed Valves are used as in-line control valves. They allow the luxury of maintaining the high insulation value and preventing frost-up.

PART 3 - TESTING AND INSPECTION

3.01 GENERAL

A. All welds on sub-assemblies and finished spools will be leak tested with a helium mass spectrometer to 1 x e-9 cc/sec.

B. After evacuation, each spool will undergo a five day vacuum retention test.

C. A settled pressure reading will be taken from piping with static vacuum each day for four consecutive days and recorded. The maximum allowable settled pressur reading will be 30 microns.

D. If the spool passes the vacuum retention testing for four consecutive days, the spool will then be flowed with liquid nitrogen after the fifth day to ensure vacuum integrity under cryogenic conditions. The entire outer jacket will be inspected for cold spots and frosting.

PART 4 - INSTALLATION

4.01 GENERAL

A. Employ experienced personnel for decommissioning, moving and installing the existing tank and vaporizer.

B. Schedule shutdown operation at the low liquid nitrogen level in the nitrogen tank.

C. Isolate the vaporizer from the nitrogen tank and vent by constant monitoring of the gas pressure in the vaporizer to a gas pressure of 20 psig

D. Drain liquid nitrogen from tank and reduce tank pressure to 20 psig by constant monitoring of gas pressure.

E. Warm tank inner vessel before moving to the new location.

F. Ensure that rigging equipment has adequate rated capacity to handle the tank weight and vaporizer weight

G. Before erecting the tank and vaporizer, inspect the tank and the vaporizer carefully for possible shipping damage. Check tank and vaporizer pressure and tank vacuum.

H. Connecting the vaporizer and the tank.

I. Fill the warm tank with liquid nitrogen according to the procedure of gas supplier

J. The Installation of VJP shall be performed by a certified VJP contractor.

K. Installed VJP shall not interfere with the operation or access to any machines and equipment.

L. VJP shall be installed as to permit piping contraction avoiding damage to joints or supports.

M. After evacuation of piping with static vacuum, no welding to the outer jacket of any spool is permitted. Welding against the outer jacket will result in vacuum loss. Welding to the outer jacket of an evacuated spool voids the warranty of that spool.

N. VJP contractor shall locate bayonets and design spool arrangements to allow for installation through and around non-movable, fixed joints.

O. VJP shall be installed with slope.

P. **Reserve maintenance space for isolation valves per manufacturer's recommendation.**

END OF SECTION