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HIGH FIELD MAGNET DEVELOPMENT HELIUM REFRIGERATION/LIQUEFIER

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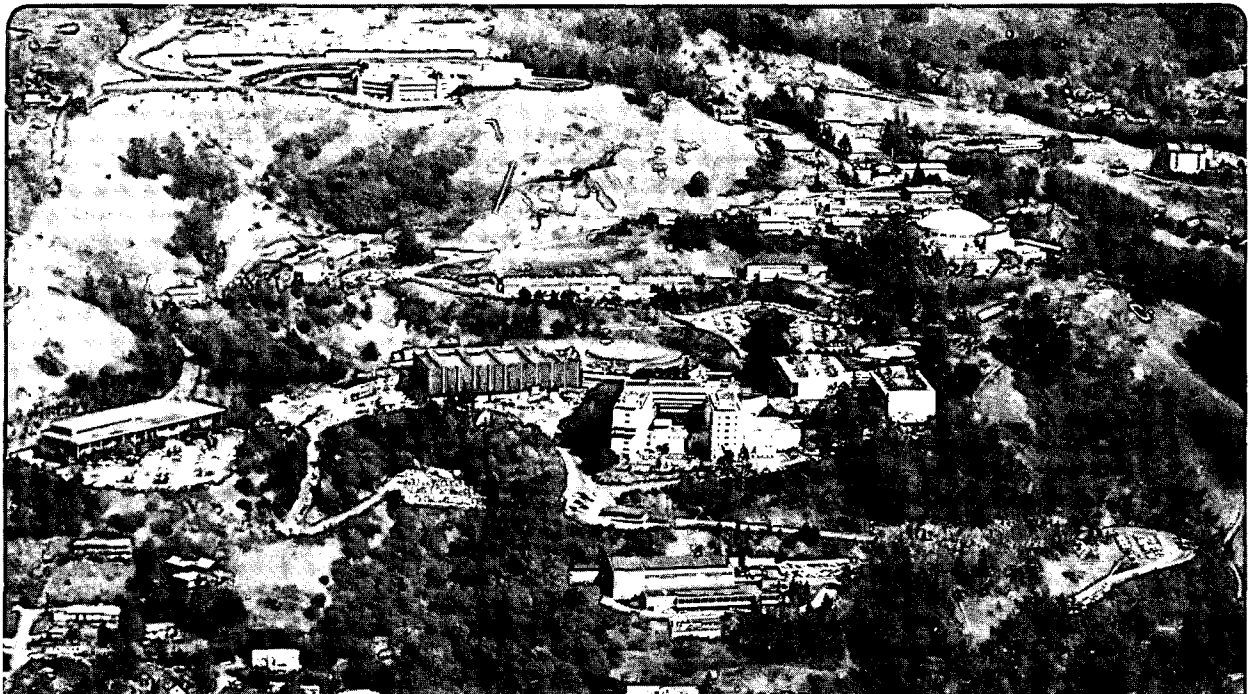
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LAWRENCE BERKELEY LABORATORY UNIVERSITY OF CALIFORNIA	CODE AA0114	SPECIFICATION		SERIAL M592 B	PAGE 1 OF 5
WRITTEN BY R. Warren/R. Byrns	DEPARTMENT Mechanical	LOCATION Berkeley	DATE March 12, 1979		
TITLE MECHANICAL ENGINEERING - MAGNETS, SOLENOIDS, COILS HIGH FIELD MAGNET DEVELOPMENT HELIUM REFRIGERATION/LIQUEFIER				CHECKED BY	

A Change 4/9/79
B Change 6/7/79

1. INTRODUCTION

The Lawrence Berkeley Laboratory (LBL) has need for a helium refrigerator-liquefier. The machine will be used on research programs related to high field magnet development.

2. SCOPE

Supply of a complete helium refrigerator-liquefier less compressors and oil clean up system is required. The cold box, purifiers, expanders, control panel, etc. are to be mounted on a single skid. Engineering start up supervision is to be included. ~~Two triaxial delivery tubes in accordance with Fig. 1 are to be supplied.~~

3.0 PERFORMANCE

With saturated LN at 20 psig

Refrigerator at 4.5 K

200 watts

Liquefier

40 liters/hr. (liquid rise rate)

4.0 DESIGN AND CONSTRUCTION

4.1 Engineering discussion between seller and LBL prior to call for prices may be held for further clarification and standardization of proposals.

4.2 Low side heat exchanger pressure drop shall not exceed 1.0 psi at maximum flow.

4.3 Seller is responsible for providing a minimum of two sets of drawings and instructions sufficient for installation, operation, and maintenance. Installation drawings showing the arrangement of subassemblies and layout of interconnecting piping shall be supplied to LBL within two months of contract award. Final drawings and test reports (6.2) shall be certified.

4.4 System shall have sufficient localized valves, controls and sensors to provide simple operation for cooldown, steady-state, warm-up, diagnostics evacuation and purge. An internal bypass valve and heater system for testing at 4.5 K with refrigerator isolated from external load with with shunt off valves in supply and return line are required.

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- 4.5 Two sets of supply and return (to and from load) connection points (bayonets) are to be provided. One pair of these will be coaxial and the other pair individual. A separate JT valve will feed each supply. Control valves will be provided in each return line.
- 4.6 System shall have safety devices to meet applicable codes and regulations and protect personnel and equipment during malfunction and fault conditions. All pressure relief devices shall be located so that there is unobstructed access to them with a hot air source. All relief devices shall be vacuum tight.
- 4.7 Expander devices may be rotary or reciprocating.
- 4.8 Purifiers at 80 K shall be sized as follows. If only one unit is provided it shall have a charcoal volume of at least 5 ft³. Dual, switchable units shall have a charcoal volume of one ft³ for systems operating at eleven atm. pressure on 2/3 ft³ for systems which operate at 18 atm. pressure. Piping shall allow each vessel to be valved off from the main refrigeration stream and reactivated.
- 4.9 System shall be designed and constructed for continuous operation (3000 hours) and must meet the latest standards of:
 - a.. Electrical - AIEE, NEMA, IEEE, UL
 - b. Pressure vessels and heat exchangers: ASME-UPV Section VIII, IX. Code stamp not required.
 - c. Piping, ASAB31.5A, ANS1B31.3
 - d. Occupational Safety and Health Act, 1970 (OSHA)
 - e. Uniform Building Code, Seismic Design based on 0.5 g (yield stress) or 0.7 g (ultimate stress) horizontal acceleration.
- 4.10 Control system failure modes shall preclude system damage when the refrigerator is operated unattended for periods of up to 16 hours.
- 4.11 Seller will specify compressor mass flow and pressure to meet the performance requirements of this specification and additional performance achievable with increased mass flow. Seller will specify necessary control interfaces with compressor.
- 4.12 Systems utilizing turbine expanders shall include a charcoal adsorber at 20 K.



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4.13 LBL WILL SUPPLY THE FOLLOWING:

- a. The vacuum system for auxiliary equipment purge and pumpdown.
 - b. Medium pressure gas storage vessel or ballast.
 - c. High pressure gas storage bottles or tube bank, manifold, and regulators.
 - d. Compressor and oil clean-up system.
- Seller will specify in technical proposal any additional equipment to be supplied by LBL; i.e., cold box vacuum system, etc.

5. TESTING

5.1 Seller shall pressure test all elements to one and one quarter times their maximum working pressure (pneumatic) or to one and one half times their maximum working pressure (hydrostatic). Low side heat exchanger pressure drop insulating vacuum pressure attainable at operating conditions with system valved off from pumps, heat exchangers cross channel leakage; vacuum leakage and external leakage at operating conditions shall be measured by seller and results made available to LBL.

5.2 Seller will perform tests for 5.1 above and provide certified procedures and results to LBL at least 15 days prior to shipping system to LBL.

6.0 STARTUP AND TRAINING

6.1 Seller will provide all labor, material and equipment, except as noted above, to startup and tune to optimum running conditions. Seller will also provide training to two key LBL operators.

7.0 ACCEPTANCE

7.1 Within 30 days of satisfactory startup, the system will be operated for 24 continuous hours at guaranteed design conditions to determine if the requirements to this specification are satisfied. Seller need not be present for these tests. If system fails to meet specification seller shall provide, at its cost, all necessary material, labor and equipment necessary to correct deficiencies

*Test may be conducted at elevated temperature and results scaled to operating conditions.

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8.0 INSTALLATION AND OPERATION

8.1 LBL will provide material and labor for equipment installation and connection, also labor for operation and maintenance. Major modification and repairs are sellers responsibility.

8.2 The system must be capable of operation with the following utility schedule.

Electrical - Power as required at voltages of 480/240 and 110v.

Cooling Water - At a minimum pressure of 40 psig and maximum temperature of 85° F, return minimum 10 psig, maximum 105° F.

Liquid Nitrogen - As saturated liquid at 35 psia.

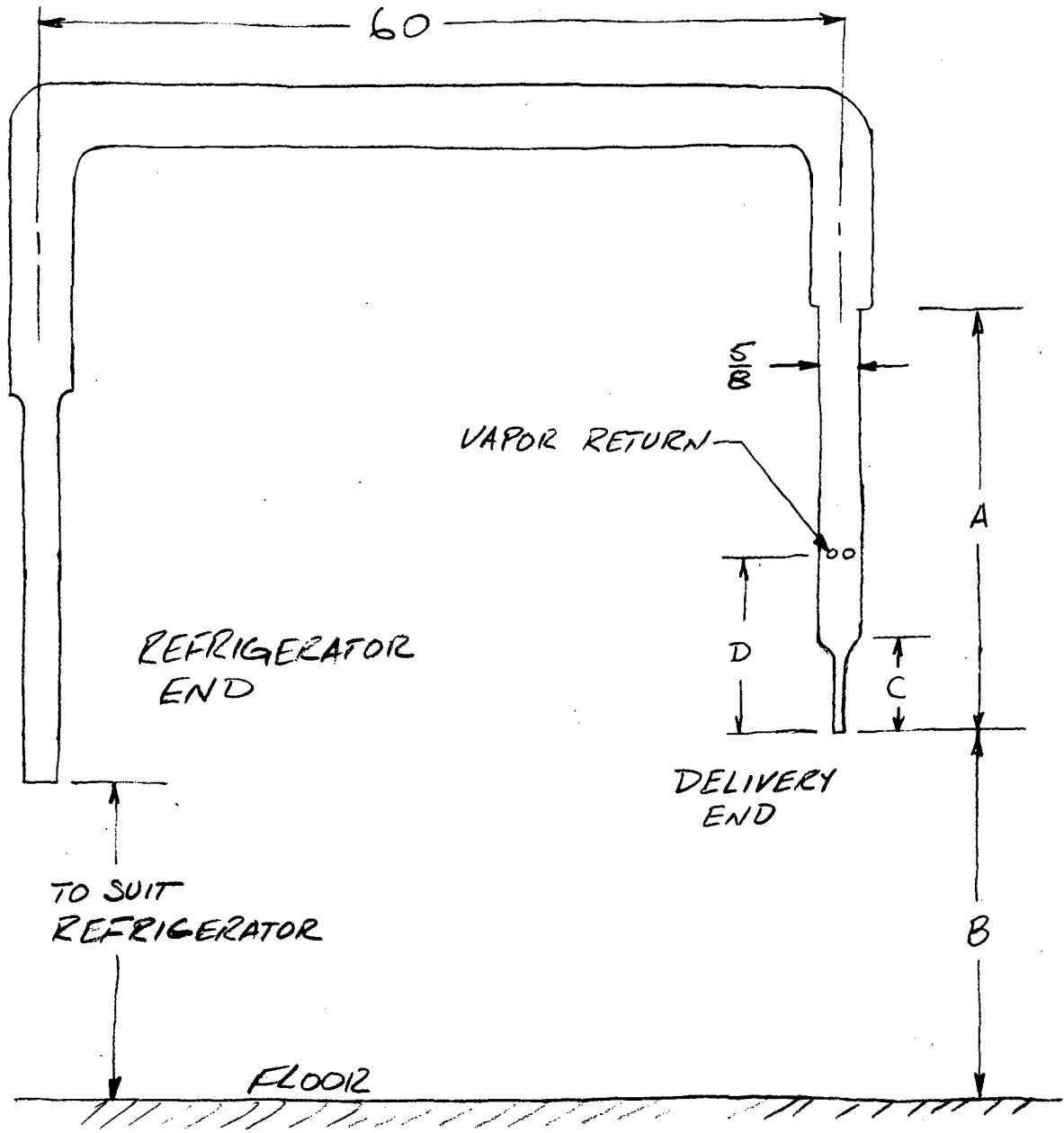
Instrument Air - Maximum pressure of 80 psia, dry, oil free.

Helium Gas - Grade E, quantity as needed.

Seller shall define quantities required.

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△B



PART NO	DIMENSIONS, (INCH)			
	A	B	C	D
1	36	60	5	10
2	52	25	20	28

FIGURE 1 REFRIGERATOR TRANSFER LINE (TRIAxIAL)

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