LBID-215 c.1
UC-38

Lawrence Berkeley Laboratory

UNIVERSITY OF CALIFORNIA

Engineering & Technical Services Division

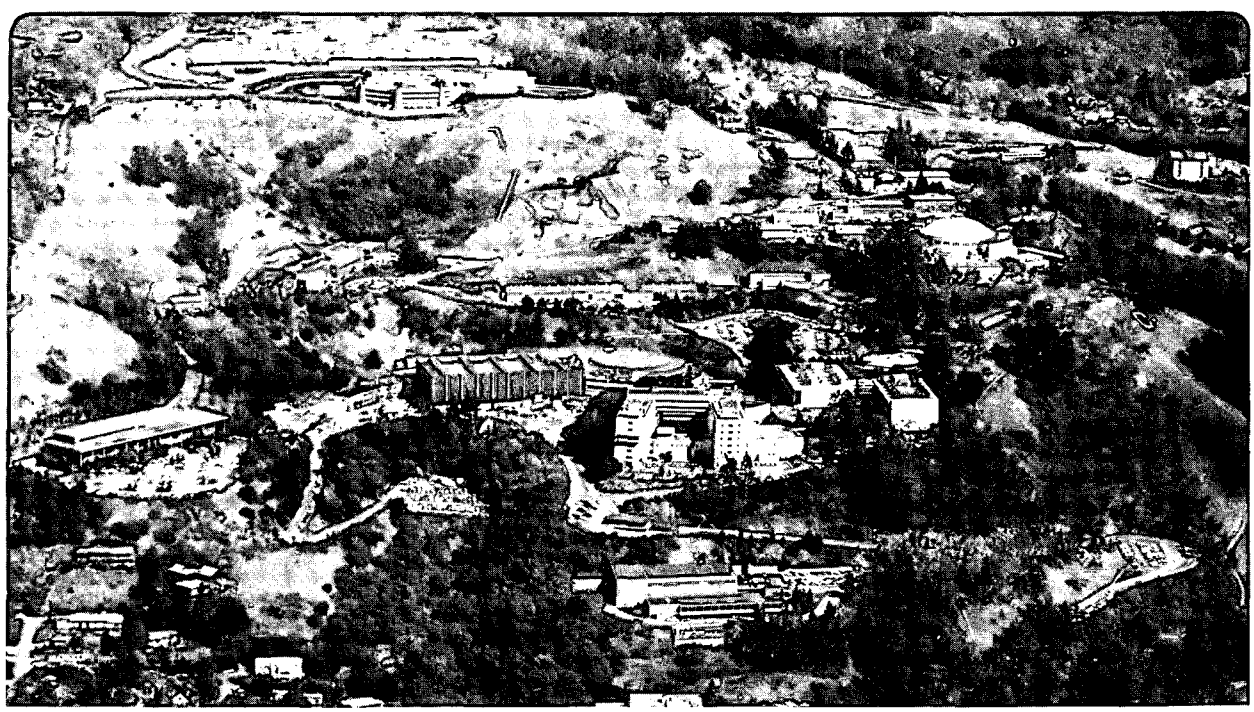
RECEIVED
LAWRENCE
BERKELEY LABORATORY

JUL 21 1980

LIBRARY AND
DOCUMENTS SECTION

For Reference

Not to be taken from this room



LBID-215 c.1

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

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.

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

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.

B 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 ft^3. Dual, switchable units shall have a charcoal volume of one ft^3 for systems operating at eleven atm. pressure on 2/3 ft^3 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, ANSIB31.3

d. Occupational Safety and Health Act, 1970 (OSHA)

B 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.

B 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.

B 4.12 Systems utilizing turbine expanders shall include a charcoal adsorber at 20 K.

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

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.

B 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

B 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.

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

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.

B Liquid Nitrogen - As saturated liquid at 35 psia.

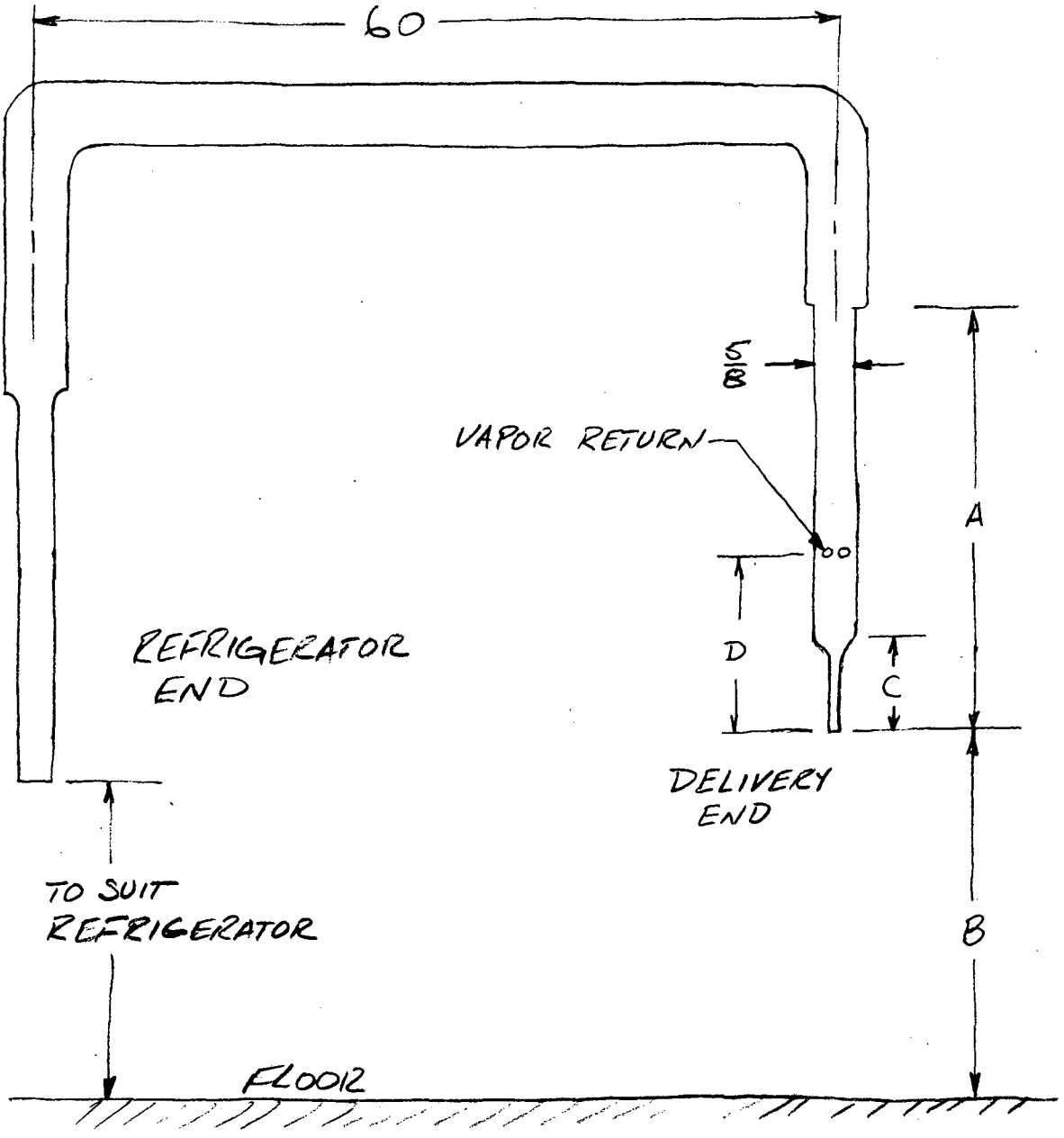
Instrument Air - Maximum pressure of 80 psia, dry, oil free.

Helium Gas - Grade E, quantity as needed.

Seller shall define quantities required.

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

B



DIMENSIONS, (INCH)

PART NO	A	B	C	D
1	36	60	5	10
2	52	25	20	28

FIGURE 1 REFRIGERATOR TRANSFER LINE (TRIAXIAL)

RL-3221

This report was done with support from the Department of Energy. Any conclusions or opinions expressed in this report represent solely those of the author(s) and not necessarily those of The Regents of the University of California, the Lawrence Berkeley Laboratory or the Department of Energy.

Reference to a company or product name does not imply approval or recommendation of the product by the University of California or the U.S. Department of Energy to the exclusion of others that may be suitable.

TECHNICAL INFORMATION DEPARTMENT
LAWRENCE BERKELEY LABORATORY
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA 94720