PRELIMINARY TITLE I REPORT

ON

CRYOGENICS FACILITY

REPORT TO STANFORD LINEAR ACCELERATOR CENTER - NO. ABA-98
STANFORD UNIVERSITY - ABA SUBCONTRACT S-136
UNDER STANFORD - AEC CONTRACT AT(04-3)-400

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CONTENTS

I. INTRODUCTION

A. SCOPE

This report presents the Title I work performed in regard to the Cryogenics Facility. Included are preliminary drawings of a site plan, building plans and elevations and mechanical and electrical schematics. Also included are outline specifications, schedule of work and a preliminary construction cost estimate.

B. FACILITY

The Cryogenics Facility building will be located near the Target Area on a site north of the Beam Switchyard and west of End Station "A", on the Stanford Linear Accelerator project site.

The building will house research laboratories, utility areas, offices and toilet facilities in a low, one-story area and will have a high bay area for purposes of assembling and testing Cryogenics devices. Storage for non-flammable gases and space for equipment required to operate the facility will be provided in adjacent outside areas. Part of this outside area will be roofed over for protection of equipment

The high bay Assembly and Test Area will be provided with an overhead crane.

II. BASIS FOR DESIGN

A. SITE

1. Location

The Cryogenics Facility is located centrally in consideration of its principal user groups who are in the Central Laboratory, Heavy Assembly Building and the Target Area End Station "A" and "B" buildings,

Future expansion is possible in the areas east and west of the building.

2. Preparation

The site will be rough graded as a change order to the Accelerator Housing contract. Similarly, yard and access road surfacing will be part of another contract.

B. BUILDING

1. General

Four research laboratories are provided in the building. Two will be used for development of cryogenics devices which use small quantities of liquid hydrogen. The other two will be used for development of devices using non-explosive liquids and gases. The two types will be separated by a utility corridor from which utilities will be stubbed into each of the laboratories.

The laboratories utilizing liquid hydrogen and the Assembly and Test Area, which also uses liquid hydrogen, are separated by another utility corridor. All indoor non-explosion proof equipment such as distribution panels, circuit breakers, motor starters, instrumentation and control equipment required during hydrogen runs will be located in this corridor and in the adjoining Utility Room.

Office areas are intended for single and multiple occupancy. Toilet facilities are provided for 22 men occupants and two women occupants.

Pertinent Data

Element	Length Feet	Width Feet	Gross Area Sq. Feet	Net Area Sq. Feet	Volume Cu. Feet
Lab-Office-Utility Area	100 60	50 8	5187	4499	88,180
Assembly and Test Area	60	40	2400	--	87,800
Covered Utility Area	50	20	1000	--	8,500

The height of the Lab-Office-Utility Area is predicated upon the requirement for 14 feet of minimum clear head room under all beams and services in the four laboratories.

Height of the Assembly and Test Area is based upon a clearance requirement of 25 feet under the crane or a 25 foot hook height above finished floor, whichever governs.

2. Architecture

The design of the building incorporates several elements of the architectural vocabulary proposed to and approved by the Stanford University Board of Trustees for use in the industrial type buildings found on the project site. Components of the vocabulary used include typical exterior walls of pressed metal siding, standard metal sash, exposed steel columns, pressed metal sight screens for concealment of mechanical equipment on the low roof, and roof overhangs for protection from sun and rain.

Ceilings will not be provided in the four laboratories, utility corridors, utility room or Assembly and Test Area. Offices and toilet rooms, however, will be furnished with ceilings.

The high bay Assembly and Test Area will be provided with a large roll-up door to permit passage of heavy equipment in and out of the building.

3. Structure

The building will have rigid structural steel frames supported on reinforced concrete spread footings.

A reinforced concrete blast wall separates the high bay from the remainder of the building. The wall is intended to protect occupants of the laboratory and office areas from possible explosions resulting from use of explosive liquids and gases in the high bay. Design pressures for this wall will be greater than the conventional loading used for the metal wall panels or the metal roof deck. It is intended that the siding and roof deck should blow out first in the event of an explosion, thus relieving pressure on the blast wall and lessening its likelihood of collapse.

Viewing ports will be provided in the blast wall to permit observation of tests in the high bay from the utility corridor.

A 10% roof slope to a center ridge will be provided in the Assembly and Test Area to facilitate the flow of accidentally released hydrogen gas to the exhaust fans located in each bay of the roof.

4. Mechanical

a. Air Conditioning

Only the office areas will be provided with air-conditioning. Air conditioning will be by means of package units having the capacity to maintain the temperature at $75^{o}F \pm 3^{o}$.

b. Heating and Ventilating

All heating will be electric. The two laboratories using hydrogen and the Assembly and Test Area will be heated by low temperature elements such as the type available in indirect systems using electrically heated water.

Heating of the four laboratories and Assembly and Test Area will be sufficient to maintain a minimum temperature of 70°F at an outside temperature of 35°F. Normal ventilation in these areas will provide for a complete air change in three to five minutes. Outside air will be reduced to about 20% of total circulation during cold weather.

In order to meet safety requirements in the Assembly and Test Area and the two labs where hydrogen is used, the ventilation system will be provided with the capability of exhausting the room in two minutes. This emergency ventilation will be activated upon hydrogen detection.

The Assembly and Test Area will be provided with vents for hydrogen boil off and for mechanical vacuum pump exhaust.

Toilet rooms and corridors will also be heated and ventilated. The toilet rooms and Utility Room will be exhaust ventilation with air from adjacent areas.

c. Plumbing

Plumbing will be conventional with office building type fixtures.

d. Utilities

Low conductivity water, compressed air, domestic water and cooling tower water will be located at the Utility corridor ceiling and stubbed into the four laboratories. Distribution within the laboratories will be by the occupant. These same utilities will be distributed to the adjacent outside storage and equipment areas as required.

Each of the utilities will be brought to a point 5 feet outside the building from the Beam Switchyard Utilities as part of another contract.

Compressed air and domestic water will be supplied to the Assembly and Test Area from the Utility corridor at intermediate columns on each wall, terminating at valved outlets approximately 10 feet above the floor. Domestic water will be connected to the various plumbing fixtures and base bibs.

Two floor drains will be provided in each laboratory. The floor drains in the two laboratories using hydrogen and those in the Assembly and Test area will be provided with screw-in sleeves for the purpose of preventing the entrance of liquified explosive gases into the sewer system.

e. Fire Protection

No sprinkler system is to be installed. Portable fire extinguishers will be provided by SLAC.

5. Electrical

a. Electrical Service

(1) Power. Electrical power will be supplied from the Research Area Substation at 480 volts, 3 phase, 4 wire, 60 cycles. Distribution of power will be made from a Control Center located in the Utility Room. The estimate does not include the cost of the 480 volt service from the Research Area Substation to the Cryogenics Facility.

(2) Power Distribution. Power at 480 volts, 3 phase will be provided for the 480 volt receptacles, heating and ventilation, crane service, roll-up door service, and for the adjacent outside storage and equipment areas as required. The 480 volt power will also be transformed to 208Y-120 volts for the 120 and 208 volt receptacles and for the 120 volt lighting. The 480 volt panelboards and the 120/208 volt panelboards will be located in the Utility Corridor adjacent to the Assembly and Test Area and the laboratories which utilize liquid hydrogen. The positive lock-out type circuit breakers will be used for control of circuits feeding conventional equipment and devices in these hazardous areas. Conventional type, general purpose enclosed panelboards for 480 volts and for 120/208 volts will be located in the two laboratories which do not utilize explosive liquids and gases. Additional conduit runs will be provided from the magnet power supply center to these laboratories and to the Assembly and Test Area. The number, size, and location of these conduits will be specified later.

b. Receptacles

(1) Laboratories will be provided with surface metal raceway type 120 volt receptacles with outlets on approximately 5 foot centers. Each room will be supplied with 10 volt-amperes per square foot of room area in this manner. Also, one 480 volt, 100 ampere, 3 phase and two 208 volt, 3 phase receptacles will be provided in each of the laboratories.

(2) Assembly and Test Area will be provided with 120 volt duplex receptacles on 20 foot centers around the periphery of this area. Four 480 volt, 100 ampere, 3 phase receptacles will

also be installed in the Assembly and Test Area.

(3) Office Areas will be provided with at least one 120 volt duplex receptacle for each office in accordance with code requirements.

(4) Hazardous Areas, such as the laboratories utilizing hydrogen and the Assembly and Test Area, will have additional power supplies in accordance with code requirements from the Utility Corridors outside these areas for service during experiments. The exact requirements for this power will be specified later.

c. Lighting

(1) The two laboratories and the Assembly and Test Area where the use of explosive liquids and gases are involved will be provided with 25 foot candles of explosion proof lighting at 30 inches from the floor. Supplemental, conventional lighting on lock-out type circuit breakers will provide lighting level intensities of 70 foot candles for the laboratories and 50 foot candles for the Assembly and Test Area.

(2) The two laboratories not using explosive liquids and gases will be provided with a lighting intensity of 70 foot candles.

(3) Offices will be provided with a lighting level intensity of 80 foot candles.

(4) All other areas will be provided with an illumination intensity of 25 foot candles.

(5) Exterior building lighting shall be installed to match that of existing buildings.

d. Grounding System

A complete grounding system will be installed as required by the California Safety Orders and the National Electrical Code. This

will include a ground loop to provide for grounding of all electrical equipment as well as the building steel. Requirements for grounding in the Research areas are to be provided by SLAC.

e. Magnet Power Supplies

The duct and cabling system for the Magnet Power Supplies are not a part of this report. Provisions shall be made for stubbing out conduits for the feeders. The number of ducts, feeders and locations will be determined later.

f. Emergency Power M.G. Set

Conduit stub-ups only will be provided at the pad for the emergency power generator set. No equipment is included in this report.

6. Hydrogen Detection System

A hydrogen detection system will be provided for the two laboratories and the Assembly and Test area where hydrogen is to be used. This system shall be interlocked with the emergency ventilation system.

7. Fire Alarm System

The project fire alarm system will be extended into the building. A fire detection system, using rate of rise detectors, will be installed. Fire alarm horns and manual fire alarm boxes will be located for adequate coverage and in compliance with the National Fire Codes. A master fire alarm box will be provided at an exterior location.

8. Communications

Provisions will be made for extension of telephone and intercom systems into the building. Conduit and outlet boxes only are included for telephone and intercom systems. Cable and communication equipment is not included in this report.

9. Crane

The electric overhead bridge crane rails will be provided as part of the building contract package. The crane itself will be furnished and installed under a separate contract.

III. OUTLINE SPECIFICATIONS

A. GENERAL

1. Occupancy - Group F-2.

2. Type of Construction - Type IV(N)

3. Number of Stories - One

4. Location on Property - Separated on four sides

5. Area Limitations

   a. Per Uniform Building Code, 1961 Edition.
   Occupancy Group F-2.
   Type IV(N), Fire Zone III, Unsprinklered.
   Maximum allowable area = 12,000 square feet.

   b. Per Atomic Energy Commission Criteria.
   Maximum allowable area = 15,000 square feet, unsprinklered.

B. FOUNDATIONS

Reinforced concrete spread footings. Concrete slabs on grade.

C. STRUCTURAL FRAME

Rigid steel frame carrying metal deck roof system.

Live Loads:

Roof	20 psf + equipment
Hoist in each laboratory	1000# from roof beam
Laboratory floors	500 psf
Assembly and Test Area floor	1000 psf
Office area floors	150 psf
Blast wall	75 psf normal to surface
Wind and seismic	UBC

Wind, seismic and lateral pressures on blast wall will be taken by the rigid frames in the lateral direction. The blast wall will serve as a shear wall in the longitudinal direction.

D. ROOF

Built up roof and gravel (colored granular material) over rigid insulation on metal deck.

E. EXTERIOR WALLS

Pressed metal panels similar to Robertson, Mahan, or equal. Panels are insulated and provided with interior finish of painted sheetrock in office, laboratory toilet and utility areas. The interior surfaces of metal panel siding will be exposed and painted in the Assembly and Test Area.

Windows will have fixed glass in metal sash.

Exposed structural columns and beams will be rolled steel sections, painted.

F. INTERIOR PARTITIONS AND WALLS

Sheetrock on wood studs. Toilet rooms to have tile wainscot behind fixtures. Blast wall between Assembly and Test Area and Utility Corridor will be reinforced concrete, painted.

G. FLOORS

Vinyl asbestos tile on concrete with rubber base in offices, Utility Room and Corridors, and the two laboratories where non-explosive liquids and gases will be used.

Ceramic tile and base in toilet rooms.

Conducting vinyl tile and rubber base in the two laboratories where hydrogen will be used.

One forth inch conducting topping over concrete slab in the Assembly and Test Area.

H. CEILINGS

Sheetrock in toilet and offices. Exposed metal deck and steel roof beams in all other areas, painted.

I. DOORS

Hollow core flush panel wood for interior doors and metal and glass exterior doors in the Office-Lab-Utility Area of the building.

Hollow core metal and metal roll-up door for the Assembly and Test Area.

J. WINDOWS

See "E. EXTERIOR WALLS."

One fourth inch plate glass in all glazed entrance doors. DSB clear glass in sash.

K. MECHANICAL

1. Air conditioning for office areas:

   Package water cooled air conditioners with electric heating elements.

2. Heating and ventilating units for Assembly and Test Area and two laboratories using hydrogen:

   Roof mounted cabinet centrifugal units with aluminum wheels, replacable media filters, electric heating elements with surface temperature below $500^{o}F$, time modulated control, overheat protection. Units are interlocked to shut off when hydrogen is detected.

   Emergency exhaust fans in these areas will be roof mounted, low silhouette dome, centrifugal exhausters with aluminum wheels, static proof belt drive, explosion proof motors and gravity dampers.

3. Heating and ventilating units for the two laboratories using non-explosive liquids and gases:

   Same as for the other two laboratories except with standard electric heating elements and without interlock to hydrogen detection system.

4. Plumbing:

   In accordance with Uniform Plumbing Code. Office building type fixtures.

5. Hot domestic water:

   Electric water heater.

6. Piping:

   Piping for compressed air at 100-110 psig will be threaded galvanized iron pipe with bronze valves. Domestic water piping will be threaded galvanized iron pipe with bronze fittings.

   Low conductivity water piping will be silver soldered copper tubing in 4 inch and smaller sizes and welded stainless steel in larger sizes. Ball valves will be used. Piping will be sized for three megawatts of cooling capacity based upon a temperature rise of $30^{o}F$ with a supply temperature of $95^{o}F$ and a supply pressure of 300 psig.

   Cooling tower water piping will be threaded black iron in sizes under 3 inch, welded black iron pipe for larger above-grade pipe, and class 100 asbestos cement for larger buried pipe.

L. ELECTRICAL

Electrical power will be supplied from the Research Area Substation at 480 volts, 3 phase, 4 wire, 60 cycles.

Lighting levels:

Assembly and Test Area	50 fc (25 fc explosion proof and 25 fc conventional)
Two labs using hydrogen	70 fc (25 fc explosion proof and 45 fc conventional)
Two labs using non-explosives	70 fc
Offices	80 fc
All other	25 fc

Building Load Requirements in KVA:

	Connected	Maximum Demand
120 Volt Receptacles	46	23
208 Volt Receptacles	44	22
480 Volt Receptacles	332	133
Explosion Proof Lighting	16	16
Conventional Lighting	26	26
Exterior Lighting	1	
Crane	20	20
Roll Up Door Motor	2	2
Hot Water Heater	3	3
Heating and Ventilating Units	10	10
Air Conditioning	16	
Exhaust Fans	46	20
Electrical Heat	200	200
Hydrogen Storage Area (apart from building)	1	1
	763	476

M. FIRE PROTECTION

The project fire alarm will be extended into the building. Also provided will be a fire detection system using rate of temperature rise detectors, alarm horns, manual alarm boxes and a master alarm box.

Portable hand extinguishers will be provided by SLAC.

N. HYDROGEN DETECTION

Detectors will be located near each exhaust opening in the roof.

O. COMMUNICATIONS SYSTEMS

Project telephone switchboard is in the Administration-Engineering Building. The telephone system will consist of conduit and outlets only provided for nominal coverage. Provisions for an intercom system will be

similar. Cable and equipment will be part of another contract.

P. All utilities to the Cryogenics Facility will be brought underground to within five feet of the building as part of the Target Area Site Improvements and Utilities package.

Q. The crane will have a 20-ton capacity with provision for adding a five ton auxiliary hoist at a later date. Hook height, lift and clearance under the bridge are to be 25 feet minimum. The crane is to be pendant operated and is to be furnished as part of a separate contract.

IV. SCHEDULE

Title I	Preliminary Draft Submittal	28 August 1964
Title I	Draft Review Completed by SLAC	14 September 1964
Title I	Final Submittal	28 September 1964
Title I	Review and Approval by SLAC & AEC	19 October 1964
Title II	50% Submittal	21 December 1964
Title II	90% Submittal	15 February 1965
Title II	Revised and Ready For Bid	26 March 1965
Bid Opening		27 April 1965
Notice to Proceed		25 May 1965
Construction Completed		31 December 1965

V. TITLE I ESTIMATE-DETAILS

CRYOGENICS FACILITY

ACCT. NO.	ITEM	QUANTITY	COMPOSITE UNIT COST	ITEM COST	TOTAL COST
5-060	STRUCTURE				
	Earthwork	392 CY	$6.00	$ 2,400	
	Concrete	310 CY	53.00	16,400	
	Blast Walls	2,100 SF	5.00	10,500	
	Structural Steel	67 Tons	490.00	32,800	
	Sheet Metal	---	LS	1,200	
	Miscellaneous Metal	---	LS	12,000	
	Operable Louvers	480 SF	7.50	3,600	
	Metal Siding & Deck'g.	17,300 SF	0.84	14,500	
	Roofing	10,340 SF	0.60	6,200	
	Windows-Glasswork	1,400 SF	4.00	5,600	
	Doors	35 EA	120.00	4,200	
	Rolling Door	600 SF	6.40	3,800	
	Dry Walls & Ceiling	8,900 SF	0.92	8,200	
	Floors-Resil.& Ceramic	4,300 SF	0.72	3,100	
	Conductive Flooring				
	Concrete Surfacing	2,400 SF	1.50	3,600	
	Vinyl Tile	800 SF	4.50	3,600	
	Paint Work	68,000 SF	0.15	10,200	
	Building Accessories			2,200	
	STRUCTURE, SUB TOTAL				$144,100
5-060	MECHANICAL				
	Plumbing			$12,000	
	Heating, Ventil., A.C.			34,000	
	Piping			21,600	
	MECHANICAL, SUB TOTAL				$ 67,600
5-060	ELECTRICAL				
	Lighting & Power			$52,500	
	Grounding			2,500	
	Fire Alarm System			4,000	
	Tel. & Communication			2,500	
	Hydrogen Detection System			8,500	
	ELECTRICAL, SUB TOTAL				$70,000
	TOTAL COST, BUILDING				$281,700

VI. DRAWING LIST

SK-506-001	Location Plan
SK-506-101	Floor and Roof Plan H.V.A.C. Plan
SK-506-102	Exterior Elevations
SK-506-103	Building Sections
SK-506-701	Single-Line Diagram