TO: G. G. Bawden
FROM: W. N. Harris
SUBJECT: END STATION "B" - TITLE I REPORT

Forwarded herewith for transmittal to SLAC are 20 copies of the Title I Report for End Station "B", Report No. ABA-92, dated May 1, 1964. Four additional copies of the report are enclosed for your use.

The draft report previously submitted has been revised in accordance with comments contained in SLAC memorandum, Savage to Harris, dated April 10, 1964. Major changes which have been incorporated as a result of draft comments are as follows:

1. The building height has been lowered three feet based on recent crane clearance information from manufacturers. (A cost reduction of approximately $18,000.)

2. The westerly portions of the north and south walls are now shown to be solid concrete in lieu of the 22-foot long by 12-foot high opening shown in the Title I draft drawings. (A cost increase of approximately $3,000.)

3. The floor slab thickness has been reduced from 9 inches to 6 inches. (A cost reduction of approximately $6,000.)

4. The building overhang, fascia and roof opening baffles have been reduced in size. (A cost reduction of $11,000.)

5. Earthwork quantities have been revised to reflect the latest shielding fill design. (A cost reduction of approximately $29,000.)

6. The electrical control center is no longer pressurized. (A cost reduction of approximately $5,000.)

7. The 480-volt service from the Research Area Substation to End Station "B" is now included in the Target Area Site Improvements and Utilities cost estimate. (A cost reduction of $5,000.)
8. The retaining wall on the north side of the building is now included in the report cost estimate and the south wall design has been revised. (A cost addition of $83,000.)

Numerous minor additions and changes have also been incorporated into the report. The cost estimate for the structure has been reduced from $1,095,000 to $1,040,000 for a net decrease of $55,000. However, the retaining wall cost has been increased from $25,000 to $108,000 as noted above. As a result of all changes, the cost estimate for End Station "B" (Account number 5-620) has increased by $22,000 to a new total of $1,304,000.

As noted in the report, the beam port shielding steel will be furnished by SLAC. Consideration should be given to the availability of this shielding in the quantity, shape and size necessary to structurally span the beam port opening. Welded straps or anchors may be necessary to assure that individual pieces can be fastened into an integral shape for seismic resistance.

W. N. Harris
Project Engineer

cc:  R. L. Sharpe
     L. W. Swanson
     R. Kitson
     G. L. Johnson
     J. R. Boyle
     E. D. Leys
     W. Savage (SLAC)
     M. C. Lewis (CLA)
TITLE I REPORT
FOR
END STATION "B"

REPORT TO STANFORD LINEAR ACCELERATOR CENTER - NO. ABA-92
STANFORD UNIVERSITY - ABA SUBCONTRACT S-136
UNDER STANFORD - AEC CONTRACT AT(04-3)-400

Submitted by W. N. Harris
Approved by Roland L. Sharpe

AETRON-BLUME-ATKINSON
A Joint Venture
ARCHITECT-ENGINEER-MANAGER
Palo Alto, California

CHARLES LUCKMAN ASSOCIATES
Architectural Associates

May 1, 1964
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. BASIS FOR DESIGN</td>
<td>3</td>
</tr>
<tr>
<td>III. OUTLINE SPECIFICATIONS</td>
<td>21</td>
</tr>
<tr>
<td>IV. DESIGN AND CONSTRUCTION SCHEDULE</td>
<td>28</td>
</tr>
<tr>
<td>V. COST ESTIMATE</td>
<td>29</td>
</tr>
<tr>
<td>VI. DRAWINGS</td>
<td>30</td>
</tr>
</tbody>
</table>
I. INTRODUCTION

A. SCOPE

This report presents the Title I design for End Station "B" and associated facilities and equipment. Included is information regarding the original criteria used as a basis for this preliminary design and a complete description of the physical features of the facility.

Included herein are preliminary plans and descriptions for the following items of work:

1. The End Station "B" structure including the beam port funnel, the target room and the target room access structure.
2. Mechanical and electrical house utilities within a line 5 feet from the building.
3. Bridge cranes for End Station "B" and the target room.
4. Retaining walls for earth shielding.

Several items of work (such as portable shielding blocks and exterior underground utility housings) are not funded under the End Station "B" budget but are, nevertheless, shown on the drawings for reasons of clarity and completeness. Wherever such exceptions occur, either in the text or in the cost estimate, explanatory notes have been added, as required.

B. CRITERIA

The basic criteria for this facility were defined in "Design Criteria Report for End Station 'B', ABA-84," dated December 20, 1963. Modifications and additional criteria were established during the Title I design period by means of
SLAC memoranda and meetings. The sequence and extent of "Target Area Facilities" construction were described in an ABA memorandum dated October 24, 1963 and in a "Time Grid" dated March 19, 1964.

Design criteria and Title I reports have previously been issued on the following related projects:

1. Title I Report, Beam Switchyard, ABA-85, dated December, 1963. The beam switchyard will provide the structural and earthwork interface at the west end of End Station "B" target room.

2. Title I Report, Target Area Site Improvements and Utilities, ABA-86 (Draft), dated April 7, 1964. Described therein is the supply of general purpose compressed air and domestic water to the underground utility housings and the supply and distribution of low conductivity cooling water and magnet power within the End Stations.


4. Heating, End Stations "A" and "B", ABA-89 (Draft), dated February 3, 1964 which presented the results of a study on heating systems for End Stations "A" and "B". Conclusions and SLAC comments are summarized in an ABA meeting report dated February 17, 1964.

5. Design criteria for portable shielding blocks will be described in a future report.
A. GENERAL

End Station "B" will be a large single story reinforced concrete structure located at the east end of the Beam Switchyard Area. This facility will house various research experiments and will be designed to provide maximum flexibility for target configurations within budgetary limitations. Figure 1 indicates the site location for End Station "B" and its relationship to other Target Area facilities.

All design work will conform to U. S. Atomic Energy Commission Manual, Chapter 6000 and the codes and standards listed therein. In addition, standards developed for this project by SLAC will be used wherever appropriate.

No personnel will be assigned to this building on a permanent occupancy basis.

B. SITE PREPARATION

1. Site. The construction site for End Station "B" will be rough graded and double seal coated under the "Accelerator Housing and Earthwork" contract. This work, including access roads to the construction site, will be completed by mid-October 1964 in order to provide an "all weather" surface for start of End Station "B" construction in January 1965.

2. Soils Investigation. Soils investigation work has been conducted in the Target Area during the past years, as was necessary to provide geological information on the site and to determine the suitability of the soils for use as shielding
fill for the Accelerator Housing and Beam Switchyard. Target Area borings were conducted in the Fall of 1963 to provide specific data for foundation design and to refine settlement predictions. Additional Target Area borings were made at the eastern perimeter of the site during April 1964 to provide permanently cased wells for observation of ground water levels and for radiation sampling. No further soils investigation is planned for End Station "B".

End Station "B" will be founded in Miocene sandstone with loading capability of up to 40 Kips/ft². Wherever possible, excavation for foundations will be cut to neat lines by the contractor to avoid disturbing original soil any more than is necessary.

C. ARCHITECTURAL - STRUCTURAL

1. Architecture. The architectural design of this building is a departure from the vocabulary established for the Campus and Shops areas of the SLAC site. This departure results from the functional and structural requirements of the building. However, because the Target Area is far enough away from these areas (approximately one-quarter mile), differences in architectural treatment will not be seen simultaneously.

2. Description. End Station "B" will be designed to accommodate large experimental equipment on a floor which is uninterrupted by partitions or columns. The building will have clear inside floor space dimensions of 75 feet by 150 feet, as shown in Figure 2. The interior building height (approximately 45 feet) will be determined either by a minimum clearance to crane girder or a hook height of 35 feet above the floor, whichever is lower. The west end of the building, above an elevation of 25 feet, will be extended westward 33 feet
to provide crane coverage of the beam port shielding. Building dimensions are as follows:

- Length (inside at floor) 150 feet
- Length (inside at roof) 183 feet
- Width (inside) 75 feet
- Height (clear under roof beams) 45 feet
- Total Floor Area 11,250 square feet

3. **Structure.** The structure will be made up of precast and poured-in-place reinforced concrete. The use of concrete was predicated on the requirement that all roof and wall areas must provide a minimum shielding mass of 300 pounds per square foot (corresponding to two-foot thick normal weight concrete walls and roof). Foundations will be reinforced concrete spread footings.

   a. **Walls.** The building will be windowless because of shielding requirements. The lower portion of the building walls will be clear openings to provide the maximum possible space for experimental set-ups which extend outside of the building. A single column will be located at the mid-point of the north and south walls with openings approximately 42 feet and 70 feet wide in each wall. The east wall will have a 62-foot wide opening with columns at the corners only. The west wall of the building will also serve as a retaining wall for the earth shielding over the target room and Beam Switchyard. These wall openings (20 feet high for the central bay of the north and south walls, 12 feet for all other walls) will be sealed with weatherproof siding and then shielded with portable blocks. The cost of the portable concrete shielding will be detailed in a separate report. Provisions will be made for attachment of shielding blocks to the building structure for lateral support from seismic forces.

- 5 -
Five 4-foot by 8-foot man doors will be installed in the weatherproof siding for air exhaust and emergency personnel exit requirements. When the shielding blocks are in place, two personnel maze passageways will be provided. A gate at the entrance to each passageway will permit emergency exit but will prohibit personnel entry when experiments are in progress. A 22-foot by 22-foot by 2-foot thick mechanically operated concrete door will be located in the south wall to permit passage of large research assemblies into the building. The door, which will weigh approximately 75 tons, will have a normal opening speed of approximately 15 feet per minute and will be equipped with a separate mechanical means of emergency opening. A 20-foot by 20-foot, motor operated, steel roll-up door will be provided behind the concrete shield door. This will permit control of wind and rain at the door opening without the necessity of closing the large concrete door each time access is required during periods when experiments are not in progress.

Three-foot diameter ports will be located in the building walls to accommodate portable hydrogen exhaust systems. Five ports will be located on each side wall and three on the east end wall as shown on the elevation drawings. The four high ports (at an elevation of approximately 30 feet) will be shielded with detachable "U" shaped, weatherproofed concrete blocks which may be used as exhaust fan structures. The nine low ports (at an elevation of approximately 20 feet) will be shielded with a combination of two exhaust fan structure blocks and seven concrete slabs which measure approximately 5 feet by 5 feet by 1 1/2 feet thick. All port shields will be detachable and interchangeable with any of the 13 openings.

b. Roof. In an effort to reduce the cost of the roof system as much as possible and to achieve a column free floor, structural steel roof beams will be
used to span the width of the building. The top flange of these beams will support precast slab units which in turn will serve as a form for a poured-in-place concrete roof slab. The steel beams will be shored in position until the roof deck is complete. The beam-slab combination will act as a structural unit.

A roof live load of 30 psf will be used in order to accommodate possible future random placement of mechanical equipment. A 10% roof slope upward to a center ridge will be used to facilitate the flow of accidentally released hydrogen gas towards exhaust openings through the roof slab between each beam. Roof openings will be shielded with one-foot thick slabs of concrete. Access to the roof for equipment maintenance will be provided by way of the shielding fill at the west end of the building.

c. **Floor.** The concrete floor will have a nominal thickness of 6 inches. The floor will be capable of supporting loads of 5,600 psf imposed on the floor by concrete shielding. Heavy, concentrated loads will be distributed by special base plates or beams installed by the building occupants. The floor will be founded on undisturbed soil wherever possible and will be kept structurally separate from the building walls.

Two groups of six-inch diameter ducts will be constructed just below the floor slab, three ducts per group, to provide a means of running cabling within the building. These ducts will extend the full length of the building and will connect the utility housing manholes as shown in Figure 2. The north row of ducts will terminate in handholes in the floor of the beam port funnel at the west end of the building and at an exterior utility housing manhole at the east end of the building. The south row of ducts will terminate in floor handholes at the west wall and at the inside face of the east wall.
4. **Utility Housings.** Three underground utility housings, approximately 8 feet by 8 feet inside dimension, will be located under the end station floor for bringing utilities and ventilation air into the building. Four 3-foot by 6-foot manholes will be provided within the building for access into each utility housing. Removable manhole covers will be of two types: one will be solid and capable of supporting the maximum floor loads when an experiment is set up in that area, and the other will be an open grating capable of carrying only moderate floor loads. The three underground housings, which run in a north-south direction, will extend beyond the building on the north side and will be connected to a common, exterior, east-west utility housing. Additional manholes will be located along this exterior, east-west housing and provision will be made at these manholes for inserting pipes with a length of 20 feet and a diameter of two feet. Gates will be provided at the north end of each utility housing to control personnel access to the building when experiments are in progress. The south end of each utility housing will be constructed to allow for future expansion. Channel inserts will be installed at 10-foot centers in the walls and ceilings of the utility housings. Electrical cable trays to be installed in these housings are described in the Target Area Site Improvements and Utilities report and the cost is not included herein. The utility housings will slope downward to the north to provide drainage. A collection sump will be constructed in the exterior, east-west housing for retention of waste water for possible radiation monitoring before disposal. An additional north-south utility housing will be located to the east of the building for use by outside experimental set-ups. The exterior underground utility housings are described in the Target Area Site Improvements and Utilities report and the cost is not included herein.
5. **Beam Port Funnel.** A tapered concrete port will be constructed at the west end of the building. In plan the taper will be an angle whose arc tan is \( \frac{1}{2} \) each side of the beam centerline; the apex is located on the beam centerline three feet west of the east wall of the target room. This angle will permit the shielding blocks in the funnel to be designed in simple 3-foot modules with the length twice the width. Vertically, the funnel extends to a height of 25 feet, at which point it flattens out to form a platform that joins the side and upstream walls of the end station. Portable shielding blocks will be fitted around the secondary beam transport equipment as required for each experiment. The portable shielding blocks will be the subject of another report and their cost is not included herein. Permanent steel shielding (8 feet thick by 20 feet high with a maximum width of 25 feet) will be located directly above the concrete port. This shielding metal will be furnished by SLAC and installed by the end station construction contractor. The floor of the funnel will be designed to withstand loading to a height of 25 feet with material of average specific gravity of 4.0 (6,250 pounds per square foot of the floor). The concrete blocks will be handled by means of the end station bridge crane.

The areas to the north and south of the beam port funnel will be crushed rock retained-by-concrete to a height of 25 feet. The crushed rock will be compacted and capped with a concrete slab. A 3-foot thick layer of beam port funnel concrete shielding blocks may be stored on top of this cap with the load being distributed to the retained crushed rock.

6. **Target Room and Access Structure.** To the west of the beam port will be located a rectangular target room with interior dimensions of 20 feet along the beam axis, 25 feet wide and 26 feet 6 inches high. The target room ceiling will
be approximately 32 feet below the outside grade and at the same elevation as
the Beam Switchyard ceiling. Two 24-inch diameter vertical shafts will be in-
stalled through the shielding fill and roof of the target room for SLAC instru-
mentation. A stainless steel lined sump will be located along the beam axis
below the floor level of the target room to contain spilled cooling water from
the target assembly and from the drain gutter in the floor of the beam port.
A 30-inch diameter shaft will slope upward to the experimental yard area on the
north side of the end station. This shaft will provide a means of emptying the
target room sump and of supplying low conductivity cooling water to the target
assembly from heat exchange equipment on a curbed, concrete pad. If required,
the pad will be shielded with portable concrete blocks.

A 10-foot wide by 12-foot high (inside dimension) structure will provide
a means of personnel and vehicle access to the target room. Concrete shielding
blocks will be used to close off the structure during operation for radiation
safety. A shielded opening will be provided at the structure entrance for per-
sonnel egress.

All portable concrete shielding will be described in a separate report.

7. Drainage. Roof rain water leaders will be connected into the nearest
yard area storm drainage lines. Downdrains will be provided on the embankment
slopes. The storm drainage system for the yard area surrounding End Station "B"
is described in the Target Area Site Improvements and Utilities report and the
cost is not included herein.

Subdrains of perforated pipe will be used along the exterior walls of the
target room and will drain westward into the Beam Switchyard subdrain system.
Polyvinyl chloride membrane will be used for moisture proofing the exterior surfaces of the target room and the underground utility housings and the top and sides of the target room access structure.

8. **Exterior Facilities.** Space allowance will be made around the building for possible future addition of more shielding. A concrete pad will be constructed on the north, east and south sides of the end station for extending experiments to the outside of the building. This exterior area is described in the Target Area Site Improvements and Utilities report and the cost is not included herein.

Walls will be constructed to the north and south of the end station as required for retaining shielding fill over the target room, access structure and adjacent Beam Switchyard structures as shown in Figure 1. The cost of these walls is included herein. The fill over the target room will consist of compacted, graded rock with an in-place density of 140 pounds per cubic foot to meet the special shielding requirements. The cost of shielding fill over the target room, access structure and as necessary to complete the Beam Switchyard fill, is included herein.

**D. MECHANICAL**

1. **Ventilation.** Ventilation for End Station "B" will be by means of roof-ridge mounted exhaust fans with one fan provided in each bay for the length of the building. The fans will receive air from the highest point of the building through shielded openings in the 2-foot thick roof slab and will exhaust the air through automatic dampers. The fan motors will be explosion proof, and fan wheels and belts will be spark proof.

In order to meet hydrogen safety requirements, the ventilation design will be based upon a two-minute air change of the upper 15 feet of the building. The
exhaust fans will be manually controlled. An override control will automatically provide for full capacity operation when called for by the hydrogen detection system.

Normal ventilation requirements will be met by air supplied from the underground utility housings up through at least six of the grating-covered floor openings. A free area of at least 100 square feet of floor grating should be open at all times. Air inlets to the utility housings will be located outside the building and will have weather protection in the form of movable filter housing structures. Filters will be the roll type, similar to those used in the air intake structures for the Accelerator Housing. Two 4-foot by 8-foot man doors located in the shielding blocks (or an equivalent area) will be opened automatically when more than 50% of the fans are on to meet the added high summer ventilation or hydrogen purge air intake requirements. Gates will be provided across the openings to control personnel access when experiments are in progress for radiation safety while permitting emergency exit.

Ventilation will be provided for the target room and the access structure be means of a separate exhaust system which will operate only when required for personnel entry. The fan will be located above the shielding fill.

2. Heating. The building will be heated, when occupied, by means of electric heating units which will re-circulate the air in the building. Air movement will be generated in the occupied space by drawing the air from near the ceiling and discharging it low so as to blanket the building openings with warm air. The inside design temperature for heating is 65°F at an outdoor temperature of 35°F. During cold weather the exhaust fans will operate only when necessary for the removal of fumes or other contaminants. Normal infiltration should be adequate
for ventilation in cold weather, in view of the low occupancy and the high cubic content of the building. The heating equipment will be sized to heat only the infiltration air plus the building transmission losses. No heat will be provided either in the target room or in the access structure.

3. Piping. Piping will be provided in the utility housings and target room for 110 psig general-purpose compressed air and domestic water. The utility housing piping will terminate just below the floor opening in each of the manholes with valved connections for the compressed air and threaded hose connections for the domestic water. A condensate trap and air filter will be provided in the air supply line to ensure delivery of air free from any contaminants which may have been picked up in the lines. Drain lines will carry waste water from connections at each manhole to sumps located in the east-west exterior utility housing. Waste water can be monitored for possible radiation prior to disposal. The extension of these utilities beyond the 5-foot building line is described in the Target Area Site Improvements and Utilities report.

4. Other Services. Low conductivity cooling water lines will also be installed in the underfloor utility housings, target room and experimental areas outside and are described in the Target Area Site Improvements and Utilities report.

There will be no natural gas, hot water, drinking water or toilet facilities provided within the building. Toilet facilities will be provided outside of the building as described in the Target Area Site Improvements and Utilities report.

E. ELECTRICAL

1. Power. Electrical house 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 to be located on the interior south wall of the building adjoining the beam port funnel. The electrical single-line diagram, Figure 7, shows the essential features of the distribution system for End Station "B".

2. Power Distribution. Power at 480 volts, 3 phase will be provided for the 480-volt receptacles, bridge crane service, motor operated concrete door, and for service to the roof-mounted ventilation fans and the electrical heating units. Control of the fans, heating units, and the motor operated door will be provided from the control center and from outside the building. The 480-volt power will be transformed to 208Y/120 volts for service to the 120-volt receptacles and for the supplementary incandescent lighting.

3. Receptacles. A 480-volt, 3-phase, 100-ampere receptacle will be installed in some of the utility manholes in the floor, at building columns about four feet above the floor, on each side of the beam port funnel recessed into the west wall, in the target room, and in the access structure as shown in Figure 2. Two receptacles will be connected to a circuit. Two duplex 120-volt, single-phase, 20-ampere receptacles on separate circuits will also be installed at each of these locations. A demand of 200 KVA will be supplied for these receptacles. In addition, six emergency 120-volt breaker panelboards, fed from the emergency generator power supply, will be installed, one at each end of each underfloor utility housing.

Receptacle power located in the exterior underground utility housings is described and the cost is included in the Target Area Site Improvements and Utilities report.

4. Emergency Power. Two 75 KVA services at 480 volts, 3 phase, 60 cycles will be provided from the Beam Switchyard Substation emergency generator unit.
This emergency supply will provide service for certain designated panelboards for research equipment, for about 15% of general lighting, and for the exhaust fans. Semi-permanent cabling will connect selected electrical equipment to the emergency electric panels as required. The cost of this cabling is not included herein. The emergency power will be switched on automatically upon failure of the conventional power or it may be manually switched on to provide power for certain critical experiments. Approximately 60 KVA of power may thus be made available. Costs for the emergency power system beyond the 5-foot building limit are covered in the Target Area Site Improvements and Utilities report.

5. Lighting. Pressurized mercury-vapor fixtures with about 15% pressurized incandescent fixtures will provide a minimum illumination of 10 foot-candles at floor level. Incandescent fixtures will provide a minimum illumination of 50 foot-candles at the floor of the target room. Incandescent fixtures will also be provided for the access structure and the underground utility housings. Control of the building area lighting will be from the control center and from the exterior of the building adjacent to the central column, south wall. Three-way control for the target room and access structure lights will be located adjacent to the personnel door into the access structure and inside the target room. The lighting will be controlled so that approximately 85% of the lights may be shut off for warning purposes.

Six 100-watt emergency lighting fixtures will be provided. Fixtures will be vapor proof and provided with wire guards. DC power will be supplied from the 125-volt battery in the Research Area Substation. This lighting will be on the dc charging circuit and connected in parallel with the battery. Additional emergency lights will be located in the target room and the access structure.
The cost of the battery is not included in this report.

A minimum amount of exterior security lighting will be provided at door and wall locations. Mounting heights will be less than a 35-foot maximum, and lighting will be just enough to permit viewing of the entire building perimeter. 200-watt incandescent lights will be installed at a 20-foot spacing in the access structure and in the underground utility housings. This lighting will consist of porcelain socket fixtures and bare bulbs with wire guards. Fixtures at utility housing intersections, a fixture in the access structure, and a fixture in the target room will be on the emergency battery powered circuits along with the other emergency lighting.

6. **Grounding System.** The Main Equipment Ground Bus, the 3/16-inch by 14-inch copper bus in the Klystron Gallery, will be extended by SLAC to End Station "B" as described in the Target Area Site Improvements and Utilities report. This bus system will be extended into the building through the underground utility housings and is to be available at each manhole for equipment grounding. The crane- ways will be connected to this bus system. The grounding of the neutral bus of the electrical power system will be kept separate from the equipment ground system. Costs for the 3/16-inch by 14-inch bus within the building area are included in this report.

7. **Magnet Power.** Additional power will be provided in the underground utility housings for magnets. This power is described in the Target Area Site Improvements and Utilities report and is not included in house power.

8. **Load Requirements.** Building load requirements, including the target room and access structure, are as follows:
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<th>NORMAL</th>
<th>CONNECTED</th>
<th>MAXIMUM DEMAND</th>
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<tr>
<td>120-volt receptacles</td>
<td>43 KVA</td>
<td>13 KVA</td>
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<tr>
<td>480-volt receptacles</td>
<td>720 KVA</td>
<td>187 KVA</td>
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<tr>
<td>General lighting</td>
<td>15 KVA</td>
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<td>Security lighting</td>
<td>2 KVA</td>
<td>2 KVA</td>
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<tr>
<td>Ventilation fans</td>
<td>27 KVA</td>
<td>3 KVA</td>
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<tr>
<td>Cranes - End Station &quot;B&quot;</td>
<td>60 KVA</td>
<td>45 KVA</td>
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<tr>
<td>- Target Room</td>
<td>10 KVA</td>
<td>10 KVA</td>
</tr>
<tr>
<td>Door motor</td>
<td>15 KVA</td>
<td>15 KVA</td>
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<tr>
<td>Heaters</td>
<td>212 KVA</td>
<td>212 KVA</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,104 KVA</strong></td>
<td><strong>502 KVA</strong></td>
</tr>
</tbody>
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| EMERGENCY                      |           |                |
| 120-volt panelboards           | 30 KVA    | 15 KVA         |
| Emergency lighting             | 3 KVA     | 3 KVA          |
| Ventilation fans               | 27 KVA    | 27 KVA         |
| **TOTAL**                      | **60 KVA** | **45 KVA**     |

| EMERGENCY LIGHTING FROM SUBSTATION BATTERY |       |       |
| General lighting                | 0.6 KVA | 0.6 KVA |
| Housing intersections           | 0.25 KVA| 0.25 KVA|
| Access structure and target room| 0.2 KVA | 0.2 KVA |
| **TOTAL**                       | 1.05 KVA| 1.05 KVA |

F. HYDROGEN DETECTION SYSTEM

1. Detectors. Individual sensing heads with positive sample flow type detectors, close-coupled to individual analyzers, will be installed just below the
root and adjacent to the exhaust hole for each of the roof-mounted fans.

2. **Pump and Flow Meters.** A panel containing a common pump and individual flow meters that adjust the flow of air through each detector will be installed at floor level.

3. **Alarm System.** An alarm system will be provided to denote when hydrogen has been detected. The system will be a dual-alarm type and will be calibrated to sound for both 20% and 25% of the lower explosive limit for hydrogen.

4. **Power Interlocks.** Power for the crane, heating, general lighting and other hazardous circuitry will be interlocked with the hydrogen detection system so as to be disconnected when 25% of the lower explosive limit for hydrogen has been reached.

   Exhaust fans and 4-foot by 8-foot man doors in the shielding will also be interlocked with the detection system. Upon reaching the 25% level noted above, all fans will be actuated and the doors opened.

   Emergency lighting and exhaust fans will remain operative at all times.

G. **FIRE ALARM SYSTEM AND RADIATION SAFETY**

The project fire alarm system will be extended into the building and the access structure. Auxiliary boxes and alarm horns will be provided. The master fire alarm box will be provided at an exterior location. A fire detection system, utilizing rate-of-temperature-rise and fixed-temperature detectors, will be installed in the target room and underground utility housings.

Fire extinguishers will be provided by SLAC. Water protection devices will not be used in the building.

Personnel access will be controlled at all entrances by means of door interlocks and radiation monitoring devices which will be installed by SLAC.
H. **COMMUNICATIONS**

Conduit only is included for telephone and intercom systems. Cable and communication equipment criteria and cost are not included in this report.

I. **CRANES**

A cab-operated electric overhead crane with 50-ton bridge capacity will span the width of the building. Mounted on the bridge will be two trolleys, each with a 25-ton main hoist. One trolley will be equipped with a high speed 5-ton auxiliary hoist. The minimum clear hook height above the floor of End Station "B" will be 35 feet.

A crane access cat-walk, running the full length of the building will be provided along the south wall. An access ladder to the cat-walk will be located on the column at the center of the south wall. A ladder from the cat-walk will provide access to the top of the beam port shielding. An additional ladder will be located at the northwest corner of the building for auxiliary access to the top of the beam port shielding.

The crane rails will be installed as a part of the building contract package. Several small cable sleeves will be provided through the concrete corbel which supports the south rail in the area directly above the electric control center.

A pendant-operated electric underslung crane with a 15-ton capacity will span the target room. This crane will handle the target, equipment and portable shielding within the target room, at the beam port and at the access structure entrance. Inserts will be installed in the ceiling of the target room to accommodate future installation of craneways for extension of the Beam Switchyard crane.

The cranes for this building will be furnished and installed under a separate contract.
Rails will be installed in the floor of the target room access structure for the target handling rail car which will be furnished by SLAC.
III. OUTLINE SPECIFICATIONS

The physical features of this facility are described in Section II, Basis for Design. The following Outline Specifications describe the material to be used and the quality of construction.

A. GENERAL


2. Construction. Type I

3. Number of Stories. One

4. Location on Property. Separated on three sides.

5. Area Limitations.
   b. Atomic Energy Commission Criteria. Floor area (11,250 square feet) is less than the maximum allowable unsprinklered area of 15,000 square feet.

   a. Roof 30 psf
   b. Floor 5,600 psf from 10-foot thick parallel walls of portable shielding spaced 15 feet apart; the 15 feet of space between walls will have concentrated loads of 20 tons.
   c. Utility Housing Manhole Covers 5,600 psf for solid covers
B. CIVIL

1. Earthwork.
   a. Compaction. The compaction will be measured according to ASTM Method D-1557 (formerly the modified AASHO Method) and the requirements will be as follows:
      (1) Backfill around foundations and underground utility housings - 95%.
      (2) Shielding around and over adjacent Beam Switchyard Structure - 95%.
      (3) Compacted, graded rock over target room - 95%.
      (4) Compacted, graded rock core in beam port shielding structure - 95%.
      (5) Shielding fill around and over target room access structure - 90%.
      (6) A pervious drainage blanket will be placed adjacent to retaining walls.

2. Erosion Control.
   a. General. All exposed slopes will be prepared for planting by covering with 6 inches of topsoil impregnated with straw mulch.
   b. Materials. Topsoil will be fertile and friable and obtained from stockpiles from previous contracts. Straw material for mulching will be rice, wheat, oats or barley as approved by the Manager. Seed for erosion control will be Birdsfoot Trefoil, Narrowleaf Trefoil - Latus Tenius, germination 90% - purity 98% or better.
   c. Construction Method. The completed slopes will be scarified and topsoil will be spread to a depth of 6 inches over the area. The straw will be spread over the topsoil at a rate of not less than four tons per acre. The area will then be rolled with a roller equipped with straight studs followed by seeding.
3. **Subdrain System.**
   a. **General.** Ground water will be intercepted by a subdrainage system consisting of drainage fill and drain tile which drains westward from the target room along the Beam Switchyard structure.
   b. **Materials.** Drainage filter will be pervious material such as crushed stone or gravel. Drain tile will be perforated asbestos-cement pipe.
   c. **Construction Method.** Pipe will have firm bedding in the drain fill and will be laid true to line and grade.

C. **STRUCTURAL**

1. **Concrete.**
   a. Concrete will conform to the requirements of the Uniform Building Code and the ACI Building Code for concrete.
   b. Cement will be an approved brand of Portland cement conforming to ASTM Designation C-150, Type II, as modified for the Accelerator Housing Contract.
   c. Minimum allowable ultimate compressive strength of 4,000 psi at 28 days will be used.
   d. Reinforcement bars will be deformed, new billet steel conforming to ASTM Designations A-305 and either A-15 (intermediate grade) or A-432 (high strength).
   e. Aggregates will be from sources which will produce concrete with minimum shrinkage.
   f. Hardener and sealer will be applied to the floors.
   g. The exterior of inset concrete wall panels will have an integral color. No concrete surfaces, either interior or exterior, will be painted.
2. **Steel.**
   a. Steel for roof beams will conform to ASTM Designation A-36.
   b. Crane rails will conform to AREA Specifications.
   c. Gratings will be galvanized steel subway type.
   d. Gates will be galvanized woven wire type.
   e. Weatherproof siding will be unitized, modular, galvanized steel panels.
   f. Structural steel will be given a prime coat and finish coat of paint. 
      Miscellaneous metal will be galvanized with no finish coat of paint.

3. **Roof.** Roof will be a 4-ply built-up type over an uninsulated concrete 
   deck and will be covered with colored granular gravel.

4. **Doors.**
   a. Man doors will be hollow metal type with automatic opening devices, 
      panic hardware and provision for interlocks which will be installed 
      by SLAC.
   b. Roll-up door will be made of interlocking steel slats and will be motor 
      operated from both faces with emergency hand chain operation on the 
      inside face.
   c. Concrete shield door will be mechanically operated with separate means 
      of emergency opening.

5. **Waterproofing.** Polyvinyl chloride membrane will be applied to all exterior 
   surfaces of the target room and the underground utility housings and to 
   the top and sides of the target room access structure.

D. **MECHANICAL**

1. **Exhaust Fans.** Fans will be 12,000 CFM, 3/8" SP, 3 HP, low silhouette dome 
   type centrifugal exhausters with aluminum wheels, static proof belt drive,
and 440-volt, 3-phase, explosion-proof motors. Discharge will be through gravity dampers.

2. **Heating Units.** Units will be 50 kw, 4,000 CPM cabinet-centrifugal type, wall mounted, belt driven from 440-volt, 3-phase, explosion-proof motors, spark-proof belts, aluminum wheels, replaceable-media filters, acoustical discharge plenum with adjustable grilles. Electrical heating elements will be 440 volt, 3 phase, finned sheath type with surface temperature below 500°F, manual control.

3. **Compressed Air Piping.** Threaded galvanized iron pipe and fittings, bronze valves.

4. **Domestic Water Piping.** Threaded galvanized iron pipe and fittings, bronze valves.

5. **Drain Lines.** Threaded galvanized iron pipe and fittings.

E. **ELECTRICAL**

1. **Lighting.**
   a. Fixtures in End Station "B" will be pendant mounted, pressurized mercury-vapor type. 15% pressurized incandescent type fixtures will be included.
   b. Fixtures in the access structure and underground utility housings will be porcelain sockets with bare 200-watt incandescent lamps and wire guards, installed at a 20-foot spacing.
   c. Fixtures in the target room will be porcelain sockets with bare incandescent lamps and wire guards.
   d. Emergency battery-powered lights will be 100-watt vapor proof fixtures with wire guards.
2. **Wiring.** Wiring will be polyethylene insulated conductors in rigid conduit with cast conduit fittings. All conduit will be exposed, surface mounted.

**F. HYDROGEN DETECTION**

Detectors will be positive sample flow type with individual sensing heads, close-coupled to individual analyzers. Response time will be one second or less, Model SM (modified) as manufactured by Johnson-Williams Company, or approved equal.

**G. FIRE ALARM SYSTEM AND RADIATION SAFETY**

1. Alarm boxes will be manual pull lever type.
2. Spot detectors will be of the combined rate-of-rise and fixed-temperature type.
3. Fire extinguishers will be installed by SLAC.
4. Door interlocks and radiation monitoring devices will be installed by SLAC.

**H. UTILITIES**

All utilities to the end station will be underground or in underground utility housings.

1. Electricity, normal
   
   480-volt distribution from Research Area Substation north of End Station "B".

2. Electricity, emergency, ac
   
   480-volt distribution from emergency generator in Beam Switchyard Substation.

3. Electricity, emergency, dc
   
   125-volt distribution from battery in Research Area Substation north of End Station "B".

5. Fire Alarm Distribution through underground utility housings from project fire alarm system.

6. Domestic Water Distribution through underground utility housings from supply line south of End Station "B".

7. Compressed Air Distribution through underground utility housings from supply line south of End Station "B".


I. CRANES

1. End Station "B". The crane will be a cab-operated electric overhead crane consisting of a 50-ton capacity bridge carrying two trolleys, each with a 25-ton main hoist. One trolley will be equipped with a high speed 5-ton auxiliary hoist. Sparking devices such as electrical control cabinets will be kept as low as possible on the crane in order to improve hydrogen safety. The crane will have a minimum clearance under the bridge or a hook height of 35 feet above the floor, whichever is lower.

2. Target Room. The crane will be a pendant-operated electric underslung crane with a 15-ton capacity.
IV. DESIGN AND CONSTRUCTION SCHEDULE

The following schedule for design and construction of End Station "B" is based on the Target Area, Time Grid" dated March 19, 1964.

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<th>Criteria</th>
<th>Draft to SLAC</th>
<th>December 6, 1963*</th>
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<td>December 17, 1963*</td>
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<td>December 20, 1963*</td>
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<td>January 14, 1964*</td>
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<td>March 20, 1964*</td>
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* Actual date
### V. TITLE I COST ESTIMATE

#### END STATION "B"

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<th>ACCOUNT NUMBER</th>
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<td><strong>Miscellaneous Metal (including crane rails, doors, cat-walk, ladders, shield block connections, shafts, roof baffle supports, stainless steel sump)</strong></td>
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VI. DRAWINGS

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