LEGEND

1. KLYSTRON D.C. SUPPLY STATION
2. COOLING TOWER NO. 1
3. KLYSTRON HOUSING
4. SUBSTATION 'A' AND 'B'

-PIPING LEGEND-

- - - DOMESTIC COLD WATER
- - - SANITARY SEWER
- - - COOLING TOWER WATER SUPPLY AND RETURN
- - - FIRE WATER SYSTEM
- - - ELECTRICAL DUCTS

LEGEND

338,000 N
337,000 N
355,000 N
356,000 N
300,000 E
300,000 W
300,000 S
300,000 N

RESERVED FOR FUTURE EXPANSION
SOFTWATER
RISE UP TO CIWNER MAINS AT CEILING

SITE       EAST SAND HILL
JOHN A. BLUME AND ASSOCIATES, ENGINEERS
612 HOWARD STREET, SAN FRANCISCO
FEASIBILITY STUDY FOR THE
U.S. ATOMIC ENERGY COMMISSION
STANFORD TWO-MILE LINEAR
ELECTRON ACCELERATOR

DUDLEY DEANE AND ASSOCIATES
CONSULTING ENGINEERS
SAN FRANCISCO
Project Implementation

General project requirements are set forth in Section XXI. Both the East and West Sand Hill sites utilize the same 10,000-foot beam path, with the end station at the east end in one arrangement and at the west end in the other. This section concerns the West Sand Hill Site.

The accelerator and klystron housing are constructed along the proposed alignment, on a foundation prepared by cut and fill methods. Earth shielding is backfilled over the completed structure. Beam switchyard housings are constructed in the same manner as the accelerator housing, and terminate at the target buildings. Beam housings for proposed future extensions of the beam switchyard are constructed to points from which subsequent construction can be initiated without interfering with existing accelerator operations.

Auxiliary and support buildings are situated in the end station area, except for a small utility building group located at a center station. Drawings WSH-1 through WSH-5 show site plans and end station and center station layouts.

Site characteristics of the Sand Hill cut and cover alignments are described in Section XXII.
Site Adaptation

The proposed beam elevation for the West Sand Hill Site is selected to obtain the maximum practical length of rock foundation for the accelerator. Cut heights of as much as 100 feet are required. Fill under the accelerator housing is restricted to a maximum of 25 feet above the existing ground elevation. Total fill heights reach a maximum of about 75 feet.

Slopes used are those recommended as maximum stable slopes for the various materials encountered. Additional space is kept available at the tops of cut slopes in the event occasional slope flattening in weak zones is found to be necessary during construction.

A minor amount of ground water seepage is anticipated at the east end. Adequate capacity for those small flows is provided by the drainage measures described in Section XXI. In the western portion of the area a significant amount of ground water seepage is expected and a cost estimate allowance is made for supplementary drainage measures, such as horizontal bored-in drains.

The End Station target buildings are located in cut areas and are consequently founded on rock. At the west end the rock is composed of steeply-inclined, alternating layers of sandstone and soft shale. Horizontal foundation cuts will expose the edges of these alternating layers. Equivalent loads will cause greater settlement in the shale than in the sandstone and differential settlement will result. Rebound in the shale is also probable and a program of observation of shale behavior during excavation should be carried out.
Water is brought to the site from an existing valve in the San Francisco Water Department's Aqueduct No. 3 which crosses the northeast corner of the Sand Hills area. The main from the aqueduct will be brought to the accelerator embankment and then routed along the length of the embankment to the west end station, with secondary distribution inside the end station area.

Sanitary sewage collection lines are provided for the end station area. Another collection line with lift stations runs the length of the Klystron Housing. The end station collection line is led into the Klystron Housing line and the combined sewage flows are routed along the Klystron Housing and down to the Alpine Road main at the same connection point as for the east end.

A natural gas regulator station is available at Sand Hill Road near the east end station location. The gas line is routed along Sand Hill Road to the west end station, with secondary distribution inside the west end station area.

With the End Station at the west end, the only permissible location for an access road intersection with Sand Hill Road is at the intersection of Sand Hill Road and Whiskey Hill Road, at the extreme western end of the site.

**Project Cost Estimate**

Cost estimates are based on construction for Stage I operation, with sufficient additional space and capacity provided to facilitate future transition to Stage II operation. Operation at the Stage II level is outlined in the table of machine parameters contained in Section XXI. Costs are based on the prevailing wage rates and unit prices
in the Palo Alto area, projected to July 1961 by adding an assumed escalation factor of 2-1/2 percent.

The Project Cost Estimate, Table XXIII-1, is abbreviated, as many of the items are identical with corresponding items in the East Sand Hill Site Project Cost Estimate, Table XXII-1. The following discussion is concerned with differences between the West Sand Hill Site costs and those for the East Sand Hill Site. Further differences between this cost estimate and that for the Sand Hill Site in the January, 1960, Volume III of the Blume Report are explained in the Project Cost Estimate discussion in Section XXII, East Sand Hill Site.

Increases in Item A, Engineering, reflect the higher construction cost for the West Sand Hill alignment. Item B, Land and Land Rights, shows no cost for either alignment because the land required will be made available by Stanford University at no cost to the project.

Improvement to Land costs, Item C1, are higher at the West Sand Hill Site because of more rugged topography, more difficult excavation, and more expensive site drainage because of the adjacent flood control reservoir. Slope protection measures for the reservoir are provided at an estimated cost of $228,000.

Item C2, Buildings, is unaffected by the choice of end station location. There are minor, offsetting differences in sub-items but the total estimated cost is unchanged.

Item C3, Utilities, shows an increase because of the longer utility runs to main service lines, which are all located near the east end of the Sand Hills area as shown on Drawing WSH-2.
An increase in Item C4, Accelerator and Klystron Housing, is due to increases in accelerator earthwork and beam switchyard costs, caused by more difficult excavation and more critical slope stability requirements at the west end of the Sand Hill area.

Items C5, Accelerator, and C6, Equipment are unaffected by the choice of end station location.

Items D, Escalation; and E, Contingency; show slight increases, reflecting the higher construction costs at the West Sand Hill Site.
### TABLE XXIII-1
WEST SAND HILL SITE - STAGE I CONSTRUCTION
PROJECT COST ESTIMATE

**A. Engineering, Design, and Inspection**

1. Site, buildings, utilities, accelerator and klystron housing, and equipment.* $ 4,550,000

   2. Accelerator  
   
   Total Engineering, Design, and Inspection Cost $ 10,590,000

**B. Land and Land Rights**  
$ 0

**C. Construction Cost**

1. Improvement to Land

   (a) Site preparation:  
   
   Clearing, grading and slope protection for end station and center station areas, excluding beam switchyard. $ 464,000

   (b) Roads and parking:  
   
   Klystron service road, end station and center station roads and walks, and parking areas. 610,000

   (c) Storm drainage:  
   
   Drainage culverts under accelerator; catch basins, pipe, and perimeter ditches for end station and center station area drainage; and storm sewer system along klystron service road. 606,000

   (d) Fencing:  
   
   Perimeter fencing for end and center station areas, and for a 1000-foot wide strip centered on the accelerator. 200,000

* Includes surveys, design, supervision, control stake out, inspection, borings, and testing of soils and materials.
(e) Landscaping:

Sprinkler system and all planting except slope stabilization. $130,000

(f) Outdoor utility areas:

Fenced and paved storage areas, transformer pads, meter enclosures, and tank bases (132,800 sq. ft.). 230,000

Total Improvement to Land Cost $2,240,000

2. Buildings (Refer to Table XXII-1)

(a) Building spaces for target measurements, laboratories, offices, shops, inside storage, and utilities. $7,053,000

(b) Shielding: 2,877,000

Total Building Cost $9,930,000

3. Utilities (Refer to Table XXII-1)

(a) Pacific Gas and Electric Company power line: single circuit 110 KV line, 110 KV circuit breaker, and metering installation. $1,040,000

(b) Substations and AC feeders: 4,820,000

(c) Power to klystrons: 2,440,000

(d) Water supply and storage:

Domestic water distribution to all buildings, fire distribution to all buildings, storage tank, fire protection main in klystron housing, fog spray system for 240 klystron cubicles. 730,000

(e) Cooling water: 5,600,000

(f) Sewers and drains:

Sanitary ejectors and toilet facilities in klystron housing alcoves, drainage ejectors in accelerator tunnel, sanitary sewers and manholes outside klystron housing and in end station area. Building drainage systems closer than 5-feet to the buildings, and site storm drainage not included. 500,000

XXIII-7
(g) Heating and ventilating: $ 297,000

(h) Natural gas system: 23,000

Total Utilities Cost $ 15,450,000

4. Accelerator and Klystron Housing

(a) Accelerator earthwork:

Preparation of accelerator and klystron housing foundations; including grading, dewatering, placing and compacting fill, trenching for accelerator; backfilling and compacting shielding earth fill over completed accelerator housing; and slope stabilization including drains, planting and sprinkler system for the 10,000-foot length of the accelerator. $ 3,750,000

(b) Klystron housing: 3,900,000

(c) Accelerator housing: 1,560,000

(d) Cross passageways and tubes: 590,000

(e) Beam switchyard:

Beam housing from 10,000-foot point to target areas and buildings; and earthwork, including initial site preparation, backfilling shielding fill over completed beam housing, and slope stabilization measures. 2,040,000

Total Accelerator and Klystron Housing Cost $ 11,840,000

5. Accelerator (refer to Table XXII-1 for cost breakdown).

Total Accelerator Cost $ 30,700,000

6. Equipment (Refer to Table XXII-1 for cost breakdown)

Total Equipment Cost $ 9,960,000

Total Construction Costs $ 80,120,000

XXIII-8
D. Escalation (5 percent per year, beginning with the second year). $ 9,990,000

E. Contingency (15 percent of all other costs). $ 15,100,000

Total Project Cost $115,800,000

(These estimates represent present planning for this machine and associated support facilities. Definitive design and technological developments may necessitate changes at a later date.)
VOLUME IV

SECTION XXIII

WEST SAND HILL SITE

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