STUDY ON WATER SUPPLY ALTERNATES
FOR THE
STANFORD LINEAR ACCELERATOR CENTER (SLAC)

REPORT TO
STANFORD LINEAR ACCELERATOR CENTER - NO. ABA-39
STANFORD UNIVERSITY SUBCONTRACT S-128
UNDER AEC CONTRACT AT(04-3)-363

Submitted by \[Signature\]  Approved by \[Signature\]

AETRON-BLUME-ATKINSON
A Joint Venture
ARCHITECT-ENGINEER-MANAGER
1455 California Avenue
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8 March 1962
Revised May 18, 1962
GENERAL

At the outset of the design for the SLAC project (in the spring of 1961) it was decided that a complete review of water supply possibilities should be made. Within a radius of about five miles from SLAC there are about a dozen purveyors of water. Some of these obtain the water from wells exclusively, some from the Hetch-Hetchy System (San Francisco Water Department) exclusively, and some from local runoff and a combination of sources. The avenues of water supply available to SLAC were:

1. Palo Alto System
2. California Water Service Company
3. Stanford System
4. San Francisco Water Department (SFWD)
5. Menlo Park System

DISCUSSION

PALO ALTO SYSTEM:

After discussion with the Palo Alto City Manager it was evident that this possibility should be dropped. Salient points in connection with Palo Alto's position were:

1. Palo Alto was interested in providing service only as a profit generating venture.
2. Palo Alto would not be interested in providing sewer service unless Palo Alto would also provide water service.
3. SLAC is in San Mateo County, whereas the existing operating portion of the Stanford campus is in Santa Clara County. This latter portion now delivers its sewage to Palo Alto. For Palo Alto to cross the County line for additional water or sewer service would cause political
complications with Menlo Park and a definite change in policy by the City of Palo Alto.

4. Palo Alto would require SLAC to engineer and build the systems and then turn them over to the City.

5. If Palo Alto were to serve SLAC, it would be through a completely separate system supplied from SFWD's aqueduct.

CALIFORNIA WATER SERVICE COMPANY

Discussion with a representative of the California Water Service Company also eliminated this purveyor from consideration. Salient points were:

1. California Water Service Company may not take on new contracts without the approval of the San Francisco Water Department and the State Public Utilities Commission. Approval by them would be unlikely as the SLAC area is now allotted by SFWD to Menlo Park.

2. A service agreement could be made with Stanford whereby Stanford would buy the water from SFWD and California Water Service Company would maintain and operate the SLAC system for a negotiated fee.

3. California Water Service Company's rates were higher than any other purveyor's who might serve SLAC.

STANFORD SYSTEM

Stanford University has a water system which now serves only the academic uses of Stanford land in Santa Clara County. Present Stanford industrial park users are all in Santa Clara County and are served by the City of Palo Alto. The University system is supplied by wells, except that at times when the wells provide inadequate flow, water from the San Francisco Water Department Hetch-Hetchy Aqueduct is admitted to bolster the supply.
Expansion of Stanford's system to serve SLAC would also be a separate system supplied from SFWD's aqueduct, and would require revision of Stanford's present contract with SFWD.

Such a revised University agreement to include SLAC service would not affect SFWD's allocation of the adjacent areas since the Stanford University system is restricted to academic uses.

SAN FRANCISCO WATER DEPARTMENT

Another possibility would be a direct contract between the Federal Government and SFWD for SLAC service direct from the Hetch-Hetchy aqueduct. This arrangement would require reallocation of the SLAC site by SFWD. The remainder of the area adjacent to SLAC would still be allocated to Menlo Park since SFWD, outside of San Francisco operates primarily in the wholesale water business and normally does not serve individual users other than the Federal Government if local purveyors are in a position to provide the service.

MENLO PARK SYSTEM

Discussion with the City of Menlo Park Water Department revealed the following:

1. Stanford lands in San Mateo County and the lands of the Sharon Estate are currently allotted to the City of Menlo Park on the SFWD maps.

2. Menlo Park and adjacent areas are served by several water systems.
(See Figure 1.)

3. The California Water Service Company is the largest supplier and serves the major portion of Menlo Park, roughly the area between Alameda de las Pulgas and Middlefield Road.

4. The city-owned Menlo Park Water Department has two separate systems
with no connection between them (they are served by different San Francisco Water Department aqueducts). The older (Eastern) system serves roughly the area between Middlefield Road and San Francisco Bay. Previously it was known as the Willow Road County Water District. In 1953 the City took this system over from the County.

5. The newer (Western) City-owned system serves the developed portions of the Sharon Estate and the Stanford Hills residential area which is roughly the area of the City west of Alameda de las Pulgas. This system has 500,000 gallons existing storage capacity. The Sharon Estate is developing fast with apartments, a golf course, club house, an Allstate Insurance building and a new P. T. & T. exchange as immediate problems. Menlo Park is expanding its water system to meet these Sharon requirements. The current Sharon needs are for 1-million gallons for Sharon alone.

Stanford University, in considering the possibility of development of Stanford lands adjoining SLAC has requested Menlo Park to reserve main line capacity for its future purposes. Thus, the main from the existing pumping plant to the reservoir site will be oversized by the City for ultimate purposes.

6. Menlo Park would be willing to deliver water to Stanford for any academic use (including SLAC) at its cost from SFWD plus an agreed amount to cover pumping and other operating costs.

7. The schedule of expansion of Menlo Park's water system is almost coincident with SLAC's water requirement schedule.

8. The City would be willing to provide line and storage capacity for SLAC needs on the basis of a charge payable at the time of connection.
9. Menlo Park's existing system is the only one immediately available for use to supply water for temporary construction and fire protection needs for the period of six to nine months after the start of construction.

COST STUDIES

Consideration of the above factors eliminated further consideration of supply from the Palo Alto System, California Water Service Company, and the Stanford System, and it was decided to perform economic analyses of the remaining logical alternatives:

<table>
<thead>
<tr>
<th>DESCRIPTION ALTERNATE</th>
<th>ALTERNATE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct Connection of SLAC to Hetch-Hetchy Aqueduct</strong></td>
<td></td>
</tr>
<tr>
<td>A. With storage at elevation 400' on a hill just south of the Freeway (not in the SLAC leased area)</td>
<td>I</td>
</tr>
<tr>
<td>B. With storage in an open reservoir in the center of the Laboratory Area at elevation 300'</td>
<td>II</td>
</tr>
<tr>
<td>C. With storage on Jasper Ridge at elevation 600' *</td>
<td>III</td>
</tr>
<tr>
<td>D. With storage on Sand Hill at elevation 485' *</td>
<td>V</td>
</tr>
<tr>
<td><strong>By Connection to Menlo Park's Expanded System</strong></td>
<td></td>
</tr>
<tr>
<td>With joint storage at elevation 485' on Sand Hill*</td>
<td>IV</td>
</tr>
<tr>
<td>*Note: These provide gravity fire flow. All others require emergency fire flow pumps.</td>
<td></td>
</tr>
</tbody>
</table>

COST COMPARISONS (See Appendix A)

Capital and connection costs for each system are summarized below. To provide comparable costs, the cost of each alternate includes the estimated construction cost plus E. D. & I. costs but no contingencies.
### Alternate I
- **Est. constr. cost**: $432,600
- **E.D.&I.**: $43,000
- **Total**: $475,600

### Alternate II
- **Est. constr. cost**: $434,000
- **E.D.&I.**: $43,000
- **Total**: $477,000

### Alternate III
- **Est. constr. cost**: $436,500
- **E.D.&I.**: $44,000
- **Total**: $480,500

### Alternate IV
- **Est. SLAC Constr. cost**: $214,500
- **Est. SLAC E.D.&I.**: $21,000
- **Est. connection charge (incl. E.D.&I. but less contingencies)**: $176,000
- **Total**: $411,500

### Alternate V
- **Est. constr. cost**: $481,500
- **E.D.&I.**: $48,000
- **Total**: $529,500

**DISCUSSION**

The above alternates fall into two groups for evaluation purposes:

**Group (1)**
- Alternates III, IV, and V which provide gravity fire flow for the fire protection reserve.

**Group (2)**
- Alternates I & II which require emergency pumps for fire flow.

The Group (1) alternates are superior because of their greater reliability for fire protection.
In Group (1), Alternate III was eliminated because Jasper Ridge is a biological preserve used by the University for academic purposes and it cannot be duplicated. The continuity of the biological preserve is also a large factor in the University's objection to the proposed Ladera Dam project. Any disturbance of this long established preserve to serve as a water-tank site could be justified only if no other alternatives existed. There was also a complication wherein the water line serving the reservoir on Jasper Ridge would be under the lake behind Ladera Dam if the Dam became a reality.

Alternate V, Group (1), provides SLAC a system directly equivalent to Alternate IV. It offers SLAC the advantage of direct ownership but costs $118,000 more, hence it was eliminated.

In Group (2), although the comparative costs of Alternates I and II are about the same, it is considered that Alternate I, offering the most conventional construction and the higher storage elevation of the two (approximately 100 feet higher), is the one that should be given a more detailed analysis to compare it with Alternate IV, the best of Group (1).

Thus further detailed analysis was narrowed to these two possibilities:

**Alternate I** - A private water system connected directly to San Francisco Water Department's Hetch-Hetchy aqueduct under a contract with Stanford or the Federal Government, with 1 million gallons of storage in a buried reservoir at elevation 400' on a hill just south of the future Freeway (approximately 1000 feet south of the SLAC leased area boundary).

**Alternate IV** - Connection to the expanded City of Menlo Park System (Western), with common storage (1 million gallons reserved for SLAC) at elevation 485' located on the top of Sand Hill, the highest piece of
ground in the area (other than Jasper Ridge.) This is located just north of Sand Hill Road, approximately 1800 feet north of the SLAC boundary.

Essentially, Alternate IV provides a premium system giving gravity flow for fire protection at a slight saving in long term costs when compared to the lowest cost alternate. (Appendix F, Sheet 5)

Alternate IV in comparison with Alternate I would offer SLAC additional long term savings except for two reasons:

1. As shown in Appendix E, the present SFWD rate structure is such that SLAC would pay SFWD 0.5 cents per 100 cu. ft. less for water than the City of Menlo Park would pay. The differential applies to purveyors who have long term contracts with San Francisco Water Department for purchase of water for resale use. Recently this differential was reduced from 1.0 cent per 100 cu. ft. and there is discussion of eliminating it completely.

2. The Group I alternates (including Alternate IV) require pumping against a higher head than the Group 2 alternates (including Alternate I.) In addition SLAC has a lower power rate than the City of Menlo Park.

Appendix A to this report contains construction cost estimates and site plans of all 5 alternates.

Appendix B contains SLAC water supply capacity requirements.

Appendix C contains calculations showing the development of connection charges for the users of the expanded Menlo Park water system (Alternate IV).

Appendix D contains the basis for the fire flow estimates used in all alternates.

Appendix E contains comparative water purchasing rates as they apply to this study.

Appendix F contains a comparison of direct billings from Menlo Park (Alternate IV), as against estimated total costs on a private system (Alternate I), including costs of water, pumping, maintenance and amortization.
The costs of water treatment were not considered in this study since all of the alternatives involve obtaining SFWD water from the same aqueduct. Fortunately, SFWD water is, relatively speaking, soft so that no treatment is necessary for domestic purposes, and only pH control treatment is needed for cooling tower water use.

RECOMMENDATION

The selection of Alternate IV (connection to the Menlo Park city water system) is in the best interests of the SLAC project, the Federal Government, Stanford University, and all others concerned.

This selection is based upon a review of the following advantages and disadvantages of both Alternates I and IV:

Alternate I - (Private System)

It would be a private system wherein SLAC would have full control of pumping storage, maintenance scheduling, etc., and it would also have full title to the whole system.

The disadvantages are:

1. Approximately $65,000 higher initial cost.
2. Higher total cost over a 10-year period.
3. Does not provide gravity fire flow and requires emergency fire pumps.
4. Requires operation and maintenance of pumping plants and storage basin.
5. Requires leasing of land for SLAC beyond SLAC's present boundary.
6. Requires additional capital expenditure prior to Stage II of approximately $18,000.
7. Forces adjacent areas to be served by an independent parallel system which
denies benefits of an integrated system to all parties.

Alternate IV - (Joining Menlo Park)

Advantages:
1. Initial savings of approximately $65,000.
2. Lower water costs than any other alternate on a 10 year write-off.
3. Gravity fire flow provided.
4. Requires no additional capital expenditure for Stage II.
5. Provides a looped system for about 3/4 of the length of the accelerator
   by reason of the fact that the new Menlo Park main parallels the
   Accelerator along Sand Hill Road.
6. Menlo Park can make its system immediately available for construction
   water requirements (backed up by 500,000 gallons of storage) by means
   of a 4-inch connection in the Stanford Hills residential area.
7. 24-hour monitoring of storage tank level as alarm system tied into
   Menlo Park Police Station.
8. Creates good-will by joining in the development of a water system to
   serve SLAC's neighbors, Stanford University and the Sharon development.

Disadvantages

Not a private system in that Menlo Park will have title to, and operate
and maintain the pumping plant, main line, and storage basin. This can be
offset by safeguards built into the contract between SLAC and Menlo Park.
The safeguards would include guarantee of reservation of 1-million gallons
storage for SLAC, notice of scheduled maintenance, refunds when future
political entities connect to system (example - new High School), and
guarantee to provide service to SLAC for 20 years with option to extend
paralleling Menlo Parks' contract with SFWD.
APPENDIX D

BASIS FOR FIRE FLOW ESTIMATE (ALL ALTERNATES)

Reference: NBFU Bulletin No. 266, "Water Works Requirements For Fire Protection."

The basis for estimating fire flow requirements is outlined in NBFU Bulletin No. 266 (Ref.). This covers both industrial and residential requirements.

I. SLAC

It is assumed that only one fire will occur at one time. The formula in Bulletin No. 266 for industrial buildings is:

$$1. \text{Ground Area of Building (A)} = \frac{1000 + \frac{A}{10}}{5000 \text{ GPM}}$$

$$2. \text{Height in Stories (Add)} = 500 \times (H-1) = 3000 \text{ GPM}$$

$$3. \text{Exposure to and from Bldg. (Add)} = \text{Judgment} = 2000 \text{ GPM}$$

$$4. \text{Credit for fireproof or semi-fireproof construction (Deduct)} = \text{Judgment} = \frac{1}{3}(1+2+3)$$

$$5. \text{Credit for non-hazardous contents (Deduct)} = \text{Judgment} = \frac{1}{4}(1+2+3)$$

$$6. \text{Credit for automatic sprinklers and other protective equipment} = \text{Judgment} = 3000 \text{ GPM}$$

Various buildings on the project would require different flows, for example:

A. Klystron Gallery

1. Max. for area (300,000 sq. ft.) = 5,000 GPM

2. Only one story (no additive) = 0

3. Exposure to and from building (add only 25% of max.) = \[\text{Total} = \frac{500}{5,500 \text{ GPM}}\]

4. Credit for semi-fire proof construction = - \[\frac{1,000}{4,500 \text{ GPM}}\]

5. Credit for non-hazardous contents = - \[\frac{1,000}{3,500 \text{ GPM}}\]
6. Credit for automatic sprinklers and other protective equipment (no sprinklers; detection system only) = \[ \frac{500}{10} \]  
Total 3,000 GPM

B. Central Lab

1. Area = 47,000 sq. ft. 
\[ 1000 + \frac{A}{10} = 1000 + \frac{47,000}{10} = 5700 \]  
Therefore, use maximum = 5,000 GPM

2. Height = 3 floors = \[ 500 \times (3-1) = 500 \times 2 = + 1,000 \]  

3. Exposure = \[ + \frac{500}{10} \]  
Total 6,500 GPM

4. Semi-fireproof construction = \[ - \frac{1,500}{5,000} \]  
5. Credit for non-hazardous = \[ - \frac{1,000}{4,000} \]  
6. Credit for automatic sprinklers = \[ - \frac{1,500}{2,500} \]  
Total \[ \frac{2,500}{GPM} \]  

* In the case of a sprinklered building, the minimum fire flow must equal that of the automatic sprinkler system plus two 750 GPM pumpers.

Similar calculations may be made for other buildings, some of which are sprinklered, some not, and some partially so. A selection of 3,000 GPM for fire flow is reasonable based on a review of all of the buildings involved in the project.

II. Stanford and Sharon

The type of development in these areas will probably be high value residences or multiple-dwelling units for four families, with moderate exposure. Bulletin No. 266 indicates 1,500 GPM to be the required fire flow for this type of development, equivalent to two 750 GPM or three 500 GPM pumpers.
APPENDIX E

COMPARATIVE WATER RATES

A. Rates Which City of Menlo Park Pays in Buying Water From San Francisco
   Water Department (Schedule W-25-Resale Use With Long Term Contract)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st 3,300 c.f.</td>
<td>29.2¢/100 c.f.</td>
</tr>
<tr>
<td>next 30,000 c.f.</td>
<td>25.9¢/100 c.f.</td>
</tr>
<tr>
<td>next 300,000 c.f.</td>
<td>21.0¢/100 c.f.</td>
</tr>
<tr>
<td>next 7,666,700 c.f.</td>
<td>15.2¢/100 c.f.</td>
</tr>
<tr>
<td>next 8,000,000 c.f.</td>
<td>14.8¢/100 c.f.</td>
</tr>
<tr>
<td>over 16,000,000 c.f.</td>
<td>14.5¢/100 c.f.</td>
</tr>
</tbody>
</table>

   Note: A demand charge of 1 cent/100 c.f. is included in the above rates.

B. Rates Which City of Menlo Park Will Charge Users Of Its System

<table>
<thead>
<tr>
<th>Volume</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>first 33,300 c.f.</td>
<td>25¢/100 c.f.</td>
</tr>
<tr>
<td>next 300,000 c.f.</td>
<td>23¢/100 c.f.</td>
</tr>
<tr>
<td>next 1,000,000 c.f.</td>
<td>20¢/100 c.f.</td>
</tr>
<tr>
<td>next 2,666,700 c.f.</td>
<td>17¢/100 c.f.</td>
</tr>
<tr>
<td>next 4,000,000 c.f.</td>
<td>16.5¢/100 c.f.</td>
</tr>
<tr>
<td>next 8,000,000 c.f.</td>
<td>16.3¢/100 c.f.</td>
</tr>
<tr>
<td>over 16,000,000 c.f.</td>
<td>15.8¢/100 c.f.</td>
</tr>
</tbody>
</table>

   Note: A demand charge of 1 cent/100 c.f. is included in the above rates.

C. Rates Which Private Users Pay San Francisco Water Department In
   Buying Water Not For Resale On Long Term Contract (W-21 Schedule)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>first 3,300 c.f.</td>
<td>29.2¢/100 c.f.</td>
</tr>
<tr>
<td>next 30,000 c.f.</td>
<td>25.9¢/100 c.f.</td>
</tr>
<tr>
<td>next 300,000 c.f.</td>
<td>21.0¢/100 c.f.</td>
</tr>
<tr>
<td>next 7,666,700 c.f.</td>
<td>14.7¢/100 c.f.</td>
</tr>
<tr>
<td>next 8,000,000 c.f.</td>
<td>14.3¢/100 c.f.</td>
</tr>
<tr>
<td>over 16,000,000 c.f.</td>
<td>14.0¢/100 c.f.</td>
</tr>
</tbody>
</table>
APPENDIX F

CONTAINING A COMPARISON OF DIRECT BILLINGS FROM MENLO PARK (ALT. IV), AS AGAINST ESTIMATED TOTAL COSTS ON A PRIVATE SYSTEM (ALT. I), INCLUDING COSTS OF WATER, PUMPING, MAINTENANCE, AND AMORTIZATION.
APPENDIX A

CONTAINING CONSTRUCTION COST ESTIMATES

OF ALL ALTERNATES

AND

SITE PLANS

OF ALL ALTERNATES
APPENDIX "B"

WATER SUPPLY CAPACITY REQUIREMENTS

Requirements:

OPERATIONAL STAGE I

Domestic

750 population @ 40 gallons per capita per day = 30,000 GPD
Allow for peak factor of 2.5
Quantity = 2.5 x 30,000 = 75,000 GPD

Rate of Flow = \(\frac{75,000}{1,440}\) = 52 GPM

Fire Flow

Hose Streams @ 1,500 GPM
Sprinkler Demand @ 1,500 GPM (30 heads @ 50 GPM)
Total = 3,000 GPM
Storage for 4 hours = (3000) (240) = 720,000 gallons

Storage makeup within 16 hours \(\frac{720,000}{960}\) = 750 GPM

Accelerator & Klystron Cooling Tower Makeup

Tower Flow = \(\frac{(21,000)(3.413)}{500}\) = 3,600 GPM

Evaporation Makeup = (3600) (0.04) = 144 GPM

Continuous Blowdown = (144) (0.4) = 57.6

End Station & Switchyard Cooling Tower Makeup

Tower Flow = \(\frac{(48,000)(3.413)}{500}\) = 13,000 GPM

Evaporation Makeup = (13,000) (0.025) = 325 GPM

Continuous Blowdown = (325) (0.4) = 130 GPM

Test Laboratory Cooling Tower Makeup

Tower Flow = \(\frac{(8,600)(3.413)}{500}\) = 1,450 GPM

Evaporation Makeup = (1,450) (0.04) = 58 GPM

Continuous Blowdown = (60) (0.4) = 24 GPM

\[ o.h = \frac{32}{110} = \frac{32}{110} \] where 32 ppm is hardness of Hetch-Hetchy water and 110 ppm is maximum desired hardness in cooling tower water system.
### OPERATIONAL STAGE I - TOTAL REQUIREMENTS

<table>
<thead>
<tr>
<th></th>
<th>Maximum (GPM)</th>
<th>Operational (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Fire Storage Makeup</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Accelerator &amp; Klystron Cooling Tower Makeup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaporation</td>
<td>145</td>
<td>145</td>
</tr>
<tr>
<td>Blowdown</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>End Station &amp; Switchyard Cooling Tower Makeup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaporation</td>
<td>325</td>
<td>325</td>
</tr>
<tr>
<td>Blowdown</td>
<td>130</td>
<td>130</td>
</tr>
<tr>
<td>Laboratory Area Cooling Tower Makeup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaporation</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Blowdown</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,545</strong></td>
<td><strong>795</strong></td>
</tr>
</tbody>
</table>

Storage

- Fire = 4 hours @ 3,000 GPM = 720,000 gallons
- Domestic = 2 days @ 30,000 GPD = 60,000 gallons

**Reservoir of 1 million gallon capacity would have excess of 220,000 gallons that would provide sufficient water for about 5 hours operation of accelerator before shutdown required.**

### OPERATIONAL STAGE II

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>75 GPM</td>
</tr>
<tr>
<td>Use 1.5 factor for increased population</td>
<td></td>
</tr>
</tbody>
</table>

Fire Flow

- Hose Streams @ 1,500 GPM
- Sprinkler Demand @ 1,500 GPM
- **Total = 3,000 GPM**
- Storage for 4 hours = (3,000)(240) = 720,000 gallons
- Storage Makeup within 16 hours = 720,000 gallons

Accelerator & Klystron Cooling Tower Makeup

- **Tower Flow** = \( \frac{(77,000)(3.413)}{(500)(46)} \) = 13,200 GPM
- Evaporation Makeup = (13,100)(0.04) = 520 GPM
- Continuous Blowdown (520)(0.90) = 208 GPM

Use: 520 GPM

Use: 210 GPM
End Station & Switchyard Cooling Tower Makeup

Evaporation Makeup = \( \frac{6 \times 430}{48} \times \text{Stage I (325)} = 430 \text{ GPM} \)

Continuous Blowdown = \( 430 \times 0.4 = 174 \text{ GPM} \)

Laboratory Area Cooling Tower Makeup

Evaporation Makeup

Use: 60 GPM

Continuous Blowdown

Use: 25 GPM

OPERATIONAL STAGE II - TOTAL REQUIREMENTS

<table>
<thead>
<tr>
<th></th>
<th>Maximum (GPM)</th>
<th>Operational (GPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Fire Storage Makeup</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Accelerator &amp; Klystron Cooling Tower Makeup</td>
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<td></td>
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<tr>
<td>Evaporation</td>
<td>520</td>
<td>520</td>
</tr>
<tr>
<td>Blowdown</td>
<td>210</td>
<td>210</td>
</tr>
<tr>
<td>End Station &amp; Switchyard Cooling Tower Makeup</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaporation</td>
<td>430</td>
<td>430</td>
</tr>
<tr>
<td>Blowdown</td>
<td>175</td>
<td>175</td>
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<td>Laboratory Area Cooling Tower Makeup</td>
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<tr>
<td>Evaporation</td>
<td>60</td>
<td>60</td>
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<tr>
<td>Blowdown</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>2,245</strong></td>
<td><strong>1,495</strong></td>
</tr>
</tbody>
</table>

Storage

- Fire = 4 hours @ 3,000 GPM = 720,000
- Domestic = 2 days @ 45,000 GPD = 90,000

810,000 gallons

Reservoir of 1 million gallon capacity would have excess of 190,000 gallons that would provide sufficient water for about 2+ hours operation of accelerator before shutdown required.
APPENDIX C

EXPANSION OF MENLO PARK WATER SYSTEM

Development of Connection Charge For Users

Menlo Park City Water Department will expand its system to simultaneously serve three major areas:

1. SLAC
2. Stanford University lands (other than SLAC) in San Mateo County
3. New commercial and residential users in the former Sharon Estate property

In order to develop connection charges for the new users it was necessary to arrive at an estimated flow requirement for each to size the system and prorate the cost.

This was done as follows:

SLAC

The system sizing is based on fire flow and Stage II operational flow requirements. As developed in ABA Report No. 39, "Study On Water Supply Alternates for the Stanford Linear Accelerator," Appendix B, Water Supply Capacity Requirements, the flow requirements are:

<table>
<thead>
<tr>
<th>Operational Stage I</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>1545 gpm</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>795 gpm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operational Stage II</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum</td>
<td>2245 gpm</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>1495 gpm</td>
<td></td>
</tr>
</tbody>
</table>

Fire Flow = 3000 gpm for four (4) hours

Water Storage = 1 million gallons

Stanford University Lands In San Mateo County (other than SLAC)

Stanford property maps in the affected area are divided into seven areas comprising a net acreage of 536 acres and an estimated future population of 11,300, which at 120 gallons/day/person results in a daily flow of 1,350,000 gallons, or 940 gpm.

Estimated fire flow = 1500 gpm

Storage = None required at present as, other than SLAC, development of the area awaits resolution of freeway, Ladera Dam, and other problems that would affect the useable area.
Sharon Development

The Sharon Estate comprises approximately 600 acres. Its use is planned to be broken down roughly as follows:

- Residential: 250 acres
- Apartments: 80 acres
- Institutional: 90 acres
- Commercial: 10 acres
- School: 30 acres
- Golf Course: 140 acres

Total: 600 acres

The estimated future population is 7500 persons, which at 120 gallons/day/person = 900,000 gallons/day, or 625 gpm.

Estimated fire flow -- 1500 gpm
Storage -- 1-million gallons initially

DESIGN BASIS

Based on inspection of the above requirements, a main sized for 3000 gpm was decided upon. The pro-rata share of line costs would be based upon normal flows, as follows:

- SLAC: 1500 gpm (Stage II)
- Stanford: 1000 gpm
- Sharon: 650 gpm

Due allowance would be given in prorating the cost for the service aspects of the main line in serving individual customers along its length.

A 2-million (50% SLAC, 50% Sharon) gallon reservoir is to be built with adjacent space allowed for a future 4-million gallon reservoir.

ESTIMATE OF PRO-RATA CHARGES ON WATER MAIN

The following calculations refer to Plate I showing the location of the water main and storage basin.

A. Estimated Construction Cost of Water Line, Pumping Plant, and Appurtenances

\[ \text{A-B (See Dwg.)} \]

- 700 L. F. 16" Conc. Cyl. Pipe @ $15/ft. = $10,500
- 1 ea. Gate Valve @ $500 = 500
- 1 ea. Pumping Plant (Expansion) = 25,000
- Pump Plant Acquisition = 2,500

\[ \text{E. D. & I. (10\%) = 3,850} \]

\[ \text{Est. Cost -- A-B = 42,350} \]

B-C

- 850 L. F. 16" Conc. Cyl. Pipe @ $15/ft. = $12,750
- 1 ea. Gate Valve @ $500 = 500

\[ \text{Total Est. Cost = 55,100} \]
C-D
3750 L. F. 16" Conc. Cyl. Pipe @ $16/ft.* = $ 60,000
1 ea. Gate Valve =
E. D. & I. = $ 60,500
Est. Cost C-D $ 66,550

D-E
700 L. F. 16" Conc. Cyl. Pipe @ $15/ft. = $ 10,500
E. D. & I. = $ 1,050
Est. Cost D-E $ 11,550

E-F
3300 L. F. 16" Conc. Cyl. Pipe @ $16.00/ft.* = $ 52,800
1 ea. Gate Valve = $ 53,300
E. D. & I. = $ 5,330
Est. Cost E-F $ 58,630

F-G
400 L. F. 16" Conc. Cyl. Pipe @ $15.00/ft. = $ 6,000
2 ea. Gate Valves @ $500 = $ 7,000
E. D. & I. = $ 700
Est. Cost F-G $ 7,700

TOTAL - Water Line Pumping Plant and
Appurtenances $ 201,355

B. Method Of Construction Cost Spread on Water Line, Pumping Plant, and
Appurtenances

Transmission main spread in accordance with estimated ultimate
donor demand:
SLAC - 1500 gpm
Stanford - 1000 gpm
Sharon - 650 gpm
3150 gpm

Distribution main spread on equivalent 8" line estimated at $5.50
per lineal foot plus 10% for engineering and overhead:

A-B -- 700' transmission only
B-C -- 850' Trans. + 850' dist. to Sharon on both sides
C-D -- 3750' trans. + 3750' dist. to Sharon on one side + 900' dist. to SLAC and 2850' dist. to Stanford on
other side.
D-E -- 700' transmission only
E-F -- 3300' transmission + 3300' distribution to Stanford
on both sides of line
F-G -- 400' transmission only

* to allow for laterals
C. Cost Spread Calculations

A-B -- $42,350

- SLAC - 1500 gpm - 47.6% = $20,160
- Stanford - 1000 gpm - 31.8% = 13,470
- Sharon - 650 gpm - 20.6% = 8,720
  3150 gpm -100.0% = $42,350

B-C -- $14,575 -- ( (850) (5.50) + 10% ) = $9,445 trans.

  4675 + 465 = 5130 dist.

- SLAC - 47.6% = $4,495
- Stanford - 31.8% = 3,005
- Sharon - 20.6% = 7,075

  9,445

C-D -- $66,550 -- ( (3750) (5.50) + 10% ) = 43,860 trans.

  20,625 + 2065 = 22,690 dist.

- SLAC - 47.6% = 20,860 + 2,720 (1) = $23,580
- Stanford - 31.8% = 13,960 + 8,625 (2) = 22,585
- Sharon - 20.6% = 9,040 +11,345 (3) = 20,385

  $43,860

D-E -- $11,550

- SLAC - 47.6% = $ 5,500
- Stanford - 31.8% = 3,675
- Sharon - 20.6% = 2,380

  $11,550

E-F -- $58,630 -- ( (3300) (5.50) + 10% ) = 38,665 trans.

- SLAC - 47.6% = 18,400
- Stanford - 31.8% = 12,300 + 19,965
- Sharon - 20.6% = 7,965

  38,665

F-G -- $7,700

- SLAC - 47.6% = $3,660
- Stanford - 31.8% = 2,450
- Sharon - 20.6% = 1,590

  $7,700
### Summary

<table>
<thead>
<tr>
<th></th>
<th>SLAC</th>
<th>Stanford</th>
<th>Sharon</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-B</td>
<td>$20,160</td>
<td>$13,470</td>
<td>$8,720</td>
</tr>
<tr>
<td>B-C</td>
<td>4,495</td>
<td>3,005</td>
<td>7,075</td>
</tr>
<tr>
<td>C-D</td>
<td>23,580</td>
<td>22,585</td>
<td>20,385</td>
</tr>
<tr>
<td>D-E</td>
<td>5,500</td>
<td>3,675</td>
<td>2,380</td>
</tr>
<tr>
<td>E-F</td>
<td>18,400</td>
<td>32,265</td>
<td>7,965</td>
</tr>
<tr>
<td>F-G</td>
<td>3,660</td>
<td>2,450</td>
<td>1,590</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>$75,795</td>
<td>$77,450</td>
<td>$48,115</td>
</tr>
</tbody>
</table>

(37.6%) (38.4%) (24.0%)

### ESTIMATE OF PRO-RATA CHARGES ON RESERVOIR (2-million gallons)

#### A. Estimate of Construction Cost

- Semi-buried reservoir - 2-million gallons @ 8.25¢/gal. = $165,000
- Controls and control lines: 5,000
- Reservoir land acquisition: 6,000

**Total:** $176,000

**E.D. & I.** 17,600

**Total:** $193,600

#### B. Pro-rata On Reservoir

- SLAC - 50% - $96,800
- Sharon - 50% - 96,800

**Total:** $193,600

### ESTIMATE OF PRO-RATA ROAD CHARGES

#### A. Estimate of Construction Cost

- Roadwork: $6,000
- Land acquisition: 2,500

**Total:** $8,500

**E.D. & I. (10%)** 850

**Total:** $9,350

#### B. Pro-rata On Road

- SLAC - 1/3 - $3,117
- Stanford - 1/3 - 3,116
- Sharon - 1/3 - 3,117

**Total:** $9,350
## CONNECTION CHARGES FOR USERS

<table>
<thead>
<tr>
<th></th>
<th>SLAC</th>
<th>Stanford</th>
<th>Sharon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>$75,795 (37.6%)</td>
<td>$77,450 (38.4%)</td>
<td>$48,115 (24.0%)</td>
</tr>
<tr>
<td>Reservoir</td>
<td>96,800 (50%)</td>
<td>---*</td>
<td>96,800 (50%)</td>
</tr>
<tr>
<td>Road</td>
<td>3,117 (1/3)</td>
<td>3,116 (1/3)</td>
<td>3,117 (1/3)</td>
</tr>
<tr>
<td>Estimated Conn. Chge.</td>
<td>$175,712</td>
<td>$80,566</td>
<td>$148,032</td>
</tr>
<tr>
<td>Contingency</td>
<td>23,988</td>
<td>10,874</td>
<td>20,168</td>
</tr>
<tr>
<td>Maximum Conn. Chge.**</td>
<td>$199,700</td>
<td>$91,440</td>
<td>$168,200</td>
</tr>
</tbody>
</table>

### Notes:

* Stanford will not be able to be serviced by the system until additional storage is constructed.

** Separate construction bids will be obtained by the City for the main, the reservoir, and the roadwork.