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INCREASED PUMPING CAPACITY AT 181-C
SCOPE AND JUSTIFICATION

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INCREASED PUMPING CAPACITY AT 181-C
SCOPE AND JUSTIFICATION

I. PURPOSE

The purpose of this report is to provide scope and justification for the installation of two new 16,500 gpm, 150-foot head pumps in the 181-C building in order to furnish sufficient additional water to increase production at 105-B and to supply the entire normal export demand from B Area.

II. BASIC ASSUMPTIONS

Any measures that are taken to increase the amount of filtered water available for process use in order to satisfy the short-range demand for increased flows through the B and C reactors due to the I & E program are to be of a nature to also be incorporated into the long-range program of increases in production at both the 105-B and 105-C reactors.

For the purpose of this report, the capacity of the filter plants and the water requirements are based on a five-hour filter backwash period during the adverse turbidity months of May and June.

III. SUMMARY AND CONCLUSIONS

A minimum of 11,000 gpm will be required to be transferred from the 183-C reservoir to the 183-B clearwell via the cross-tie line during the adverse turbidity period when the I & E program is in effect at 105-B. It is contemplated to transfer 15,000 to 20,000 gpm so as to provide the necessary water for this increased flow at 105-B and to reduce the flow through the existing 183-B filters (Ref. 1).

It is apparent that the pumping capacity at 181-C is not adequate to supply this extra water at 183-C unless all export pumps are used to pump water to 183-C. If this increased demand were met by using the export pumps, the 100-D Area would have to supply most of the export demand to the 200 Areas which is anticipated to be 12,000 to 15,500 gpm. After the new expected I & E flows are achieved at 105-D and 105-DR, D Area will have only enough surplus water to supply about 4,000 gpm of the export demand. Since it is economically advisable to supply all of the export water from one area, it is recommended that the normal export water demand be supplied from B Area and that two 16,500 gpm, 150-foot head pumps be installed in the 181-C river pumphouse to supply the additional water required at 183-C.

Ref. 1 HW-55183 (SECRET), "Project Proposal Filtered Water Cross-Tie, 183-B and 183-C," D. E. Newby, Marsh 27, 1958.

The project is estimated to cost \$245,000 and the resulting production increases will pay off this project in one year.

IV. DISCUSSION

A. Capacities of Present Systems

The capacity of the 183-B filter plant is limited to approximately 75,000 gpm of process water during the adverse turbidity periods⁽¹⁾ and is the limiting factor in the 105-B production. Approximately 79,000 gpm is required at the 183-B head house in order to produce this 75,000 gpm of process water, plus the filter backwash water and required sanitary water. The pumping capacity at 181-B is adequate to supply this 79,000 gpm demand. A flow of 82,500 gpm was obtained at 183-B head house when eight 181-B pumps were used for the A.T.P.'s conducted at B area during the CG-558 outage.

The filter capacity of the 183-C building is approximately 155,000 gpm. The actual amount of water that can be supplied to the 183-C building, however, is considerably less than this amount. Tests conducted by the B-C Power Operation gave the following flows to 183-C building:

At 142' TDH	{	11 - 181-C pumps	105,000 gpm
		11 - 181-C pumps plus 1 export pump	111,500 gpm
		11 - 181-C pumps plus 2 export pumps	117,500 gpm
		11 - 181-C pumps plus 3 export pumps	123,000 gpm

When these export pumps are used to supply water to 183-C for approximately six hours, it becomes necessary to supply export water from 100-D area.

B. 181-C Pumping System

The present 181-C pumping system consists of eleven 10,000 gpm, 150-foot head, 450 HP pumps which pump directly to the 183-C building, and one 10,000 gpm export pump. There are also two spare spaces for new pumps on the 181-C side of the pumphouse.

For the past several years one, two, and even three 181-C pumps have been down for repairs almost continuously. These repairs include sheared shafts, burned-out motors, excessive vibration, and routine Class "A" overhauls. At times, one or more export pumps have had to supplement the 181-C pumps in order to furnish enough water to 183-C building. From past experience, it is evident that for reliable operation, there should be at least one spare pump in the 181-C system.

(1) HW-53683 (SECRET), "183-B-C Cross-Tie Justification and Scope", L. B. Brinkman, dated December 2, 1957.

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C. 183-C Building Requirements

Since the filtering capacity of the 183-B building is the limiting factor in the 105-B production, a 30-inch crosstie line between the 183-C reservoir and the 183-B clearwell is presently under construction to transfer filtered water from 183-C to the 183-B clearwell. During the period of adverse turbidity a minimum of 11,000 gpm from 183-C will be necessary if the anticipated flow of 83,000 gpm to 105-B is to be achieved. The anticipated water requirements at 183-B are as follows:

105-B	83,000 gpm
Backwash	4,000 gpm
Miscellaneous	<u>3,000 gpm*</u>
TOTAL REQUIRED	90,000 gpm
Available from 183-B	<u>79,000 gpm</u>
Minimum to be supplied from 183-C	11,000 gpm

It is desirable to supply as much as 20,000 gpm to 183-B from 183-C so that the 183-B filters would not have to operate at their maximum capacity. In order to supply even the minimum of 11,000 gpm to 183-B, additional water will be required at 183-C. The anticipated minimum water requirements at 183-C are as follows:

105-C	95,000 gpm
Backwash	5,500 gpm
Miscellaneous	<u>4,500 gpm</u>
TOTAL C AREA REQUIREMENTS	105,000 gpm
183-B Requirements	<u>11,000 gpm</u>
Total 183-C Requirements	116,000 gpm

Under the present setup, not more than ten 181-C pumps should be considered as operating for reliable water plant operation. Ten pumps will supply to 183-C approximately 98,000 gpm which is less than the C area requirements. Ten 181-C pumps and one export pump or eleven C pumps are now required to supply the present C area requirements which are about 105,000 gpm. Additional pumping capacity is required if the minimum demand of 116,000 gpm at 183-C is to be met. At least 123,000 gpm is desirable.

D. Export Water

At the time that the crosstie line was proposed, it was anticipated that B area would be able to supply approximately 7,000 gpm to the export system provided all 181-B, all 181-C, and two export pumps were in operation, and that D area could supply the remainder.

* This figure includes water for thermal shield and rod cooling, powerhouse use, and 190 building cooling.

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Since that time, however, due to technological advances not foreseen a year ago, the predicted I & E flows at 105-B, 105-C, 105-D, and 105-IR have increased to the point where even the two areas together will not be able to supply the entire export demand when these I & E flows are achieved. With the existing pumping facilities, B area will be able to supply only about 4,000 gpm for export use when all 181 pumps except one 181-C pump are operating.

With thirteen process pumps and the one export pump operating at 181-D, the total flow is approximately 180,000 gpm. This leaves only one electric pump in the entire 181-D building for a spare. The anticipated water consumption in 1959 is as follows:

Total flow		180,000
D and IR reactor	158,000	
Backwash water	9,000	
Miscellaneous use	<u>9,000</u>	
TOTAL		<u>176,000</u>
Available for export		4,000

The 100-F and 100-H areas have also been considered as sources of export water. A review of the pumping capacities and water requirements for F and H areas reveals that the amount of export water that could be supplied by either area is very small. The 181-F building has ten 10,000 gpm pumps. Nine pumps, which is the maximum number that can be considered as operating at one time for reliable service, will supply about 90,000 gpm to the 183 head house. With the current flow of 80,000 gpm at 105-F, this would leave only 10,000 gpm for filter backwash, miscellaneous use, and export. At the best, only 2,000 to 3,000 gpm would be available for export.

The 181-H building has nine 10,500 gpm, 180-foot head pumps. Eight pumps will supply approximately 89,000 gpm to the 182 and 183 buildings. When the anticipated I & E flow of 82,000 gpm is achieved, only 7,000 gpm will be available for filter backwash, miscellaneous use, and export. Less than 2,000 gpm could be used for export water. Even the two areas together could supply less than one-third the export requirements.

Without additional pumps at 181-C, at least three areas would have to supply a portion of the normal export water demand and 105-B would be limited to a flow of 80,500 gpm. In order to confine the export crew to a minimum of personnel, it is economically desirable to supply the entire normal export demand from one area. Since there are two spaces at 181-C and three export pumps, the 181-C building is the logical place to add the pumping capacity.

E. New Pumps in 181-C Building

By adding two 16,500 gpm, 150-foot head, 900 HP pumps in the two spare spaces in 181-C building, an additional pumping capacity of 23,000 gpm @ 155-foot head will be achieved. With this additional pumping capacity, the following flows at 183-C head house are expected: (See Appendix C)

At 155' TDH { 9 existing pumps plus two new pumps - 117,000 gpm
10 existing pumps plus two new pumps - 123,000 gpm
11 existing pumps plus two new pumps - 128,000 gpm

Ten existing pumps and two new pumps should have sufficient capacity to supply in the neighborhood of 123,000 gpm to the 183-C head house. This flow would enable approximately 18,000 gpm to be transferred to 183-B via the crosstie line, which would supply the increased flow at 105-B and also ease the demand on the 183-B filters.

It is proposed to install a 16,500 gpm pump in the No. 1 and No. 10 spare spaces in the 181-C building and tie-in the discharge pipes to the existing 48-inch header in the C pipe gallery. Each discharge line will have a rubber spool piece, check valve, and gate valve similar to the existing lines. Building modifications similar to the floor strengthening at 181-D during CG-558 will be required for the two pumps at 181-C.

F. Electrical Modifications

The addition of two 900 HP pumps at the 181-C building will require modifications and additions to several parts of the electrical power supply to the building. Existing equipment has insufficient capacity to serve the new loads and maintain the necessary reliability and continuity of service expected of these facilities. Several schemes were studied to determine an efficient and economical method of meeting the increased power demand.

The proposed plan provides the necessary power facilities for the new load, improves the existing operating facilities in the 181 building, and adds reliability to the 13.8 KV overhead line power source to the building. It utilizes surplus switchgear and transformer cooling fans available on the plant site and removes obsolete unusable equipment from 181 building. The alternate plan, while simpler and somewhat less costly, does not provide the several system improvements included in the recommended plan. The proposed plan and alternate are described below:

1. Additional transformer capacity (See Fig. 1)

The four existing transformers at 181 B-C have a combined continuous rating of 14,000 KVA. It is necessary that the transformer capacity be capable of carrying the pumping load during a period whereby one transformer is out of service if continuity of operation of both reactors is to be assured. As indicated in Chart A, the 4500 KVA

transformer would be overloaded under this condition and it is necessary that the three transformers be paralleled to utilize the available capacity. Parallel operation requires switching in the 151-B substation to parallel primary 13.8 KV lines. Under these conditions there is insufficient spare capacity available to serve this project addition of 1800 HP.

CHART A - PRESENT TRANSFORMER LOADING

<u>Transformer</u>	<u>Rating</u>	<u>KVA</u>	<u>Load KVA</u>		
			<u>Present</u>	<u>(1)</u>	<u>(2)</u>
#1	4500	(1)	2490 ⁽³⁾	(1)	2490
#2	4500	4500	2890	4970 ⁽⁵⁾	5100 ⁽⁵⁾
#3	2500	2500	1660 ⁽⁴⁾	2070	1660
#4	<u>2500</u>	<u>2500</u>	<u>2210</u>	<u>2210</u>	<u>(2)</u>
Total	14,000	9500	9250	9250	9250

- Note: (1) With one 4500 KVA transformer out of service
 (2) With one 2500 KVA transformer out of service
 (3) With one 450 HP pump spare
 (4) With one 600 HP pump spare
 (5) Exceeds transformer rating

To provide the necessary additional transformer capacity at the 181 B-C building, the two 2500 KVA transformers, #3 and #4, at 181-B will be interchanged with two 3000/4000 KVA transformers at 182-B. Forced air cooling fans which were to be surplus from Utilities Operation will be installed on the 3000/4000 KVA transformers to make the 4000 KVA rating available. Additional fans will be installed on the 4500 KVA transformer banks to obtain a 5175 KVA forced-air rating. Automatic temperature control will be provided to operate the fans when the load requires the forced-air rating. It is anticipated that the fan ratings will be required only during the unusual condition as continued operation with one transformer out of service. Individual low voltage supplies for fans on each transformer bank will be provided from each 2300 V bus in the respective substation at 181-B.

The proposed modifications will provide 1000 KVA additional capacity (nonforced-air cooled) and 4350 KVA with forced-air cooling. Under normal conditions all building loads including the two 900 HP pumps can be operated without using the forced-air ratings. When any one transformer is out of service, the remaining three transformers will have sufficient capacity, and feeder loads are divided so that full operation of equipment may be maintained without paralleling transformers.

It is expected that the loads at 182-B will be less than 2500 KVA. The interchange of transformers will provide two 2500 KVA transformers for a normal load of two 1000 HP export pumps, one 500 HP export pump, and one 400 HP condenser pump. Several 200 HP process pumps are not normally used but may be run while both transformers are in service.

2. Motor control switchgear (See Fig. 1)

Various additions and modifications of pump loads at the 181 B-C building have developed an unusual six-bus arrangement supplied from the four transformers. The switchgear consists of three separate groups which are the General Electric, the original Rowan gear on the "B" side, and the Allis Chalmers on the "C" side. All incoming line breakers are rated 1200 amperes with adequate interrupting capacity for this system position.

The General Electric switchgear (buss "E" and "F") was salvaged from 190-B building and installed on project CG-558 for the eight 600 HP motors. There are no spare units in this group. The Rowan switchgear (bus "A" and "B") consists of two incoming line compartments, a bus tie disconnect switch and eight feeder compartments. Three of the feeders are used for two 450 HP motors and the building service transformers. Five feeder compartments are now spare, having been replaced by the General Electric switchgear. The Rowan motor starters are rated 500 HP maximum and cannot be modified to serve the two 900 HP motors now being added.

There are now twelve 450 HP pumps served from the Allis Chalmers switchgear (bus "C" and "D"). Normally, six pumps may be run on each of two buses. Under conditions when one incoming line breaker is open and the bus tie breaker is closed, the breaker ratings (1200 A) will allow operation of only eleven of the twelve pumps and the incoming line cable will be overloaded approximately 16 percent. Therefore, there is no spare capacity on this bus for the additional loads.

It is proposed to replace the Rowan switchgear with nine switchgear units available in surplus rated for the larger motors. This equipment is now located at the 101 building at Hanford. It is available at 10 percent of its book value (approximately \$300 each unit) and is identical switchgear to that which was installed in 181-B under project CG-558. This equipment is now disassembled (in part) and will be rehabilitated, modified, and tested as required for service to the motor and transformer loads at 181 B-C. The removal of the physically large Rowan motor starters with its five unused compartments will provide ample room to install the replacement switchgear.

The operation of the switchgear after the proposed modification will be as shown in Fig. 1 with the six incoming line breakers normally closed and the four bus ties normally open. When one transformer is out of service (#4 for instance), the incoming line breakers X84, X42,

INCOMING LINE CABLES

- (a) three 500 MCM/φ, rated 1056 AMP, 4360 KVA
- (b) three 500 MCM/φ, rated 981 AMP, 4070 KVA
- (c) two 500 MCM/φ, rated 826 AMP, 3430 KVA
- (d) one 500 MCM/φ To be added in existing conduit.

FIG. 1
 PROPOSED ELECTRICAL MODIFICATIONS -- 181 E-C
 FOR ADDITION OF TWO 900 HP MOTORS

and X41 will be opened and bus tie breaker X83, X43, and X73 will be closed. Similar switching will be required for transformer #2, i.e. X42, X39, and X41 would be opened while X83, X43, and X73 would be closed.

This proposed plan will have no effect on the existing limitation on operation of only eleven of the twelve C pumps in the event that one incoming line breaker is open. However, the addition of the two new C pumps will ordinarily make available for spare or maintenance one of the existing C pumps and one additional pump. The probability of requiring the operation of all twelve existing C pumps at a time when one incoming line breaker is open will be greatly reduced after the completion of this project, and it is anticipated that the water operation will not be encumbered by this limitation.

3. Cable (See Fig. 1)

It is proposed to install a third 500 MCM cable per phase in existing conduit from each 3000/4000 KVA transformer to buses "E" and "F". This will provide cable rating in excess of the 4000 KVA transformers capacity. The present cable capacity is 3430 KVA. The existing bus tie cables, 450 HP motor feeders, building service feeder, and incoming line cables will be disconnected from the Rowan switchgear and extended to the new buses "A" and "B" as required. New feeder cables, in trays and conduit, will be run to the two new 900 HP motors.

4. 13.8 KV overhead lines

Chart B shows the rating of sections of the existing lines C2-L3 and C2-L10:

CHART B - Present Load and Line Ratings

<u>Line</u>	<u>Actual KVA Load (a)</u>	<u>Connected KVA Load (b)</u>	<u>Rating of Lines</u>	
			<u>Cable (d)</u>	<u>Overhead Line (e)</u>
L-3	4380	5100	346A = 8500 KVA	285A = 6800 KVA
L-10	<u>4930</u>	<u>5100</u>	346A = <u>8500</u> KVA	285A = <u>6800</u> KVA
Present				
Total	9310	10200	17000	13600
Future (c)				
Total	11000	11900	17000	13600

(a) Calculated from substation records

(b) Estimated from pump data

(c) Estimate includes two 900 HP pumps as proposed herein

(d) Cable in underground duct from 151-B to pole line

(e) 2/0 - single conductor, air, 13.8 KV (3/0 = 346A rating)

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With one line (L3 or L10) out of service, the remaining line must be loaded to 108 percent on the cable portion and 135 percent on the open wire with present loads. After the addition of two 900 HP motors, these overloads will be 130 percent and 170 percent, respectively, and can be carried only for very short periods. For continuity of power to 181 B-C in the event of extended outage of one line, a third line with switching to substitute for either normal supply is required.

A 13.8 KV overhead line extension of line C2-L9 (see Fig. 2) will be constructed on new poles from the vicinity of the 184-B building to the 181 B-C building. A pole top disconnect switch, 400 amperes, 13.8 KV, will be mounted on the first pole from the tap point of line C2-L9. Two similar pole top switches near the 181-C building will allow connection to either one of the two existing overhead 13.8 KV buses (L3 or L10 sections). The existing pole top switch serving as a line tie between lines L3 and L10 at the 181-B building will be removed.

5. Alternate Proposal (See Fig. 3)

An alternate proposal is to add two new power transformers rated 1000 KVA, 13.8 KV primary, 2300 V secondary, adjacent to the 181 B-C building. Secondary cable would be run from each transformer to added motor control switchgear inside the 181-C building. To provide space for the switchgear, the 440-volt motor control center (five compartments) and approximately 17 small feeders and/or control circuits in the 181-C building would be relocated. The additional overhead 13.8 KV tap line from line C2-L9 is included in this alternate.

This alternate proposal would provide the necessary power for the new loads at a minimum of cost and disruption of existing equipment but would not improve the operation of the existing equipment in 181 building. It is estimated to cost about \$15,000 less than the proposed plan and would make the total project cost about \$230,000. The advantages of the proposed plan over the alternate are as follows:

- a. It provides more space in the switchgear area eliminating the necessity of relocating the 440-volt motor control centers.
- b. It eliminates the necessity of paralleling all three buses in case one transformer is out of service, thereby saving switching and still maintaining two sources of supply.
- c. The 181-B side would have capacity to add approximately 700 HP.
- d. It replaces the undersized, unusable Rowan switchgear with greater capacity switchgear available on plant site. To replace this Rowan switchgear sometime in the future would probably necessitate the purchase of new equipment which would increase the cost of this operation about \$25,000.

FIG. 2

PROPOSED 13.8 KV LINE TO 181 B-C
FOR ADDITION OF TWO 900 HP MOTORS

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FIG. 3

ALTERNATE ELECTRICAL MODIFICATIONS — 181 B-C
FOR ADDITION OF TWO 900 HP MOTORS

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The advantages gained by replacing the present Rowan switchgear, the increase in transformer capacity, and the improvement in operating conditions justify the added cost of the proposed plan over the alternate plan.

G. Spare Equipment

For normal operation, with the crosstie line in service and the increased capacity of the two new pumps proposed for installation, there would be one spare pump in 181-C and one spare pump in either the 181-B or export system and all export water would be supplied from 100-B Area.

The need for additional spares in 183-B and 190-B has not been established. Continued operation with I & E fuel elements is required in order to establish a level of confidence as a basis for flows in excess of those discussed. It is possible that the need for additional equipment may develop as future advantage is taken of improved technology, but the need for such equipment is not firmly established at this time.

H. Detailed Justification of Proposed Work

Justification for the expansion of the 181-C river pumphouse by adding two 16,500 gpm pumps is based primarily on the increased production at 105-B. A 105-B flow of 80,500 gpm was considered in the justification of the crosstie line. Advances in reactor technology during the past year now permit effective utilization of 83,000 gpm at 105-B. Although the potential for this additional flow through the 105-B reactor will have been provided by the reactor modifications for the I & E program, the actual flow through the reactor and the increased production will be dependent on the amount of filtered water available.

Since this increase in flow will not be possible without the additional 181-C pumping capacity, the increased production due to an increase in flow from 80,500 gpm to 83,000 gpm will be used as a basis for justifying this project.

1. Increased production

The production increase due to the additional 2500 gpm flow will vary for certain periods of the year. For approximately 75 days during the summer, it will be based on bulk temperature limits. For the remaining 290 days, it will be based on tube power limits. The anticipated production increase is as follows:

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- a. During bulk temperature limits (75 days)

$$MW = 2500 \times 8.34 \times 1.8 \times (93-20) \times 1.758 \times 10^{-5} = 48$$

$$$/yr. = 48 \times 75 \times 0.75 \times 30.00 = \$81,000$$

- b. During tube power limits (290 days) - An increase in flow from 80,500 gpm to 83,000 gpm will yield an increase of 20. KW/tube.

$$MW = 1425 \times .020 = 28.5$$

$$$/yr. = 28.5 \times 290 \times 0.75 \times 30.00 = \$185,000$$

- c. Total production = $\$81,000 + \$185,000 = \$266,000/\text{year}$.

2. Capital costs

- a. This project = $\$245,000$

3. Increased water plant operating cost

- a. Electrical - Additional power consumption for pumping 2500 gpm.

181-C	100 KW
183-B	100 KW
190-B	<u>900 KW</u>
TOTAL	1100 KW

$$$/yr. = 1100 \times 17.50 = \text{-----} \$19,200$$

- b. Chemical

$$$/yr. = \frac{2500 \times 1440 \times 365 \times 0.9 \times 7.00}{106} = \$ 8,300$$

$$\text{TOTAL} = \$27,500$$

4. Pay-off period

$$\begin{aligned} \text{Amortization period} &= \frac{\text{Capital cost } (\$)}{\text{Production gained } (\$/\text{yr}) - \text{Increased Costs } (\$/\text{yr})} \\ &= \frac{\$245,000}{266,000 - 27,500} = \text{one year} \end{aligned}$$

J. Additional Benefits

An additional benefit from the proposed work is the increased reliability of the plant. As pointed out earlier, past experience makes at least one spare pump mandatory for reliable water plant operation. Without one spare unit, 105 production would have to be decreased according to the amount of water the 181 pumphouse could supply when one unit is down for repairs. The amount of future downtime for 181 pump repairs is expected to be at least as much as in the past since the pumps are becoming older.

K. Alternate Solution

The only alternate solution to increase the pumping capacity at 181-C would be to change the bowl assemblies of the existing pumps and re-wind the existing 450 HP motors to 600 HP to increase the available head and discharge of the pumps. This modification on the 181-C pumps should increase their pumping capacity only about 500 to 1000 gpm per pump. According to the costs incurred in project CG-558 for similar work on eight pumps in the 181-B side, this work is estimated to cost in the neighborhood of \$400,000 and would not give the flexibility that two new pumps would give.

V. ACKNOWLEDGMENTS

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- B. HW-55183 (SECRET), "Project Proposal Filtered Water Crosstie, 183-B and 183-C", D. E. Newby, dated March 27, 1958.

VII. APPENDICES

- A. Estimate Sheet
- B. 181-C River Pumphouse Layout
- C. 181-C Pumping System Curve

APPENDIX A

Study Estimate

<u>FEATURE</u>	<u>TOTAL</u>
<u>Construction Operation:</u>	
Structural Modifications	\$ 4,500
Equipment	86,000
Piping	12,500
Electrical, Power & Control Wiring at 181-B	29,000
Other Direct and Indirect Costs	<u>17,100</u>
<u>Plant Forces:</u>	
Interchange Transformers and Add Fans	<u>9,000</u>
<u>Fixed Price Contractor:</u>	
Electrical, 184-B to vicinity 181-B	<u>12,900</u>
Sub-Total	\$171,000
Supervision, Title III	7,000
Contingency	30,000
Escalation	10,000
General Overhead	<u>11,000</u>
Total Installation & Erection Cost	\$229,000
Management Services	3,000
Design, Title I and II	<u>13,000</u>
TOTAL CONSTRUCTION COST	<u>\$245,000</u>

Note: The estimate is based on the assumption that structural modifications and installation of pumps with connections to existing pipe header and electrical power and control wiring at 181-B will be performed by Construction Operation, the interchanging of transformers and addition of fans will be performed by Plant Forces, and the construction of the 13.8 KV line will be performed by a fixed-price contractor. All work is based upon the usual five-day, forty-hour week.

APPENDIX B181-C RIVER PUMP HOUSE
LAYOUT

DECLASSIFIED

181-C PUMPING SYSTEM HEAD VS TOTAL FLOW

**DATE
FILMED**

10/18/94

END