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183 B-C CROSS TIE JUSTIFICATION AND SCOPE

By

L. B. Brinkman

November 27, 1957

UTILITIES ENGINEERING OPERATION
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183 B-C CROSS TIE JUSTIFICATION AND SCOPE

I. INTRODUCTION

After the present solid slugs are replaced with the new I&E elements in the 105-B reactor, the friction loss for the reactor cooling water will be decreased with a resulting opportunity for increase in flow through the reactor. The amount that this flow could be increased is limited by the capacity of the B water plant as well as the reactor itself.

It is possible that there will be a shortage of filtered water at 183-B during the critical periods of each year. To overcome this possible shortage of water it has been proposed to construct a thirty inch tie line from the 183-C reservoir to the 183-B clearwell to supply filtered water to 183-B by gravity flow from 183-C.

II. CONCLUSIONS

It is almost a certainty that there will be times when the 183-B filter plant will be unable to produce sufficient filtered water to fulfill potential requirements at 105-B reactor. Since the existing 183-C filter capacity is much greater than post CG-600 and I&E slug requirements, it is feasible to install a tie line from 183-C reservoir to the 183-B clearwell and it is recommended that this tie line be installed before May 1958.

The following factors determine the feasibility of the tie line:

- A. The present capacity of the 183-B filters when all filters are in operation and in good condition is just barely adequate to supply the anticipated requirements of the 105-B with I&E slugs.
- B. The recent increased flow to supply the present CG-558 requirements of 71,000 G.P.M. is already causing a severe loss of sand in the filters.
- C. Continued high rates of flow through the present 183-B filters will necessitate rebuilding the filters in the near future.
- D. Due to the age of the filter equipment and the fact that limited spare equipment is on hand, extended shut downs of one or more filters are anticipated for the purpose of making repairs.
- E. Unusual condition of high turbidity of the river water at rare intervals reduce the capacity of the filters to a point way below that usually expected.
- F. If and when additional improvements are made to reduce friction loss through the reactor, the present filter capacity will be inadequate.

- G. A savings of about \$6500 a year can be realized by processing 10,000 G.P.M. of B reactor's water at the 183-C filter plant.
- H. Increasing the production at 183-C and reducing the production at 183-B will increase the life of the 183-B filters.
- I. A tie line can be constructed now while the material is available on the plant for about half the cost of a line using new materials.

III. DISCUSSION

A. Capacities of the Individual Parts of the Flow System

An analysis of the flows of the eight separate parts of the B Area system was made by W. D. Bainard and reported in document HW-49777. This analysis revealed that the system from the rear of the reactor to the river has a capacity in excess of 100,000 G.P.M. Only the capacities of the parts from the 181-B to the reactor rear face need be considered for this study.

The capacity figures for the various parts of the flow systems shown below were obtained from A.T.P.'s conducted at B Area during the CG-558 outage and from other special tests conducted during the recent months. The anticipated reactor flow with aluminum tubes and I&E slugs for 105-B and 105-C was obtained from K. W. Hess, Reactor Engineering Operation. The capacities of the various parts in B and C Areas are as follows:

1. 181-B to 183-B

7 pumps	76,500 G.P.M.
8 pumps	82,500 G.P.M.
*9 pumps	86,000 G.P.M.

2. 183-B Filter to Clearwell (during most adverse conditions)

**11 $\frac{1}{2}$ filters	75,000 G.P.M.
----------------------------	---------------

3. 183-B Pump Room to 190 Storage Tank

5 pumps	88,600 G.P.M.
6 pumps	98,000 G.P.M.

*Only eight pumps are ordinarily available for pumping to the 183-B because of export demand. This test shows that the one additional ninth pump increased the total flow only 3500 G.P.M.

**Only 11 $\frac{1}{2}$ filters are available for process water during the period when separan is used in the treatment process. The $\frac{1}{2}$ filters is used for sanitary water, and no separan is added to this water. Sanitary water cannot be supplied from 183-C during the period that separan is used because the separan is added to the water at two common points -- one for each group of six filters. To isolate one filter would require a complete overhaul of the separan system.

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4. 190-B to Reactor Rear Face By Pump (Aluminum tubes and I&E Slugs)

	<u>40# throttled</u>	<u>Unthrottled</u>
6 pumps	72,000 G.P.M.	74,000 G.P.M.
7 pumps	74,000 G.P.M.	76,000 G.P.M.
8 pumps	75,500 G.P.M.	77,500 G.P.M.

5. 181-C to 183-C

9 pumps	92,000 G.P.M.
10 pumps	101,500 G.P.M.
11 pumps	108,000 G.P.M.
12 pumps	*112,000 G.P.M.

6. 183-C Filter to Reservoir

12 filters	156,000 G.P.M.
------------	----------------

7. 190-C to Reactor Rear Face (Aluminum tubes and I&E Slugs)

10 pumps	94,000 G.P.M.
----------	---------------

A review of the capacity of the various parts of the B Area flow system shows that the 181-B pumping system and the 183-B filter system definitely limit the capacity of the flow system. The filter capacity of the 183-B during the months of May and June is just about equal to the anticipated flow of seven pumps with aluminum tubes and I&E slugs. If it were decided to operate seven pumps unthrottled, there would already be a shortage of water to the reactor. Recent widening of high and low pressure gauge limits almost assures this possibility.

A review of C Area capacities and requirements reveals that C Area can produce an excess of approximately 18,000 G.P.M. of filtered water even after CG-600 and the I&E slugs. The normal capacity of the C Area is presently determined by the pumping capacity at 181-C -- twelve pumps producing 112,000 G.P.M. However, additional water can be supplied to 183-C head house by means of twenty-four inch tie line from 182-B to 183-C. Approximately 6000 G.P.M. can be added to the 183-C through this line. Even with this flow of 118,000 G.P.M., the filter rates of the C filters would be about three-fourths their capacity of 156,000 G.P.M.

*This figure was obtained by extrapolation since only eleven pumps were run during the test.

B. 183-B Filters

1. Capacity of 183-B Filters

Figure one shows the filter rate curves for the two extreme conditions -- the extreme good condition existing in September and October when the water is clear, and the extreme bad condition existing in May and June when the turbidity is at the maximum. The worst condition must be considered as the controlling factor in calculating filter capacity. Using a five hour back wash period, which gives the optimum in filter flow, we have the following computations:

Average flow for five hour period	=	7,400 G.P.M. per filter
Total flow = $11\frac{1}{2} \times 7400$	=	85,100 G.P.M.
Deduct 7.1% for out of service time	=	<u>6,040 G.P.M.</u>
	=	79,060 G.P.M.
Deduct 4.77% for back wash water	=	<u>4,060 G.P.M.</u>
Available flow to clearwell	=	75,000 G.P.M.
Power house use and losses	=	<u>500 G.P.M.</u>
Available flow to reactor	=	74,500 G.P.M.

The above 74,500 figure is based on all filters being in operation at all times and all filters being in good condition. The life of a filter is considered to be from ten to fifty years depending on the care and use of the filter. The filters at B Area are now thirteen years old and are far from being in the best of condition.

2. Loss of Sand in Filters

In August 1955, prior to project CG-558, the proportion of sand and anthrafil was changed in order to increase the flow through the filters. The depth of the sand was decreased to five inches and the depth of anthrafil was increased to twenty-five inches. In the past, anthrafil has been added to the filters every one to two years to replace the amount which was lost during back washing. Ordinarily, no sand was added. Since the increased flow after CG-558, all filters are losing sand through the gravel beds in varying degrees as well as anthrafil from back washing. The south half of number five filter has lost four and a half inches of sand. Several others have lost from one and a half to two and a half inches of sand.

The loss of sand, which is due to the disarrangement of the gravel bed, is dependent on: A) the frequency of back washing, B) the method of back washing, and C) the amount of air in the filter beds.

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The frequency of back washing is dependent on the flow through the filters. The greater the flow the more often back washing is required.

The method of back washing may be improved by experimentation. Experiments completed to date have indicated that any improved method of back washing requires a longer period of time for the back wash procedure. The improved methods include slower opening and closing of valves, shutting off the back wash flow completely at times, and extending the back wash time.

Air is present in the Columbia River water all year round, but for some unknown factor it is more troublesome during the most adverse period of April, May, and June. During this period Separan is added to the water to help in the treatment process, and this Separan forms a layer in the upper portion of the bed effectively sealing it if the bed is not washed often enough. When the head losses go up sufficiently due to this layer, a vacuum is pulled on the bed bringing the air out of the solution and depositing it in the bed. When this air is forced from the filter during the back washing, it comes to the surface in bursts and displaces the gravel leaving holes or depressions. Sand is then pulled down through these holes into the false bottom.

3. Rebuilding 183-B Filters

The best way of combatting this excessive air and reducing the sand loss is by better back wash procedures which require more time and by less frequent back washing. A continued high flow of 7500 G.P.M. through each filter will require frequent back washing of the filters and will make it necessary to rebuild some filters in the near future unless the gravel beds can be stabilized by the addition of small gravel and excessive back washing. The rebuilding of a filter will cost about \$10,000 each.

4. Limited Spare Equipment On Hand

There is limited spare filter equipment on hand such as valves, controllers, etc. If any of this equipment goes bad, the filter must be shut down until the equipment is secured and repairs are made. If one filter needs to be shut down during the adverse period, there would be a shortage of water even with the present flow through the reactor.

5. Unusual High Turbidity of Water

There have been times in the past when certain conditions such as flash floods have increased the turbidity of the river water to the extent that the filter rates have dropped way below the curve shown on figure one. When such conditions

exist, the 183-B filters will be unable to produce sufficient water for the reactors operating at its peak. It may even be necessary for B reactor to shut down until the turbidity is low enough to enable the filters to produce 75,000 G.P.M.

C. Future Outlook of River Water

The long term future outlook of the condition of the Columbia River water is that the water will become progressively more difficult to treat. The Priest Rapids Dam will have a good effect on the turbidity of the Columbia River water in that the lake will clear up the water to some degree. However, this condition will be more than offset by the increase of turbidity, organic matter, and chemical wastes due to cultivation of land, water draining back into the river, and the general growth of civilization.

Past experience has proved that the bad effects of the advance of civilization wins out over the good effects of a dam as far as the condition of the river water. One can only assume that this condition will also develop here in the Columbia River.

D. Increased Flow Through the Reactors

It is very conceivable that the flow through the reactor will be increased in the near future even greater than that permitted by the use of I&E slugs. There are potential changes that might be made to decrease the friction loss through the reactor and thereby increase the flow. When these changes do take place, the present filter capacity will be inadequate for the increased flow.

It is admitted that improvements in the filter operations will also increase the filter rates, length of run between back wash periods, etc. However, it is anticipated that the increase in filter capacity will not keep pace with the increase capacity of the reactor.

E. Savings In Chemical Cost At 183-C Filter Plant

Due to the more modern design of the C filter plant, the rate of alum used at 183-C for water treatment is about twenty percent less than that at 183-B. Operating costs reveal that this decreased cost amounts to approximately \$1.25 per million gallons of water treated. If an average of 10,000 G.P.M. were processed at 183-C and used in the B reactor, a saving of about \$6500 would be realized each year.

F. Increased Production At 183-C Filter Plant

At the present time the 183-C filters are working up to half their capacity while the 183-B filters are being pushed to their limit and are rapidly approaching the end of their life. By

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increasing the production of the C filter plant and reducing the production of the B filter plant by 10,000 to 12,000 G.P.M. all year round, the flow through the individual B filters can be reduced by 1000 G.P.M. Since the life of a filter is dependent on the frequency of the back washing and the frequency of back washing is dependent on the flow through the filters, a reduced flow rate through the filter will extend the period before rebuilding is required and may even make the rebuilding in the near future unnecessary. A reduced total flow through the filters at B will make possible better maintenance which will create a condition of greater reliability for each filter and the filter plant in general.

G. Filtered Water Tie Line Between 183-C and 183-B

Since C Area has an excess of about 18,000 G.P.M., it is proposed to construct a thirty inch steel line between the 183-C reservoir and the 183-B clearwell so that filtered water can be supplied to 183-B by gravity flow from 183-C. Also a twenty-four inch tie line is proposed between the new thirty inch line and the existing south thirty-six inch filtered water header supplying the 190-B tanks. This twenty-four inch tie line will permit pumping filtered water from 183-B clearwell to 183-C reservoir. A motor operated valve is to be installed at the 183-B end of the thirty inch line and a gate valve at the 183-C end of the line. The motor operated valve will be controlled by a float in the 183-B clearwell. A twenty-four inch gear operated cone valve is to be installed in the twenty-four inch line. A reversible flow meter is to be installed in the thirty inch line to permit control of flow and charges between areas.

The difference in elevation of the top of reservoir at 183-C and top of clearwell at 183-B is 21.5 feet. This 21.5 foot head will permit a flow of approximately 24,000 G.P.M. through the 1205 feet of thirty inch pipe with two gate valves. This line will adequately supply 183-B with the required water from 183-C. Since the flow will be by gravity, there will be no extra operating expense.

At the present time there is available in the 185-B and 185-D buildings sufficient surplus pipe and valves to install the line complete. A high spot estimate for removing the material from the 185 buildings and installing the line is \$48,000. A high spot estimate for construction of the line using new materials is \$90,000. A savings of \$42,000 can be realized by constructing the line now with the excess material on hand. The rebuilding of five filters will pay for the line if it is constructed now while the material is available.

H. Additional Benefits Derived From the Tie-Line

There are several additional benefits that can be realized by the construction of the tie line. They are as follows:

1. Greater flexibility in the two systems -- 181 can switch B pumps over to the C system thereby utilizing the 183-C filters to a greater extent.
2. Water from B clearwell could be transferred to C reservoir during shut down conditions at B.
3. The entire water needs at B during a B shutdown could be supplied from C.
4. The entire water needs at B and C could be supplied from B during a B and C shut down.
5. The safety of both reactors would increase since water could be supplied to either or both reactors from either of the two water systems.

I. Alternate Solution

An alternate solution would be to build two or more filters at 183-B and to add additional pumps and transformers at 181-B. This would cost over \$1,000,000 and would not give the flexibility in the system that the tie-line will give.

IV. ACKNOWLEDGEMENTS

The author wishes to express appreciation to the 100-B Power Operations, Project Engineering Operations, W. R. Conley, and K. W. Hess for their assistance in preparing this report.

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- C. Final Report on Investigation of Anthrafil Loss, N.E. Bennowitz, dated September 20, 1957.

B AREA FILTER CAPACITY

Extreme Good Condition
September & October

WATER LOSSES DUE TO BACKWASHING

Length of Run—Hours	% Backwash Water	% Out of Service Time
4	6.05	9.1
5	4.77	7.1
6	3.92	5.9
7	3.33	5.0
8	2.90	4.4
9	2.56	3.9
10	2.30	3.5

Extreme Bad Condition
May & June

HOURS SINCE BACKWASH

FIGURE 1

PROPOSED CROSS-TIE BETWEEN 100 B&C AREAS

UGH!

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APPENDIX D

HI-SPOT ESTIMATE
USING EXISTING MATERIAL NOW ON HAND

CROSS-TIE, 30", 183-B CLEARWELL TO 183-C RESERVOIR AND CROSS-TIE, 24"
FROM EXISTING 36" TO NEW 30" LINE

Excavation and Backfill	\$ 5,200
Concrete reinforcements; 2 ea. at R.R. 5'6" x 12'	2,500
Corrugated steel beneath roadways 3 ea.	1,700
*Pipe installed in place 24", 30", & 42" as available	5,600
Sand cushion 170 cu. yards	1,200
Gasket material	900
Welding, spud in two 24" pieces	300
Enter 2 reservoirs including spool pieces, caulking, etc.	2,300
Entrance into existing 36" and contemplated 30"	220
Bitumastic pipe cover	2,400
*Blank off flanged openings in 42", 30", and 24" pipe including gasket material	1,400
*Transition piece 42" x 30" exists but to cut off and weld into new position	500
Remove existing pipe, valves, etc. from 185 bldgs.	5,600
Valve boxes, 4'x4'x7' deep of reinforced concrete	700
Electrical; conduit, wire, float controls, etc. to motorized valve	400
Meter, 2-way including orifices, air supply line, with canopy etc.	2,000
Equipment Usage	<u>3,500</u>
Sub-Total	\$36,200
Engineering	\$ 5,000
Contingencies	<u>7,000</u>
Sub-Total	<u>12,000</u>
TOTAL	<u>\$48,200</u>

CONST COST

\$ 121,000

*There is insufficient 30" pipe on hand. A portion of the line can be built using 42" pipe which is on hand.

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APPENDIX DHI-SPOT ESTIMATENEW PIPE AND VALVES30 INCH CROSS-TIE, 183-C RESERVOIR TO 183-B CLEARWELL, AND 24 INCH CROSS-TIE, EXISTING 36 INCH FILTERED WATER LINE TO ABOVE 30 INCH LINE

Excavation and Backfill	\$ 5,000
Concrete reinforcements @ R.R. (2)	2,500
Corrugated Steel Reinforcements @ Roadways (3)	1,700
Sand Bed (170 cu. yards)	1,200
Pipe, 30", Black, coal tar enameled, 1205' @ \$26	31,300
Pipe, 24", Black, coal tar enameled, 190' @ \$20	3,800
Valves, 30", Crane, flanged, gear opr. (1)	2,500
Valves, 30", Crane, flanged, motor opr. (1)	3,000
Valves, 24", Crane, flanged, gear opr. (1)	1,950
Entrance into clearwell and reservoir	2,300
Electrial to 30" motorized valve	400
Meter, 2-way including orifices, air supply line, panel with canopy, etc.	2,000
Valve boxes	700
Welding	3,300
Miscellaneous covering (C.T. Enamel) welds, valves, etc.	1,000
Equipment Usage	<u>4,000</u>
Sub-Total	\$66,650
I.M.E.	<u>23,000</u>
TOTAL	<u>\$89,650</u>

END

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