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8 Pages

REVIEW OF DR WATER PLANT DESIGN FOR POSSIBLE EXPANSION

A study of the design of the DR Water Plant made for the purpose of estimating the feasibility of effecting an expansion of capacity has shown the following:

1. The Charles T. Main Company design has incorporated spare spaces and other provisions to permit a relatively simple increase in capacity to 42,000 GPM without undue additional design or procurement being required.
2. An increase in capacity to 44,000 GPM would require considerable re-design of the 183-DR, 190-DR and interconnecting pipe lines, and would incur costs which may be out of proportion to the small increase in flow attained.

In view of the urgency for the completion of the design and construction of this Water Plant, further consideration of an expansion to 44,000 GPM is not recommended.

Problems associated with the expansion to 42,000 GPM are discussed in greater detail below.

The following general assumptions have been made:

1. Normal flow to 105-D will be 32,000 GPM at a pressure of 338 psi measured at the top of the front face riser.
2. Normal flow to 105-DR will be 42,000 GPM at a pressure of 375 psi measured at the top of the front face riser.
3. The steady state shutdown condition as now designed for DR provides 25,500 GPM at 190 pounds at the top of the riser. The addition of two more pumps in the spare spaces provided should bring the total emergency steady state flow to 29,700 GPM at 190 pounds.
4. At an undetermined time after electric power failure the flow to each pile can be reduced to approximately 16,000 GPM, at which flow the high tank check valves are just maintained closed.

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5. At a later time the flow will be reduced to approximately 7,000 GPM per pile. The high tank discharge valves will be maintained closed during periods of this low flow. The necessity for these reductions in flow will be developed later. Consideration should be given to the development of an automatic valve to replace the check valves in the high tank lines to obviate the necessity for this manual operation.

Normal Operation

The capacity of the various facilities during normal operating conditions are as follows:

(1) 181-D

The capacity of the electric pumps in the 181-D pump house appear to be satisfactory under the proposed increased load.

(2) Water Lines 181-D to 183-DR

The adequacy of the two 36" lines and the two 24" 183-DR inlet control valves provided by the present design should be carefully reviewed as it appears that they may be undersized under a condition of single-line operation.

(3) 183-DR

The addition of two additional filters, space for which has been provided by present design, should be adequate for the increased flow. No additional subsidence basin capacity is required. This is based on comments of Sheppard T. Powell on the existing design.

The bulk storage capacity of Ferrisul will be reduced to 27 days at the maximum feed of 60 p.p.m., or 93 days at the average feed of 17 p.p.m. The lime storage capacity will be reduced to 34.7 days at the maximum feed of 20 p.p.m., or 139 days at the average feed of 5 p.p.m. Day storage capacity of lime and Ferrisul will be reduced to 21 and 10.4 hours respectively at the maximum feeds.

During periods of maximum chemical treatment demand, the full capacity of two dry feeders each for lime and Ferrisul will be required. There will be a spare feeder available for each.

The retention time of the flash mixers will be reduced from 11 seconds to 9 seconds.

The storage capacity for silicate and dichromate will be reduced from seven days to five and a half days.

No increase in capacity of 183-DR clearwells should be necessary. The intake and outlet lines and valves for the clearwells have been sized for 12,000 GPM.

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(4) 190-DR

The addition of two new pump sets will be necessary to achieve the higher flow. The DR design has left provision for the addition of these pumps by providing room for building expansion at either end. Steam and electric capacity to power these pumps is available. The water pipes from 190-DR to 105-DR are of sufficient capacity to carry the increased flow under conditions of 4 line operation only. Further study of pump pressure limitations of 3 line operation will be required.

(4) 105-DR

The facilities and piping in the 105-DR valve pit, front and rear face risers, and downcomers are capable of carrying the proposed flow.

(6) Process Sewers - 105-DR to 107-DR

The process sewers are of adequate size to carry the increased flow.

(7) 107-DR

107-DR retention basin has sufficient capacity for the increased flow.

(8) Instrumentation - General

The instrumentation to be supplied by the present design is in general of sufficient range and capacity to cover the proposed additional flow. A more detailed investigation of this subject should be made.

Emergency Condition

During the period immediately following an area-wide electrical failure, it will be necessary to draw down on the water reservoirs until the water flow to each of the piles can be reduced to within the steam pumping capacity. Figure I shows diagrammatically the water demands and the steam-driven pump capacity available shortly after an electric power failure when the water demand of each pile has been reduced to 16,000 GPM.

There are presently installed in 181-D four steam turbine driven pumps rated at 7,500 GPM each. There are no spare spaces available in this building and the addition of any more pumping capacity would be expensive. If it is assumed that the water flow from 181-D be divided as shown in Figure I, the steam pumping capacity of each of the 100-D water plant buildings limits the transfer of water so that the reservoirs are drawn down at the following rates:

182-D	6,000 GPM	- empty in 69 hours.
183-D	4,000 GPM	- empty in 41 hours.
190-D	4,000 GPM	- empty in 31 hours.
183-DR	0 GPM	-

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P. E. Lowe (cont.)

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Under these conditions it will be necessary to further reduce the flow to the piles before any of the reservoirs are drawn down to a dangerously low level. Figure II shows the conditions which would exist with a flow of 7,000 GPM to each pile. Under these conditions the 183-D and 190-D reservoirs can first be replenished and shortly thereafter the 182-D reservoir can be refilled. The above analysis has assumed that all steam turbine pumps in each building have been in service. The unavailability of any of these pumps would make the situation proportionately less favorable.

184-D Boilerhouse

The existing 184-D Boilerhouse as modified by the addition of one boiler will be of sufficient capacity to supply the increased flow as shown on the attached estimate of steam demand. Following is a series of comments on certain of the items appearing on the tabulation.

General

Maximum instantaneous demand is the total of all steam loads which come on automatically with an area failure of electric power and includes certain manually applied loads which might be in service at the time of interruption.

1. Assumes that one steam driven condenser water pump would be operating normally sharing the load with one electric driven pump, and upon electric interruption, the Copes regulator would speed up the steam driven pump to handle full load equal to 10,000 GPM.
2. 3. Pumps put on line by operator.
4. Assumes ten 190-D turbines on line each delivering average of 395 BHP at 2480 RPM, consumption of each 10,000# steam/hour.
5. Assumes one turbine delivering power requirement for a pump operating against shut off and ready to replace one in normal operation.
10. Assumes the new DR electric driven blower is out of service and the two existing steam driven blowers are in normal operation.
- 11,12. Assumes one dryer room is on regeneration cycle and two are drying (one for 105-D and one for 105-DR).
15. Assumes 12 or 14 190-IR turbines on line, each delivering average of 480 BHP at 2660 RPM, consumption of each 8200# steam/hour.
23. Present maximum winter heating load obtained by difference between 195,000#/hour January, 1950, and 120,000#/hour July, 1949, less calculated difference 15,000#/hour in steam required for feed water heating under these conditions. The winter heating obtained by this means includes the difference in line loss.

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24. Additional heating required by new DR water plant for 183-DR and 190-DR taken at one sixth of present heating load maximum.
25. Line loss estimated at approximately 1.5% of steam flow delivered from power house to the area.
26. Steam requirement for 187-DR tanks estimated at full flow from 2 - 3" lines at 30 p.s.i.
27. Maximum instantaneous demand for steam by the 750 KW turbo-generator taken from Mfg. water rate data corresponding to a night time demand of 612 KW. Additional steam of 7,000#/hour under hand control corresponds to addition of one electric driven backwash pump on top of maximum instantaneous demand. Figures assume that the exhaust would be entirely to atmosphere.
29. Estimates for feed water heating steam assumes a summer temperature into the heater of 66°F. and winter temperature of 47°F. The steam requirement will be made up of exhaust from 184-D auxiliary drives and/or live steam makeup.

Joseph H. Black

J. Murphy

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FIGURE I
LONG TIME SHUT DOWN FLOW
16,000 GPM/PILE

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FIGURE II
LONG TIME SHUT DOWN FLOW
7,000 GPM/PILE

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D+DR
Present

		MAX Turbine	MAX Turbine	MAX Turbine	MAX Turbine
		Desired	Load	Total	Desired
Item 182 D					
1	1 Condenser Pump 1000000	9000			9000
2	1 P.H. Supply Pump		4000		
3	1 P.H. Exhaust Pump		2700		
190 D					
4	10 P.H. Pumps F.L.	100000			100000
5	1 Start	5500			5500
6	11 Spectra 100 Tm	1100			1100
105 D					
7	2 Supply Pumps	7200			7200
8	2 Exhaust Pumps	12000			12000
9	10 Turbine Spectra	1000			1000
115 D					
10	2 Circ. Pumps	3600			3600
11	2 Dryer Pumps	3600			3600
12	1 Exp. Turbine	2650			2650
13	1 Air Compressor	450			450
14	1 Vent. Fan	2500			2500
190 DR					
15	12 Turbine Pumps F.L.	100000			100000
16	12 Spectra 100 Tm	1200			1200
105 DR					
17	2 Supply Pumps	7600			7600
18	2 Exhaust Pumps	12000			12000
19	10 Turbine Spectra	1000			1000
20	20 Turbine Spectra	1000			1000
21	1608 Turbine 40 HP @ 40 W.R.	1600			1600
22	1608 D 70 HP @ 40 W.R.	400			400
23	1000000 Turbine 40 HP @ 40 W.R.				1000000
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98	1000000 Turbine 40 HP @ 40 W.R.				1000000
99	1000000 Turbine 40 HP @ 40 W.R.				1000000
100	1000000 Turbine 40 HP @ 40 W.R.				1000000

Steganograph

82. D

D + DR
PERPES

RM. 11. 11. 11.
J. H. BIRCH

Steganograph		Writer	
MAX. Instant. Demand	Disposal. Load	MAX. Instant. Demand	Disposal. Load
9000	4000	9000	4000
4000	2700	4000	2700
100000	5500	100000	5500
1100	7200	1100	7200
12000	1000	12000	1000
3600	3600	3600	3600
2600	3600	2600	3600
2650	450	2650	450
450	2500	450	2500
14 Pages	115000	14 Pages	115000
12 Lines	1400	12 Lines	1400
3600	7600	3600	7600
12000	12000	12000	12000
7500	7500	7500	7500
4600	4600	4600	4600
400	400	400	400
4000	4000	4000	4000
36500	7000	36500	7000
13700	13700	13700	13700
1500	2400	1500	2400
36500	13700	36500	13700
484500	16600	484500	16600

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