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REPORT HDC-2351

This document contains of

13 pages, No.

PILE WATER MODIFICATIONS
AT DR AND H AREAS FOR
INCREASED PRODUCTION FACILITIES

Compiled by
R. K. Andersen

RECEIVED

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300 AREA
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October 4, 1951

THIS DOCUMENT CONTAINS INFORMATION
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*Production
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SUMMARY

A detailed study was undertaken to investigate the feasibility of modifying the front and rear face piping at DR and H Areas to permit increased production rates. This study is in conjunction with a larger investigation concerning methods of increasing plant production facilities.

The results of the subject study indicate that approximately one year would be required for the design, procurement, and delivery of critical materials, and that the estimated construction shutdown time to complete each unit is 50 work days on a three shifts basis. Although the length of time required to perform the proposed construction work is not in line with the planned 30 day shutdown period, it is believed that the 50 days reflected by this estimate is realistic and necessary. A critical material schedule, design schedule, construction schedule and force requirement charts are presented on pages 9 to 13 inclusive.

BASIS OF ESTIMATES

The study involved revisions of front and rear face process piping to provide for a system capacity of 50,000 GPM at an operating pressure of 475 PSI at the top of the riser. This involved use of enlarged (1 inch diameter) flexible connectors, thus requiring new nozzles, new or reworked crossheaders, and a new temperature control system. (No increase in outlet temperature is permitted to obtain higher operating levels).

Critical material schedules were based on the assumption that NPA assistance would be used. Construction schedules assume that all material, adequate manpower, and qualified supervision are available. The number of man days presented by the construction force requirements are those required to do the prescribed items of work and do not reflect any SWP conditions as to the number of craftsmen actually required to perform the work. All labor and materials are estimated on the basis of direct costs. Labor costs for inspection forces, field engineering forces, and supervision above foremen have not been included. A figure of \$3.70 per man hour (or \$30.00 per man day) was used as a direct labor cost.

The process piping design, including a critical material list, design schedule, and manpower chart was prepared by E. L. Reed. The scoping of the construction work, including a construction schedule, manpower chart, and direct cost estimate, was prepared by L.R. Lucas and P. A. Hesselgrave. The section on Estimated Radiation Levels was prepared by P. M. Donelson of the Radiological Sciences Department.

DESIGN ALTERATIONS

The major process piping design changes that are necessary to increase the water system capacity are described below:

Valve Pit DR Unit: The 24" lines, check valves, gate valves and strainers are adequate, the pipes being schedule 80 and the valves 600#. The 36" pipe between the 24" lines and the 36" check valves must be replaced. It is 5/8" thick ASTM A-155 Gr. A steel having a permissible stress of 11,000 PSI, whereas the stress at 475 PSI water pressure is approximately 14,000 PSI. The 36" check valves are 400# A.S.A. rating, with an adequate cold water rating for use at the pressure involved in this application.

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Valve Fit H Unit: The 24" lines, 24" and 16" check valves, and 24" - 36" transition piece are adequate without change. The 24" piping is Schedule 40, 24" check valves 600# ASA, 16" check valves 400# ASA, and transition piece 5/8" 20% stainless clad (304, 316, or 347 on ASTM A-212 Gr. B). Both base material and cladding have ultimate tensile strength in excess of 70,000 PSI.

Front Face DR and H Units: Inlet risers in DR are 36" diameter of 5/8" thick stainless steel (the type used is not available from design or procurement records). The risers are of adequate size for the flow and are believed to be of adequate strength (assuming the material is 302, 316, or 347 stainless). A pressure test at 750 PSI should be performed prior to operation.

Inlet risers in H are adequate at 5/8" thickness without change. The material is ASTM A-212 Gr. B (70,000 PSI T.S. min.) clad with 20% stainless 304, 316, or 347, (85,000 PSI T.S.). The stress at working pressure is approximately 14,000 PSI. Pressure testing at 750 PSI is required.

In order to provide for installation of cross header check valves in 105-DR, it is planned to cut the risers, near the base, rotate them 90° and reweld. It will be necessary to relocate riser fittings other than the cross header takeoffs.

A 4" check valve will be installed at each end of each of the 23 cross headers. Probable location is as shown in the sketch below:

It is believed that check valves can be installed in R without change in the position of the risers. The proposed location is shown below:

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For the proposed design flow in DR and H, a reduction in pressure drop of approximately 16 PSI could be realized by increasing pipe and valve sizes from 4" to 5" in the section between riser and cross header. The additional cost in materials approximates \$40,000. Since amortization by reduced pumping cost would require at least two years, this change has not been recommended.

Average flow per cross header, with 23 headers, will be 1090 GPM, with a maximum of 1.13×1090 or 1230 GPM. This flow occurs only in that portion of the cross header upstream from the first nozzle takeoff. The flow represents a 20% increase in flow and velocity as compared to present H flow and an increase of 45% in pressure drop.

For the specified flow, pressure drops across the process tube assembly are of low enough magnitude to permit operation at 475 PSI at the top of the riser in both DR and H.

Rear Face DR and H Units: In both DR and H, all cross headers will be replaced with new assemblies having larger fittings to accommodate the "enlarged pigtails." All nozzles will be replaced. Flexible outlet connectors ("pigtails") will be installed having cross sectional area equivalent to a 1" diameter tube. Design pressure will be 75 PSI.

Downcomers in DR and H are designed for 50,000 GPM and are therefore adequate for the current practice of using only one downcomer at a time.

CRITICAL MATERIALS

A description of critical materials is presented below; the critical material schedule is presented on page 9.

<u>Item</u>	<u>Material</u>	<u>Quantity per Pile</u>	<u>Delivery</u>
1. Piping (36") Valve Pit to Riser	ASTM A-106 Grade A	6 Tons (DR only)	6 Mos.
2. Check Valves	4" - 400#	46	6-9 Mos.
3. Outlet Flexible Connector	Stainless Bellows - Rubber Covered	2050 (App rox. 8000#)	4-6 Mos.
4. Nozzles, Outlet	Cast Aluminum	2050 (App rox. 20,000#)	6-9 Mos.
5. Cross Headers, Outlet	Sch. 40 Stainless	6.5 Tons	7 Mos.
6. Riser to Header Piping	4" Fabricated Piping	1.3 Tons	4 Mos.

CONSTRUCTION WORK SCOPE

A description of the major steps involved in the construction schedule and a summarized direct cost estimate are itemized below. The close similarity of work to be done at both DR and H areas makes it possible to use the same figures for both units.

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Consideration was given to the possibility of reworking the cross headers in place in comparison to removing and replacing with new cross headers. The latter was selected for the estimate because of the following major reasons:

1. The existing cross header pigtail connections are spaced too closely for any additional openings.
2. Confined space and position of cross header would result in time-consuming work if drilling and welding had to be performed in place.
3. If pigtail connector locations similar to 105-C are used, it would be extremely difficult to drill and weld with the cross headers in place.

Front Face:

1. Install Front Face Risers (far side only).
 - (a) Close 4" cross header valves, disconnect and remove connecting pipe.
 - (b) Close necessary valves in valve pit.
 - (c) (DR Unit only) cut riser near base, rotate 90°, and reweld.
 - (d) Install flanges for new piping accommodating check valves.
 - (e) Install 23 new 600# check valves and reconnect cross headers.
2. Install Front Face Riser (near side only).
 - (2) Duplicate steps of operations as used on far side.
3. Replace 36" piping from base all of risers back to 36" check valves located in process tunnel.
4. Change out 200# pressure monitoring orifices located on front face. This operation is based on two rows of process tubes being down at one time and work will run simultaneously with nozzle replacement on rear face.
5. Preparatory work and clean up.

	<u>Man Days</u>	<u>Labor</u>	<u>Materials</u>	<u>Total</u>
TOTAL	1235	\$37,000	\$72,000	\$109,000

Rear Face:

1. Decontaminate rear face, "D" elevator and appurtenances.
2. Remove concrete plug, small section of roof, and install rigging for removing cross headers.
3. Close valve to cross header (one only) and remove pigtails.

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4. Dismantle cooling loop, overflow, and oil discharge lines. Pipe is to be moved to the sides of the unit to facilitate clearance for removal of cross headers.
5. Remove nozzles, cup tubes and clip off thermocouple wiring (two rows of tubes only).
6. Dismantle gun barrel flanges, remove existing cross header, and replace with new cross header (one only).
7. Install and align new nozzles and check Vanstane if necessary (two tube rows only).
8. Install new pigtails and insert thermocouple elements (two tube rows only).
9. Test assembly (two rows only).
10. Re-install cooling loop, overflow discharge, oil discharge and appurtenances.

	<u>Man Days</u>	<u>Labor</u>	<u>Materials</u>	<u>Total</u>
TOTAL	4000	\$120,000	\$168,000	\$288,000

Instrumentation:

1. Pressure Monitoring System.
 - (a) Rework Panelite gauges (two tube rows only).
2. Temperature Monitoring.
 - (a) Run new duct from Control Room to barrier wall at rear face.
 - (b) Run duct from barrier wall across the top of the rear face of the unit.
 - (c) Run thermocouple tubing from panel to pigtails on rear face.
3. Miscellaneous Instr. (removal and re-installation).

	<u>Man Days</u>	<u>Labor</u>	<u>Materials</u>	<u>Total</u>
TOTAL	2505	\$75,000	\$111,000	\$186,000

Miscellaneous Repairs, Clean-up, Burial and Disposal of Materials:

	<u>Man Days</u>	<u>Labor</u>	<u>Materials</u>	<u>Total</u>
TOTAL	300	\$9,000	\$ 3,000	\$ 12,000

Temporary Construction and Burial Facilities:

	<u>Man Days</u>	<u>Labor</u>	<u>Materials</u>	<u>Total</u>
TOTAL	300	\$9,000	\$ 9,000	\$ 18,000

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Total Construction Cost: Summary of the above operations results in the following total figures:

	<u>Total per Unit</u>	<u>Total for Two Units</u>
Man Days	8340	16680
Labor Cost	\$250,000	\$500,000
Material Cost	\$363,000	\$726,000
Total Cost	\$613,000	\$1,226,000

ESTIMATED RADIATION LEVELS

The following is a summary of the current time limits for discharge area work and an estimate of the radiation level after decontamination. The latter is purely an estimate and not based on actual data.

	<u>Daily permissible time limits in minutes*</u>	
	<u>100-DR</u>	<u>100-H</u>
<u>Time limits at present</u>		
General, on elevator, away from unit above row 40	120	300
Below row 40	60	100
Working on nozzles and pigtails range	9 to 120	1 to 300
average	20	30
<u>Time limits following decontamination</u>		
General, on elevator, away from unit	240	300
Working on nozzles and pigtails	120	150

*Based on an allowance of 50 mrem/day. The Hanford Works permissible limit is actually 300 mrem/week.

General Considerations

1. It is estimated that from three to seven days (24-hour working days) would be required for effective decontamination, depending upon the methods used and the manpower available. Decontamination could be started on previous shutdowns.
2. It is anticipated that time limits would progressively increase as old nozzles and pigtails were removed and new ones installed. Probably an eight-hour time limit would be available at the completion of work, provided other discharge area surfaces were sufficiently decontaminated.
3. It is understood that storage basin cleaning is planned in all areas during the period in question. The loss of the water, which shields the contamination in the discharge chutes, would definitely decrease the time limits available in the discharge area.

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4. Several decontamination agents have been tried by the Reactor Section of the Manufacturing Department, the general effectiveness of which were as follows:

- a. Sandblasting was quite satisfactory in decontaminating the 100-F elevator.
- b. Trisodium phosphate solution and Stoddard Solvent have been effective in removing the oil film from nozzles and caps.
- c. Chromic acid has proved effective in removing the scale from nozzles and caps.
- d. Varsene and soap solution have not proved satisfactory.

It is the opinion of H. A. Laybourn of the Reactor Section, who has had considerable experience in discharge area decontamination, that TSP followed by chromic acid would be the best agents for caps, nozzles, and pigtails, while sandblasting would prove most effective on other surfaces in the discharge area. Mr. Laybourn also feels that a commercial steam-cleaning rig presents possibilities.

It is recommended that actual tests be made to select the most efficient decontamination agents.

5. An investigation might be made into the feasibility of installing a sprinkling system to continuously wash the rear faces for some time previous to the contemplated work.

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CRITICAL MATERIAL SCHEDULE

105-DR Unit

105-H Identical Except Item 1 Omitted

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DESIGN SCHEDULE 105-DR & 105-H Units Individually

ITEM	WEEKS											
	1	2	3	4	5	6	7	8	9	10	11	12
Total Pile Modification	To be furnished by others											
Front Face Piping	To be furnished by others											
Front Face Instruments	To be furnished by others											
Rear Face Piping	To be furnished by others											
Rear Face Instruments	To be furnished by others											
Downcomer	Design not necessary											
Effluent Line	Design not necessary											
Temporary Construction, Burial Grounds, etc.	Design not necessary											

Directive Approval Date

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ESTIMATED FORCE REQUIREMENTS

Based on a 40 Hour Work Week
105-DR & 105-H Units
Individually

Weeks to Physical Completion

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CONSTRUCTION SCHEDULE 105-DR & 105-H Units Individually

PHASE	WEEKS													
	-4	-3	-2	-1	1	2	3	4	5	6	7	8	9	
	-52 Weeks				Required time for pile shutdown									
	Final Cleanup													
Total Pile Modification	To be furnished by others													
Front Face Piping & Piping to Valve Pit					50	100								
Front Face Instruments												100		
Rear Face Piping												100		
Rear Face Instruments					10	30	50					100		
Downcomer	Construction not necessary													
Effluent Line	Construction not necessary													
Temporary Construction, Burial Grounds, etc.		20			50		70			90	95	100		

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ESTIMATED FORCE REQUIREMENTS

Based on a 48 Hour Work Week
105-DR & 105-T1 Units
Individually

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