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NUMERICAL RESULTS OF PRODUCTION TEST IP-326-I,
LOW FLOW CALIBRATION TESTS AT DR AND C REACTORS,
AND OF PRODUCTION TEST IP-395-I,
REMOVAL OF HIGH TANK DISCHARGE LINE STRAINER GATES
AT B, D, AND F REACTORS

By:

J. L. Benson

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September 29, 1961

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NUMERICAL RESULTS OF PRODUCTION TEST IP-326-I,
LOW FLOW CALIBRATION TESTS AT DR AND C REACTORS,
AND OF PRODUCTION TEST IP-395-I,
REMOVAL OF HIGH TANK DISCHARGE LINE STRAINER GATES
AT B, D, AND F REACTORS

Introduction

Low flow calibration tests^(1,2,3) have now been completed at all old reactors as a part of the program⁽⁴⁾ to determine the adequacy* of the old reactor last ditch water backup system more accurately. In addition, the high tank discharge line strainer gates have been removed at B, D, and F reactors⁽⁵⁾ in order to increase the emergency high tank flow rates to the reactors and thereby increase high tank water backup adequacy. The purpose of this document is to list the results of the last two low flow calibration tests at DR and C reactors (calibration test results at B, D, F, and H reactors are listed in reference 7) and to list the increased high tank flow rates that were obtained at B, D, and F reactors when the strainer gates were removed.

Summary

Low flow calibration tests have now been completed at all six old reactors. Results are tabulated and graphed in this document and in reference 7; these graphs accurately depict the various reactor hydraulic resistances as of the dates that the tests were conducted. These data have also been corrected so they can be used to assess high tank water backup adequacy as shown in Table II. High tank discharge line strainer gates have been removed at B, D, and F reactors in order to increase emergency high tank flow rates to the reactors. Several tests have been performed in order to determine the amount of the increases, and the results of these tests are also shown in Table II together with appropriate corrections for use in assessing high tank water backup adequacy.

* The word "adequacy" refers to the capacity of the last ditch water backup system in terms of flow and temperature to prevent boiling in the reactor(s) (sufficient to keep the bulk outlet temperature $\leq 90^{\circ}\text{C}$) in an emergency where BPA power to all reactor areas has been interrupted and the steam supply to one old reactor has been lost.

Discussion**DECLASSIFIED**A. Test Procedures

General test procedures used to obtain the data and results listed in this document are described in references 1, 3, 5, and 6. Detailed procedures covering these tests were written by, and can be obtained from the reactor process engineer.

B. Tabulated Results of DR and C Reactors Low Flow Calibration Tests

The results of the low flow calibration tests at DR and C reactors are presented in tabular form in Table I below and are shown in Figures 1 and 2 as part of the reactor hydraulic demand curves. Compilations and calculations performed in order to obtain these numbers generally follow the methods outlined in reference 7.

C. Tabulated Results of High Tank Discharge Line Strainer Gate Removal at B, D, and F Reactors, and Corrected High Tank Flows for Use in Assessing Water Backup Adequacy

The increased high tank flow rate obtained at B reactor after the high tank discharge line strainer gates were removed was measured directly by stopping all reactor process water flow and measuring the resultant high tank flow rate to the reactor. Increased high tank flow rates obtained by gate removal at D and F reactors were determined by measuring the resultant decrease in high tank discharge line hydraulic resistance. This was accomplished by measuring high tank flows and strainer pressure drops while flushing through the 12 inch drain line downstream of the strainer before the gates were removed and after the gates were removed. Old and new high tank supply curves were then constructed based on data from reference 8; and the intersection of these supply curves with reactor hydraulic demand curves, which were constructed based on data from reference 7, showed the effective increase in emergency high tank flow.

Calculations to obtain water level, water temperature, and error factors needed for converting high tank test flows to high tank flows that would be obtained in an emergency* generally follow the methods outlined in reference 7. For convenience, previous data listed in reference 7 is also tabulated here.

Because of prior test arrangements, the Groves valves in the high tank discharge line piping at DR reactor were closed during the calibration

* The word "emergency" in this document is defined to mean that the BPA power supply to all old reactor areas has been interrupted and the steam supply to one old area has been lost.

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test. Since the Groves valves will normally open in an emergency, a correction has been made on the table as shown to account for the increased high tank flow that would be obtained. This correction was obtained from reference 9. Corrected high tank flows listed in Table II contain no allowances for strainer plugging.

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TABLE I

DR AND C REACTORS CALIBRATION DATA

<u>Item</u>	<u>DR Reactor on 5/19/61</u>			<u>C Reactor on 8/22/61</u>			
	<u>Full High</u>	<u>Normal</u>	<u>Full High</u>	<u>Full High</u>	<u>Normal</u>	<u>Normal</u>	<u>Normal</u>
	<u>Tank Flow</u>	<u>Cold High</u>	<u>Tank Flow</u>	<u>Medium</u>	<u>Low</u>	<u>Cold High</u>	<u>Cold High</u>
	<u>Point (Groves</u>	<u>Flow</u>	<u>Point (Groves</u>	<u>Flow</u>	<u>Flow</u>	<u>Flow</u>	<u>Flow</u>
	<u>Valves Closed)</u>	<u>Point</u>	<u>Valves Open)</u>	<u>Point</u>	<u>Point</u>	<u>Point</u>	<u>Point</u>
Near High Tank Flow in GPM	5,935	2,300	---	7,220	4,815	2,885	---
Far High Tank Flow in GPM	7,155	3,060	---	6,420	4,385	2,505	---
Total Flow in GPM	13,090	5,360	79,500	13,640	9,200	5,390	94,200
Near Riser Pressure in PSIG	22.0	7.6	---	12.4	6.48	2.91	---
Corrected to TORP	24.6	10.2	487	17.8	11.93	8.36	383
Far Riser Pressure in PSIG	22.0	7.6	---	12.3	6.48	3.11	---
Corrected to TORP	24.6	10.2	487	18.0	12.15	8.78	383
Average TORP	24.6	10.2	487	17.9	12.04	8.57	383
Corrected to Water Level in Rear Crossover (ΔP_f of Friction Pressure Drop Across Reactor)	18.0	3.9	484	11.3	5.64	2.27	380
Inlet Temperature in °C.	16.5	13.1	13	22	22	22	16.3
Outlet Temper- ature in °C	17.9	16.9	14	23	24	25	17

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TABLE I (Cont.)

Item	DR Reactor on 5/19/61			C Reactor on 8/22/61			
	Full High	Normal	Normal	Full High	Medium	Low	Normal
Tank Flow		Cold	Cold High	Tank Flow	Flow	Flow	Cold High
Point (Groves	Low Flow	Flow		Point (Groves	Flow	Flow	Flow
Valves Closed)	Point	Point		Valves Open)	Point	Point	Point
Near Strainer							
ΔP in PSIG	3	0	---	4	2	1/2	---
Far Strainer							
ΔP in PSIG	6-1/2	1	---	5	2	1	---
Crossheader							
ΔP in Inches		70 &					
of H ₂ O	Full Scale	90	---	Full Scale	142	55	---
Estimated							
maximum error*							
for test in							
% of total							
flow.	$\pm 3\%$	$\pm 4\%$	---	$\pm 2-1/2\%$	$\pm 3-1/2\%$	$\pm 5-1/2\%$	---

* The probable error for each measurement affecting results was estimated, added together, and doubled to obtain the "estimated maximum" error.

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TABLE II

HIGH TANK FLOWS FOR ASSESSING WATER BACKUP ADEQUACY
(No strainer plugging assumed)

<u>ITEM</u>	<u>REACTOR</u>					
	<u>B</u>	<u>C</u>	<u>D</u>	<u>DR</u>	<u>F</u>	<u>H</u>
High tank test flow in GPM	10,755	13,640	10,110	13,090	10,000*	11,900
Test date	3/3/61	8/22/61	8/8/60	5/19/61	9/1/60	9/8/60
High tank flow with Groves valves open	---	---	---	13,490	---	---
High tank flow after strainer gates were removed	10,755	---	11,360		11,100	---
Correction for maximum error in flow measurement	-2%	-2-1/2%	-5%	-3%	-7%	-3%
Correction for difference in reactor outlet water temperature between test and emergency (90°C)	+3%	+2%	+2%	+2-1/2%	+2%	+2%
Correction for difference in high tank water level between test and critical point **	+2%	+5%	+4%	+5%	+2-1/2%	+2-1/2%
Assumed critical point [‡]	4 mins.	4 mins.	4 mins.	3 mins.	4 mins.	3-1/2 mins.
Corrected high tank flow	11,100	14,300	11,400	14,100	10,800	12,100
Normal cold high flow points on test date,						
Flow in GPM	79,000	94,200	80,900	79,500	79,900	78,600
TORP	528	383	565	487	525	512

* This figure was not obtained directly. See reference 7 for analytical derivation of this flow rate.

** See reference 7, page 4 for a definition of the critical point.

[‡] Slightly conservative from a high tank flow standpoint, based on data from reference 4. Do not use to obtain heat decay factors.

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CHANGE DATED 12-14-61

Figure - 1

DR Reactor Hydraulic Demand at 16°C

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CHANGE DATED 12-14-67

Handwritten notes and calculations:

- 2.27
- 5.64
- 9.2
- 11.3
- 13
- 6.4
- 12.2

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