AIM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

MANUFACTURED TO AIM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

(CLASSIFICATION)

DECLASSIFIED

HW-69530

HANFORD TECHNICAL RECORD GENERAL ELECTRIC

SERIES AND COPY NO.

DATE

May 11, 1961

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

TITLE

FLOW INCREASE - C REACTOR

XX

RESTRICTED DATA
THIS DOCUMENT CONTAINS RESTRICTED DATA AS
DEFINED IN THE ATOMIC ENERGY ACT OF 1954
TRANSMITTAL OR DISCLOSURE OF
CONTENTS IN ANY MANNER TO AN UNAUTHORIZED
PERSON IS PROHIBITED.

OTHER OFFICIAL CLASSIFIED INFORMATION

THIS MATERIAL CONTAINS INFORMATION AFFECTING
THE NATIONAL DEFENSE OF THE UNITED STATES
WITHIN THE MEANING OF THE ESPIONAGE LAWS,
TITLE 18, U. S. C., SECS. 793 AND 794, THE TRANSMISSION OR REVELATION OF WHICH IN ANY MANNER
TO AN UNAUTHORIZED PERSON IS PROHIBITED BY
LAW.

AUTHOR

W. J. Tupper

ISSUING FILE

THIS DOCUMENT MUST NOT BE LEFT UNATTENDED WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS
TO IT. WHEN NOT IN USE, IT MUST BE STORED IN AN APPROVED LOCKED REPOSITORY WITHIN AN APPROVED
GUARDED AREA. WHILE IT IS YOUR RESPONSIBILITY AND UNTIL YOU HAVE OBTAINED A SIGNED RECEIPT FROM
THE ISSUING FILE, IT IS YOUR RESPONSIBILITY TO KEEP IT AND ITS CONTENTS WITHIN THE LIMITS OF
YOUR PROJECT AND FROM ANY UNAUTHORIZED PERSON. ITS TRANSMITTAL TO, AND STORAGE AT, YOUR PLACE
OF RESIDENCE IS PROHIBITED. IT IS NOT TO BE DUPLICATED. IF ADDITIONAL COPIES ARE REQUIRED,
OBTAIN THEM FROM THE RELATED ISSUING FILE. ALL PERSONS READING THIS DOCUMENT ARE REQUESTED
TO SIGN IN THE SPACE PROVIDED BELOW.

ROUTE TO:

PAYROLL NO.

LOCATION

FILES ROUTE
DATE

SIGNATURE AND DATE

RECORD
COPY

Indefinite Retention

Disposal Date

Authority

Authority

MASTER

54-3000-340 (3-57) AEC-GE RICHLAND WASH

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

(CLASSIFICATION)

DECLASSIFIED

DECLASSIFIED

-1-

HW-69530

This document consists
of 9 pages. No.
of 23 copies.

FLOW INCREASE - C REACTOR

W. J. Tupper

REACTOR MODIFICATION DESIGN
FACILITIES ENGINEERING SECTION

May 11, 1961

Classification Cancelled and Changed To

DECLASSIFIED

By Authority of RM Allen

CG-PR-2 2-28-94

By J E Saurly 3-4-94

Verified By DK Hanson 3-17-94

Classified by: H W Heacock

DECLASSIFIED

DECLASSIFIED

-2-

HW-69530

FLOW INCREASE - C REACTOR

DISTRIBUTION

1. E. R. Astley
2. J. H. Brown
3. W. J. Ferguson
4. W. D. Hamilton
5. A. K. Hardin
6. C. E. Harkins
7. H. W. Heacock
8. R. T. Jaske
9. R. T. Jessen
10. T. H. Lyons
11. A. R. Maguire
12. F. J. Mollerus
13. R. S. Peterson
14. R. W. Reid
15. D. L. Renberger
16. G. J. Rogers
17. W. C. Royce
18. W. Seeburger
19. W. J. Tupper
20. F. W. Van Wormer
21. W. W. Windsheimer
22. D. F. Watson
23. H. A. Zweifel

DECLASSIFIED

-3-

HW-69530

FLOW INCREASE - C REACTOR

INTRODUCTION

At the request of B-C Maintenance Engineering, this study was initiated to investigate the feasibility of replacing the 190-C and 105-C process water flowmeter orifices with venturi tubes. Specific aspects of the problem studied were potential flow increases, accompanying production increases, costs, and the ability of the existing 190-C pumps and motors to provide the potential flow increase.

SUMMARY AND RECOMMENDATIONS

Replacement of the existing flowmeter orifices at 190-C and 105-C with Dall Flow Tubes or similar low loss differential producers, will result in a process water flow increase of about 1200 gpm. This flow change should increase plutonium production by about six kilograms per year, valued at \$196,000. The total cost of the proposed modification would be about \$140,000, which would be compensated for by increased production in about 0.7 year.

Although the 190 pump motors are now operating close to their maximum horsepower limit, it appears that they can safely supply this small increase in flow.

In view of the large value of the potential production gains in relation to the cost of the proposed modification, it is recommended that project action be initiated to replace the flowmeter orifices at 105-C and 190-C with flow tubes.

DISCUSSION

System Revision

At present a flowmeter orifice is installed in each 18-inch pump discharge line at 190-C and also in each of the six 24-inch process water headers at 105-C. The system arrangement is shown schematically in SK-1-4959. The 190-C orifice plates are sized to produce a pressure differential of 331 inches of water at 12,000 gpm while those at 105-C are sized to produce a differential of 464.4 inches of water at 19,000 gpm.⁽¹⁾ It is calculated that 45 percent of the 190 orifice differential and 54 percent of the 105 orifice differential is permanently lost. Replacement of the orifice plates with venturi type differential producers would greatly reduce this permanent loss and result in a lower system flow resistance. For a standard venturi tube the permanent loss would be reduced to about 12 percent of the differential. For a low loss flow tube, the permanent loss would be only about 3 percent of the differential. Since it appears that flow tubes would be somewhat less expensive than standard venturis, it was assumed that flow tubes would be used.

For all calculations in this study it was assumed that the differential to be produced by the flow tubes would be 150 inches of water at 19,000 gpm at 105, and 100 inches of water at 12,000 gpm at 190. These values were recommended by W. D. Hamilton in reference (1) and are consistent with the differentials in use for process water flowmeters in areas presently equipped with venturis. Since about 97 percent of the differential developed will be recovered, the flow increase calculated for the proposed modification would be relatively unchanged even if a significantly higher differential were eventually selected.

To install the flow tubes it was assumed that the following procedures would be used. At 190, the pump discharge line would be cut off upstream of the existing orifice flanges, a new flange would be welded on, the weld stress relieved, and the flow tube bolted in place. At 105 it was assumed that the short lengths of pipe between the orifice flanges and main header check valves would be replaced with shorter prefabricated sections. Thus, no cutting or welding would be required in the 105 pipe tunnels for flow tube installation.

It is estimated that all five flow tubes on one side at 190 could be installed during a 48 hour outage. During the same time the three flow tubes on the same side at 105 could be installed. Since the entire job could be completed in two successive 48 hour outages, and since this replacement should offer negligible interference with other outage work, no outage time chargeable to this work should be required. If no 48 hour outages are conveniently scheduled, the work could be further subdivided and completed in four 30 hour outages.

Flow Increase

Characteristics of the process water system with the existing orifices and with the proposed flow tubes are shown in Figure 1, Data for the pump curves were obtained from reference (2) and modified slightly to agree with the more recent test data in reference (1). Data from reference (1) and (3) were used in calculating the system curves for present operating conditions. The system curves for expected conditions following the planned reactor modification and water plant expansion were calculated from data in references (1) (3) and (4). As is apparent from the curves, under present conditions, with either nine or ten pumps, a flow increase of about 1200 gpm can be expected from the proposed flow tube installation. An increase of about 1400 gpm over that otherwise obtainable would be possible with 11 pump operation following completion of the expansion program. Although not shown in Figure 1, similar calculations were completed for orifice replacement with standard venturi tubes. In this case the flow increase to be expected under present conditions was about 1100 gpm.

190-C Pump Motor Load

At present the 190-C pump motors operate close to their winding temperature limit, particularly during the summer months. A limit of 3,660 horsepower based on motor winding temperature limits has been established for these motors. A 1,200 gpm flow increase as proposed would mean an increase in average pump motor load of 20 horsepower with nine pump operation. The motors should be able to handle this small increase without exceeding limits (5). However, as shown in Figure 1, the motors would be very close to maximum horsepower limits.

DECLASSIFIED

-5-

HW-69530

If, as now planned, 190-C begins ten pump operation soon, all motors will be well below maximum horsepower limits, both with present orifices and with proposed flow tubes. Similarly, with eleven pump operation following the expansion program, no problem with maximum horsepower limits should occur.

Justification

C Reactor is expected to begin operating on bulk outlet temperature limits shortly and continue so, either on a year-around basis, or for most of the year. While on bulk outlet temperature limits, a 1.25 percent flow increase as proposed would result in a 1.25 percent plutonium production increase. Using a present C Reactor annual plutonium production of 492 kilograms (4) as in the Plant Improvement Program Sustaining Case, the proposed modification would give an annual production increase of 6.1 kilograms. Using a value of \$32 per gram (\$50 per gram minus U-235 burnout charges and metal fabrication and processing costs), this additional production is worth \$196,000 per year.

A preliminary cost estimate for replacing the flowmeter orifices with flow tubes is \$140,000. This includes an allowance of \$1,000 for necessary instrumentation changes. The cost of the proposed modification would be repaid by increased production in about nine months.

Alternate Modifications

An appreciable process water flow increase could be achieved by replacing the existing orifices with larger orifices. However, this should be done only after consultation with the flowmeter manufacturer, as too great an increase in the ratio of orifice diameter to pipe diameter would reduce flowmeter accuracy below an acceptable level. The flow increase to be gained, and so the incentive for making an orifice change, is of course dependent on the maximum orifice size which can be installed. If the orifice diameter to pipe diameter ratio could be increased to 0.8, a flow increase of 600 gpm would result. Since the cost of orifice changing is estimated to be about \$7,500, the resulting production increase would pay for the cost in about one month.

If this orifice change were made, the potential production increase from a later replacement with flow tubes would be reduced by one-half, but would still pay for the cost of replacement in about 1.4 years. Since project action would not be required for installation of larger orifices, it could presumably be completed sooner than flow tube installation, and because of the short payout periods involved there could be justification for an early change of orifice plates followed by later installation of flow tubes.

Two suggestions have recently been made concerning the orifices in the 190-C pump discharge lines. One suggestion was to remove all of these orifices, while the other was to remove the orifices from six pump discharge lines, leaving four in service. The first proposal would give a flow increase of about 500 gpm, while the second would give about 300 gpm additional flow. However, any pump without a flowmeter orifice would have to be operated on manual control, and of course there would be no direct indication of individual pump flow. It is possible that the operational disadvantage of these changes would outweigh the potential flow gains.

DECLASSIFIED

-6-

HW-69539

REFERENCES

1. HW-69202 Process Water Flow Tests - C-Reactor, W. D. Hamilton, April 11, 1961, Secret
2. HW-60816 190-C Pump Capacity, D. F. Watson, June 22, 1959, Secret
3. HW-68499 100-C Water Plant, J. D. Agar, February 20, 1961, Secret
4. HW-68075 FY-1963 PA&C Budget, Reactor Modification Program, 100-C Area, M. H. Schack, February 22, 1961, Secret
5. Personal communication, F. J. Mollerus, Principal Engineer, Electrical.

DECLASSIFIED

-7-

HW-69530

COST ESTIMATE

24-inch Flow Tubes - 105-C

Fabrication	\$ 40,000
Installation	10,700

18-inch Flow Tubes - 190-C

Fabrication	28,000
Installation	<u>17,300</u>

Total Construction Cost	96,000
-------------------------	--------

Construction Supervision	5,000
Contingency	25,000
General Overhead	3,000
Management Services	6,000
Design	<u>5,000</u>

Total Project Cost	\$140,000
--------------------	-----------

NOTES:

1. Work to be performed by CPFF contractor during scheduled reactor outages.
2. Dall flow tube inserts to be purchased, welded into short, flanged, sections of pipe, and bolted into place.
3. At 105-C, header piping between orifice flanges and check valves to be replaced with two flanged, prefabricated sections, one containing the new flow tube.
4. At 190-C, a section of piping upstream from existing orifice flange to be cut out, a new flange welded on, and new flow tube assembly bolted in.

PUMP TDH AND SYSTEM HEAD - FT.

FIG. 1

DECLASSIFIED

HW-69530

SK-1-4959

NO.	DESCRIPTION	REV.	BY	DATE	APP'D	DATE	REF. NO.	REFERENCE DRAWINGS
1	REVISIONS							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

CHECKED DATE 12/1/61 SCALE NONE DESIGNED BY DATE 12/1/61 DRAWN BY DATE 12/1/61 PREPARED BY DATE 12/1/61		COMMENTARY DATE APPROVED FOR CONST. DATE APPROVED FOR PURCHASE DATE APPROVED FOR DESIGN DATE NONE		U. S. ATOMIC ENERGY COMMISSION MANFORD ATOMIC PRODUCTS OPERATION CENTRAL ELECTRIC PROCESS WATER PIPING STUDY 105-C 7000 SK-1-4959	
---	--	---	--	---	--

DATE

FILMED

8/8/94

END