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REAR FACE PARKER FITTING REAMING

by

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December 6, 1960

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December 13, 1960

O. C. Schroeder, Manager
Manufacturing Operation
1704-H Building, 100-H Area

- Reference; 1) Letter, O. C. Schroeder to R. T. Jessen, "Rear Header Parker Fitting Reaming," dated November 11, 1960.
- 2) HW-67713, "Rear-Face Parker Fitting Reaming," by L. B. Brinkman and J. P. Corley, dated December 6, 1960.

I am forwarding the attached document which constitutes a review of our technical position. Based on these findings, we recommend that the reaming of rear-face fittings be given further study and review. Certain intermediate steps can be taken now which will permit some flow increases (2 - 3 percent), but the attainment of the full advantage will require improved pigtails, crossheader expansion joints, and possible minor modifications to effluent piping, solutions for which will not be available for general use before July 1, 1961.

We are continuing on the preliminary engineering of the interim flow increase program, hopeful that we can achieve the potential returns. We will initiate project action upon your request.

Manager
Facilities Engineering Operation

RT Jessen:RTJ:dgm

cc: RT Jaske
WW Windsheimer
RT Jessen-2

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REAR HEADER PARKER FITTING REAMING

Ref: Letter, O.C. Schroeder to R.T. Jessen, same subject, November 11, 1960.

INTRODUCTION

Certain questions have been asked as to the possibility and timing of rear face Parker fitting reaming. It is the intent of this document to answer the questions that can now be answered, to point out the remaining unknown areas, and to give an estimate of the time required to resolve these unknowns sufficiently for planning purposes.

Piping in the old reactors has deteriorated to the extent that an increased rate of component failures can be expected even without increased flows. A number of piping modifications and replacement items have been budgeted. It is not the intent of the discussion below to rule out the need for any such modifications or replacements, but simply to point out those areas where such need will or will not be affected by the proposed reaming.

It cannot be too strongly stressed that our analysis of these problems is applicable only at the current bulk temperature limit of 93.5 C. Considerable evidence exists of rapidly mounting problems with increased bulk temperature above the current limits.

SUMMARY

1. Although a full reactor job procedure has not yet been prepared, techniques and equipment used in a current production test are adequate with minor modifications for full reactor Parker fitting reaming. With existing reactor hardware, available flow increases at B, D, and F Reactors would be limited to about 2,500 gpm.
2. The extent of additional rear face piping problems which may be encountered as a result of reaming cannot in several instances be predicted with confidence at this time. It is expected that preliminary answers to currently foreseen problems will be available by April 1, 1961. To some extent, however, this is dependent on production tests under way or proposed, and will require coordination with various Manufacturing Operations. For vibration and flow problems in the down-comer approach piping, conclusive answers may not be available before July, 1961, although there is no positive evidence that the flow increases cannot be absorbed.
3. Increased pressurization of effluent line junction boxes at 105-D has been solved by improved box venting. Increased flows resulting from reaming may require still greater venting capacity, which would be available for capital expenditures on the order of \$3,000 - \$5,000 per area.

DESCRIPTION OF WORK DISCUSSED

Results discussed below are based upon expected individual reactor flow rates of up to 90,000 gpm. This is expected to be available from a combination of reaming Parker fittings and installing flexible pigtails. Until the flexible pigtails become available, interim reaming of the B, D, and F Reactor rear face Parker fittings could be utilized to achieve a flow increase of about 2,500 gpm. In this case, the cross-header fittings would be reamed to an I.D. of about 0.535 inches for helical (duPont type) and to about 0.610 inches for J-2 pigtails. The nozzle fittings would be reamed to about 0.535 inches for both types.

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DISCUSSION

1. Timing - Procedures and Equipment

In the opinion of the Equipment Development Operation, the equipment used in the limited production test at 105-F⁽¹⁾ is sufficiently proved to be considered adequate, with minor modifications, for full-pile work. Estimated procurement time is three months for the necessary assemblies (six) for a full-reactor effort; the earliest probable availability date at present is, therefore, April 1.

Although the reaming technique is fairly well resolved, no full-reactor job procedure has been prepared. This can be done whenever requested by Manufacturing.

2. Rear-Face Piping Problems

Potential problems now foreseen are listed below.

a. Rear Pigtail Connections

The present J-2 type pigtails are not satisfactory even for present flows. Recommendations have been made by FES to replace the J-2 pigtails with the helical type as an expedient until a flexible pigtail is tested and approved. Since the helical pigtails have proven to be more trouble-free than the J-2 type, the replacement of J-2 pigtails as needed with the helical type will improve the maintenance situation even with moderately increased flows. The flexible type pigtail, due to its increased diameter, will be more compatible with the reaming program and permit greater flows than either the J-2 or the helical type.

To insure satisfactory connections, the reaming procedure should be aimed at a particular pigtail design; current development work on reaming has been aimed specifically at a J-2 pigtail connection. The equipment and technique are applicable to various fitting diameters and could be used on fittings for helical pigtails. Without further development of a satisfactory adapter, however, the reamed diameter at the crossheader fitting would be limited to about 0.535 inches as compared to the 0.610 inches proposed for this fitting with a J-2 pigtail. The reamed diameter of the nozzle fitting is limited to the smaller size in both cases. The limitation on the crossheader fitting diameter arises as a result of the decreased surface area available for the flared metal-to-metal seal, and the increased probability of bending the tip of the fitting into the flow stream when drawing the pigtail up tight. Development of a satisfactory adapter would require three to six months, and is not currently scheduled.

With the flexible pigtail now under development, larger fitting diameters will be possible, since fitting adapters will be used that can be modified to make a different type of seal with reamed fittings. If the rear-face Parker fittings are reamed at an earlier date to the smaller diameter, another reaming will be necessary to take advantage of expected future water plant capacities.

(1) HW-64854 (Secret), "Production Test IP-318 E. Reaming of Rear-Face Parker Fittings", P. A. Carlson, P.B. McCarthy, and A. Russell, dated June 1, 1960.

b. Mechanical Strength of Reamed Crossheader Fittings

The reduction in metal thickness at the threaded section of the fitting creates an area of more concentrated stress. Tests on unused fittings⁽²⁾ indicate adequate mechanical strength at this section after reaming to 0.610 inches. However, before full-scale reaming is attempted in any reactor, it may be appropriate to remove an existing crossheader for metallurgical examination and have the fittings reamed and tested for strength. Removal of this crossheader (after suitable interim steps) is authorized in PT-IP-352-AE⁽³⁾ which has been proposed but not approved as yet. This program of examination and testing can be accomplished in three months after approval of sufficient outage time is available. The work procedure for the reaming of the Parker fittings should also include a procedure for replacing any unusable fittings on the crossheader.

c. Cavitation at the Crossheader Fittings

Cavitation now occurs in many of the crossheader fittings⁽⁴⁾. This is due in large part to critical flow at this location with central zone tubes. Tests with sufficiently enlarged fittings on the 189-D tube mock-up⁽⁵⁾ indicate that critical flow will not exist at present or moderately increased flows at current maximum tube outlet temperatures. Elimination of critical flow in the header fitting would not be expected with a reamed diameter of 0.531 to 0.535 inches associated with the existing helical pigtails. The production test at 105-F, which calls for complete reaming of one crossheader, should be completed to confirm the improvement expected with reaming to 0.610 inches. Current indications are that sufficient shutdown time to do this will not be made available before January. Results will, therefore, not be available before March.

d. Crossheader Stresses

Both low and high frequency vibrations have been measured on the crossheaders. The primary exciting force for the high frequencies is believed to be the cavitation at the fittings discussed above. The low frequency vibration is attributed to bowing of the crossheaders from thermal expansion, and is a contributing factor in the potential failure of the crossheader-riser connection⁽⁴⁾. Eventual elimination of this problem is expected from the provision of flexible couplings and center clamping of the crossheaders. A test installation⁽⁶⁾ is tentatively scheduled for January at 105-H provided material is delivered in time. Results should be available by May 1.

- (2) HW-64310 (Unclassified), "Reamed Rear Face Parker Fittings", P.B. McCarthy, dated March 17, 1960.
- (3) HW-66339 (Unclassified), "Production Test IP-352-AE, Rear Face Piping Examination", J.H. Hoage, et al.
- (4) HW-65269 (Secret), "Existing Reactor Rear Face Piping Review", D.F. Watson, et al, dated May 25, 1960.
- (5) HW-63756-1 (Conf.-Undoc.) "Laboratory Determination of Normal Operating Flow Rates with Enlarged Outlet Fittings - B,D, and F Reactors", E. D. Waters, dated February 2, 1960.
- (6) HW-66650 (Unclassified), "Production Test Authorization PT-IP-356-AE, Rear Crossheader Expansion Joints", J.H. Hoage and O.E. Adams, dated September 14, 1960

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For the immediate future or until new pigtails and expansion joints are installed, it may be desirable to accompany any increase in reactor flow resulting from reaming with a corresponding decrease in outlet temperature in order to avoid aggravation of the existing stress problem. A definite recommendation in this respect cannot be given until results of a full crossheader reaming at F can be evaluated. Timing of this is dependent upon available shutdown time as discussed above.

e. Vibration in Risers and Crossover Lines

Some evidence exists of large amplitude vibration on the downcomer approach piping at H and DR. Measurements, however, are limited and not completely consistent with visual observations. Additional vibration measurements are planned to better define the magnitude of the problem and to determine whether it exists at other reactors. Results are expected to be available by March 1, 1961. It is probable that the over-all increase in reactor flow through reaming, provided no further increase in bulk temperature occurs, would not appreciably increase the probability of structural damage.

f. Flow restriction in Crossover Lines and Elbows

This problem is currently under analysis by Research and Engineering. Theoretical analysis is expected to be completed by March 1, at which time we expect to be able to predict the effects of the increased flow with more confidence. However, final confirmation by model tests (Contract DDR-95) is not expected before July 1, 1961. Data from 105-DR and limited data from 105-D indicate that pressures in the crossover line are much more sensitive to temperature than to flow in the current bulk temperature region.

g. Vapor Emission from Downcomer Vent

The increased flow expected from reaming should result in more air entrainment, reduced pressure on the downcomer lid, and consequently less vapor emission from downcomer vent provided current bulk temperatures are not exceeded. The problem is interrelated, however, to the flow phenomena in the crossover elbow. A final answer may not be available pending completion of the model tests mentioned above.

h. Downcomer Hydraulic Capacity and Pressures

Previous model tests and current data indicate that with the trays as now perforated, no problems of capacity or ~~low~~^{high} pressure will exist for the minor flow increases expected from reaming.

3. Effluent Line Pressures

With the increased flow, somewhat greater air entrainment is expected, and additional venting capacity at B and D will probably be required. Currently, satisfactory venting of the junction box in the D effluent line was accomplished at an equivalent expense of about \$3,000; costs of the same magnitude should be adequate to improve venting capacity in both areas if required by increased flows.

ACKNOWLEDGEMENTS

Information contained in this document is based not only on the reference material, but also on personal contributions of a number of FES personnel, especially P.B. McCarty, P.H. Hutton, W.W. Porter, J.M. Fox, Jr., and J.H. Hoage, as well as A. Russell, L.C. Lessor, S.S. Jones of Research and Development, and E. D. Waters of HLO.

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