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TITLE

INCREASED COOLANT FLOW FOR H REACTOR

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INCREASED COOLANT FLOW FOR H REACTOR

By

I. L. Huffman

IRRADIATION PROCESSING DEPARTMENT

October 23, 1963.

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Introduction

The purpose of this letter is to outline the immediate and long-range plans for increasing the H Reactor coolant flow.

Summary

The flow can be increased immediately from the present base of about 84,000 gpm to about 88,000 gpm via the following changes:

1. Routine purges.
2. Use of non-bumpered fuel.
3. Increasing the flow through Fringe enrichment and Fringe Poison tubes by changing orifices.
4. Reaming damaged rear fittings to their original size.

The flow can be increased to about 94,000 gpm via the following changes:

1. Installing larger Venturis throughout the reactor.
2. Reaming rear fittings to a larger size.
3. Installing rear nozzles that permit higher tube flows.
4. Charging I&E Poison elements in Fringe tubes.
5. Some changes in the water pumping facilities may be necessary.

Discussion

The following action can be taken immediately to increase the coolant flow at H Reactor.

1. Purge - The purge pumps are being readied for routine purges of the process tubes with diatomaceous earth. It is estimated that routine purging could increase the flow by an average of 400-500 gpm. This would increase the total flow from the present base of about 84,000 to 84,500 gpm.
2. Non-Bumpered Fuel Elements - The use of smooth fuel has begun (about 470 tubes). The resultant flow increase appears to be about 400 gpm. In January, 1964, essentially all tubes will have been charged with smooth elements; another 1000 gpm increase is expected. This will bring the total flow to about 85,500 gpm.

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Discussion (Continued)

3. Fringe Enrichment Tubes - There are 145 fringe enrichment tubes that are equipped with large orifices instead of Venturis. Their flow is about 35 gpm each. Their orifices can be replaced with regular-sized Venturis (.310"), giving them the same flow as other Venturied tubes (45 gpm). Assuming that 60% of the apparent flow increase would be an actual increase to the total flow, an increase of 870 gpm would result. This would bring the total flow to 86,370 gpm.
4. Fringe Poison - Row 1 (30 tubes) is charged with solid Li-Al elements and the tubes are equipped with large orifices; their flows average about 33 gpm. The other 140 Fringe P tubes are charged with the same material but have smaller orifices; their average flows are about 25 gpm. The 140 tubes could be re-orificed with large orifices and the resultant flow increase would be about 700 gpm. The total flow would be about 87,070 gpm.

The logic used to arrive at the foregoing conclusion (that all Fringe Poison tubes can operate with large orifices) can be taken a step further. Tube 2355 has been charged with solid Li-Al elements since about May 1963. The tube has been equipped with a regular .310" Venturi during its entire operating period. Its flow has been 40 gpm. No deleterious effects have been observed as a result of the relatively high flow with a solid Li-Al charge. Therefore, it is concluded that all Fringe Poison tubes can be equipped with Venturis, and that their flows will be increased accordingly. The row 1 tubes could produce an additional 120 gpm (30 x 7 x .6) and the other Fringe Poison tubes could produce an additional 1360 gpm (140 x 15 x .6). The total flow would then be increased to 87,850 gpm.

5. Other - The rear Parker fittings can be reamed to their original size on about 200-300 low-flow tubes; this would provide an additional 150-250 gpm. Long rear spacers (3/4" aluminum pipe) used in all tubes could provide a 25-50 gpm increase. About 10 tubes are under-orificed compared to the master plan; correcting these variances could provide another 50-100 gpm. The total gain from these miscellaneous improvements would be about 200-400 gpm., and the total flow would be about 88,000-88,200 gpm. The average tube flow would be about 44.2 gpm.

If the foregoing improvements were made during or before the January 1964, outage, and if no further improvements were made, the 1964 production would be about 525-530 units.

Very significant flow increases can be made in addition to those previously discussed. However, before these changes can be made, outside assistance will be necessary to obtain test data, to plan the precise changes to be made, to prepare design changes and to expedite the procurement of equipment.

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Preliminary studies indicate that a total flow of about 94,000 gpm can be obtained. The changes necessary to obtain this flow would be directed toward equalizing and maximizing the flow through all active process tubes. The thermal loop (filtered water) contributes over 1200 gpm; therefore, the process water through process tubes would be 92,800 gpm. There are 1988 cooled process channels. An average flow of 46.7 gpm through all tubes would yield the 92,800 gpm, or a total coolant flow to the downcomer of 94,000 gpm. The average tube flow through the 1673 Venturied tubes is currently about 45 gpm, ranging from 42 gpm to 48 gpm. Since this is close to the desired average flow, it can be seen that most of the flow equalizing and maximizing must be done in the fringe tubes.

The changes that are necessary to obtain the desired total flow are:

1. Remove the present Venturis and orifices from all tubes (including the Fringe Poison tubes) and replace them with larger Venturis. This would eliminate the need for installing normal Venturis and/or orifices in fringe tubes as discussed previously in paragraphs 3 and 4. The exact size of the larger Venturis will have to be specified by Research & Engineering.
2. Remove the rear nozzles and connectors from all tubes and ream the crossheader Parker fittings to a larger size. This will eliminate the need for maintenance reaming as discussed previously in item 5. The optimum amount of over-size reaming will be determined by Research and Engineering and/or other engineering organizations.
3. Nozzles, connectors and adaptors with improved flow characteristics will be re-installed. At present, it appears that an inventory of nozzles removed from a K Reactor can be modified for re-use on the rear of H Reactor. The exact modifications will have to be specified by engineering organizations.
4. The 170 Fringe Poison tubes are presently charged with solid Li-Al target elements. It has already been proposed that these tubes should be re-charged with I&E target elements. Flow tests are being run to determine the behaviour of the lighter elements with high flow rates. The precise I&E charge that can be loaded will be specified by R&E.

Recharging the Fringe Poison tubes with I&E elements would increase their flow about 5 gpm per tube; the total flow would be increased from 88,000 to 88,400 gpm. Preliminary flow studies indicate that the foregoing major hardware changes (Venturis, rear nozzles and fittings) could increase the flow by as much as 6,000 gpm, bringing the total flow to over 94,000 gpm. If this flow could be attained during the January 1964 outage, the production for the year would be about 550 units.

This assumes an additional week of outage time for work associated with the change.

It does not appear likely, however, that all preparations can be made before the January outage to accomplish the major changes. Therefore, the changes would not

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be made until the outage in April 1964. An interim program is advisable to accomplish those changes that will produce the greatest results in the shortest time. The following program is presented for immediate execution during unscheduled outages:

1. All orifices currently installed in the reactor will be removed and replaced with .310" Venturis. This will be done when unscheduled outage time and manpower are available. The solid Li-Al elements in the Fringe tubes will not be disturbed until all problems are solved relative to the use of I&E elements.
2. Purging with diatomaceous earth will be started as soon as the purge equipment is ready. The frequency of purging will be determined from the results obtained.
3. The charging of smooth fuel elements will be continued as previously decided unless the rupture frequency increases past the break-even point.
4. The program of reaming rear Parker fittings on low-flow tubes will be continued as available outage time and manpower permits.
5. The study on the use of long rear spacers will be continued on a low priority basis. Their use will be initiated when and if the uncertainties have been resolved.

All parts of the interim changes should be started promptly. However, it is realized that a review of the plan may raise questions or problems that require further resolution. Therefore, the installation of the Venturis in the Fringe Poison tubes will be delayed until about mid-November to permit a thorough review and concurrence by the recipients of this letter.

I. L. Huffman
Analyst
H Processing Operation
H REACTOR OPERATION

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END