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REORIFICING PROPOSAL
D REACTOR

by

P. J. Hollifield
Process Engineering Unit
Process Technology Subsection
Research and Engineering Section
IRRADIATION PROCESSING DEPARTMENT

MASTER

October 19, 1962 *dx*

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October 19, 1962

J. T. Baker, Manager
D Processing Operation
D-DR Reactors Operation

REORIFICING PROPOSAL

INTRODUCTION

The single 0.239 inch orifice currently used in the fringe (O3) zone at D reactor operates very close to minimum operating pressure (MOP) permitted by Process Standard A-050, Section 50.03.

To avoid violating the MOP requirement, it has been necessary to install two solid aluminum pieces in the downstream dummy pattern on a number of fringe tubes. This practice, although adequate for meeting limits in isolated cases, becomes increasingly difficult to administer and requires additional outage time since these tubes are necessarily handled as specials. Further more the potential for inadvertently operating with cavitation is increased. As OIII elliptical bumper fuel with lower hydraulic resistance is charged, the problem will become progressively worse.

The approach to alleviate this problem is to mechanically raise Panellit pressures--hence base pressures-- of the O3 zone tubes by installing a calibrated flow restriction uniformly throughout the affected zone instead of charging solid aluminum pieces into individual tubes as they are required.

RECOMMENDATIONS

It is recommended that a secondary 0.361 inch diameter orifice with taper upstream be installed into the existing orifice cages on all O3 zone tubes. To offset the flow loss caused by addition of the secondary orifice, it will be necessary to install an additional 40 venturis. The venturis would be added primarily along the sides and in the corners of the existing fringe zone pattern.

The 0.239 primary plus 0.361 secondary orifice combination is compatible with the present natural fuel charge and with the proposed OIII natural fuel with elliptical bumpers.

DISCUSSION

In arriving at a satisfactory solution to this problem, the hydraulic characteristics of several flow measuring devices were considered. These were:

1. A "B" reactor double orifice.

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2. A "DR" reactor double orifice.
3. Use of 310 venturis.
4. A 0.361 secondary orifice.

Cases 1 and 2 would permit operating further from the MOP limit by 65 and 60 psi and reduce tube flow by about 2.0 and 3.0 gpm respectively. In both cases, the assemblies achieve critical flow first in the secondary orifice or almost coincident with primary orifice critical flow, hence the more restrictive low trip, i.e., before reaching critical flow in the secondary orifice, would control.

The third case, use of 0.310 venturis entirely would result in a significant flow increase exceeding what is believed to be the present water plant capacity.

Of the three cases which retain the use of a fringe orifice, adding a secondary orifice to the current primary orifice, appears to be the best solution for the present charge and the hydraulically less restrictive OIIN elliptical bumper fuel which will be available in the near future.

On the average, the 0.361 secondary orifice will restrict flow about 1.5 gpm per tube and permit operating further from MOP by about 45 psi with a 32-piece OIIN elliptical fuel charge and standard downstream dummy pattern. Addition of the secondary orifice will not change Panellit procedures in effect now, but will eliminate the necessity of charging solid aluminum pieces in the downstream dummy pattern.

In order to cancel the effect of restricting flow in the orifice pattern, about 40 additional tubes adjacent to the existing orifice zone must be equipped with 0.310 venturis.

The total reactor flow including loop header after the proposed reorificing and venturi addition will be 87,600 gpm with the present fuel charge and approximately 88,700 gpm when the benefits of OIIN elliptical fuel are fully realized. This flow is what could be pumped through the reactor based upon its hydraulic resistance and should be attainable based on past experience at flows in this range. The D water plant has provided flows in excess of 88,000 previously but changes in the hydraulic resistance (new tubes, bumper fuel, etc.) have gradually reduced flow to the present 87,600 gpm. Installation of the third stage impellers in the 181 river pumps will increase flow to the DR water plant and should allow some reduction in the filtered water export to the DR side.

Production of elliptical fuel has proceeded somewhat slower than originally expected and beneficial use, i.e., any significant flow increase, is not expected before April, 1962.

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It should be noted that a certain hydraulic flexibility is inherent in the

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method of reorificing and adding venturis which will permit approaching the water plant capacity as closely as is desired. The installation of 40 additional venturis with the present fuel charge will not exceed the water plant capacity. As elliptical fuel is charged in place of regular bumper fuel, the flow increase will be gradual and may be stopped at any point by removing a compensating number of venturis.

No formal schedule for installation of the secondary orifice will be presented here. Instead it is recommended that outage time availability and procurement be the governing factors. The process engineer will provide a list of tubes to receive secondary orifices each outage and will supplement this list with compensating venturi changes to maintain bulk flow.

It is recommended that this letter be followed by an appropriate design change to be initiated by D Processing Operation.

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