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SUBJECT: Feed Pump and Purge Water Flow Measurements

TO: S. E. Beall

FROM: P. H. Harley

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It is felt that flow metering of diaphragm pumps on the HRT is a desirable objective. A reduction in flow is the first warning the operator gets of pump gas-binding, check valve trouble or changes in the phasing of the pumps. Knowledge of the flow rates is also necessary for making heat and material balances in the system. The signals from the flow-meters proposed herein can be made to annunciate low flow.

In the HRT mockup three types of " ΔT " flow meters have been used satisfactorily. It is recommended that two of these types be used in the HRT to measure the feed pump rate, the pressurizer and the circulating pump purge water flows.

For the feed pump, preliminary tests for a direct reading flow meter have been made using the Feed Pump Test Loop #1. The flow meter consists of thermocouples on the inlet and outlet of the cooling water and process fluid of the heat exchanger between the dump tank and the feed pump. The cooling water flow was kept constant and measured by a Potter Flowrator.

Results of the preliminary tests are plotted in Figure 1. A straight line relationship exists between feed pump rate and the ratio of the cooling water ΔT to the process liquid ΔT .

A calculated heat balance showed a maximum deviation of 5.0% and an average deviation of 2.48% for the ten points taken.

In these tests the temperatures were recorded and actual pump flow measured by a rotometer. However, instruments are on order which will convert the ratio of the two ΔT 's to an electrical signal which can be calibrated to record the flow directly.

In the mockup, the ΔT 's are recorded and the flow determined from a graph.

The purge water flows to the mockup circulating pump and pressurizer are measured by recording the ΔT of the liquid flowing through a 1 KW and a 1.5 KW wrap-around type electric heater for the respective flows. The calculated flow and measured flow versus ΔT of the purge water for the two heaters are shown in Figures 2 and 3.

Also, in Figure 2, a plot of purge water flow versus ΔT is shown for a 12 in. long steam jacket on the line to the circulating pump. The steam meter was calibrated from the electrical flow meter using 12 psig steam pressure in the jacket.

The electric flow meters give more reproducible flow measurement but for the HRT operation the steam jacket would be satisfactory. Flooding the HRT during shut down would not damage the steam jacket and also there would be no danger of burning out a heater. However, constant steam pressure and proper steam trap operation is necessary for good results from the steam flow meter.

P. H. Harley
P. H. Harley

PHH: job
Attachments

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Pulsefeeder Flow

Flow - GPM

□ Calculated - Heat Balance
 ○ Measured - Refonometer
 Cooling Water - 1 gpm

$$\frac{\Delta T_{\text{cooling water}}}{\Delta T_{\text{process water}}}$$

Fig. 1

Circulating Pump Purge Flow

□ Calc Flow - Electric
○ Measured Flow - Electric
△ Measured Flow - Steam
Electrical curve for 330 watts
Steam curve for 12 psi steam

Flow - GPH

KE 20 X 20 TO THE INCH 359-10 1/2 G
KEUFFEL & ESSER CO. MADE IN U.S.A.

Fig. 2

Pressurizer Purge Flow Electric Heater

□ Calculated Flow -
○ Measured Flow
Curve for 1570 watts input

Flow - GPH

20 X 20 TO THE INCH 359-10 1/2 G
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Fig 3