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TITLE

PRODUCTION TEST HP 326-I

LOW FLOW CALIBRATION TESTS AT THE OLD REACTOR

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IRRADIATION PROCESSING DEPARTMENT

June 20, 1960

PRODUCTION TEST IP-326-I:
LOW FLOW CALIBRATION TESTS AT THE OLD REACTORS

OBJECT

The purpose of this test is to establish the reactor hydraulic flow vs. pressure demand curve in the low-flow regions of around 4 - 10,000 gpm.

BASIS AND JUSTIFICATION

Recent changes in reactor hydraulic characteristics and increases in power levels have necessitated a review of the capabilities of the water backup systems. As a result, several trip-out tests have been run in order to determine the reactor flow decay when power is lost to the reactor and to determine the reactor flow capabilities of the water backup systems. These tests are usually run by monitoring the changes in the TORP and converting this to flow later by means of a flow-pressure reactor characteristic curve. These curves are adequate at the normal

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high flows and pressures; however, in the critical low-flow regions of around 4 - 10,000 gpm or where the high tank-export water supply system is operating, the flow-pressure reactor characteristic curves are not accurate enough. This occurs because the curve flattens out at low flows and an error of a pound or two in the TORP could cause an error of 10 per cent or more in the total reactor flow. Since this is a region of critical interest, an accurate low flow-pressure calibration test is needed to obtain the most accurate flows for the pressures monitored on previous and future tests.

TEST DETAILS

A. Low Flow Calibration Test

This test should be run after the reactor has been down for at least 20 hours and will consist of a drawdown test on the two high tanks. The drawdown test would consist of two parts, one at the maximum flow rate obtainable and the other at a flow rate of about 4,000 gpm. While the test is being run, water should be available immediately, if needed, from the export line capable of supplying at least 3,000 gpm, and one or more 190 steam pumps capable of supplying at least 15,000 gpm to the pile (a TORP of 40 psig will give about 15,000 gpm).

Instrumentation would consist of accurate high tank water level indicators, calibrated Heise gauges at all desired points, accurate TORP indicators, four calibrated crossheader differential pressure indicators located in the control room, and temperature indicators on the inlet and outlet water. An accuracy of 1% in the flow rate will be the criteria used in setting up instrumentation. A detailed test procedure will be written by the reactor process engineer; however, in general this would be:

1. Set up all required instrumentation and communication during the outage so the test will be ready to start when the reactor has been down 20 hours.

Clean the high tank strainers thoroughly. Bleed water through the high tank if necessary to keep the temperature of the water below 20°C.

2. Insure that the export line is flushed, that the Groves valve is checked for operability, and that sufficient pumping capacity is available as specified above. Also insure that an emergency water supply from one or more 190 steam pumps is available for immediate (within 30 seconds) use if needed, as specified above. All 190 electric pumps should be shut down.

In the unlikely event that water supply to the reactor drops below 2,000 gpm anytime during the test, flow should be restored from the 190 Building or the export line immediately. If flow stops completely or if there is possible steam formation, the 15,000 gpm standby in the 190 Building should be restored immediately since it will be sufficient to sweep out steam. Make sure valving to the reactor is normal and no caps are removed.

3. Valve off both high tank Groves valves (at DR and C only), and the sensing lines to the raw water Groves valve's pilot valve. Set up

the pilot valve for fast manual operation if needed as specified above. The four crossheader ΔP gauges set up in the control room should never be allowed to drop below a reading of 40 inches during the test; this corresponds to a tube flow of about 1-1/2 gpm which will be ample cooling 20 hours after shutdown. A man should also be stationed at the raw water Groves valve. If export line flow is needed at any time the assigned man should be notified to open the valve immediately.

4. Gradually reduce normal water supply to the reactor until the high tanks cut in, and then shut off the normal reactor supply as quickly as possible while maintaining maximum reactor flow from the high tanks. This will be 6 - 11,000 gpm depending on the reactor.
5. While this is being accomplished, the 25 hottest tubes in the pile should be monitored continuously on the cornpopper to insure that no tube temperature goes above 60°C. Any temperature above 60°C at any time during the test will require that the test be stopped and that flow be restored immediately.
6. When the water levels in the high tanks have dropped down to the straight portion of the tanks, start stop watches and take accurate readings at time zero. Readings should include both high tank levels, TORP's, bulk inlet and outlet temperatures, and crossheader differential pressures. Maintain the maximum flow rate by switching strainers if the ΔP across them exceeds 5 psi anytime during the test. Repeat readings listed above at one minute time intervals and continue the test until about 200,000 gals. of water has been drained (this will take about 20 to 30 minutes).
7. Then carefully throttle the high tank flow on both tanks equally until the total flow is about 4,000 gpm. When this is done, restart the stopwatch and take accurate readings at time zero. Maintain the TORP at a steady value and take readings in two minute time intervals. Continue the test until about 200,000 gals. more has been drained. (This will take about 50 minutes.)
8. After the final readings are obtained, the reactor should be returned to normal immediately and the high tanks should be refilled as rapidly as possible.

HAZARDS AND PROCESS STANDARDS

A. Low Flow Calibration Test

Process Standard A-080.01 specifies that one full or two half full high tanks be maintained during shutdown; however, this test authorizes draining the high tanks below halfway. The test will use up about 500,000 gals. of the 600,000 gal. capacity of the tanks. The rest will still provide about 25 minutes of flow to the reactor at the final flow rate established in the test. Also, adequate backup will be provided by either automatic or manual operation of the raw water Groves valve and by standby flow immediately available by manual operation of the 190 control room steam pumps master air controller switch (which will provide full flow in about 30 seconds).

A flow of about 4,000 gpm will be maintained during the lowest flow portion of the test. Actually 2,000 gpm will be sufficient to keep the pile well cooled 20 hours after shutdown. Monitoring for the unlikely event that flow is stopped or inadequate will be done with the 25 hottest tubes on the cornpopper, by monitoring TORP's, by the bulk outlet temperature and by four crossheader differential pressure indicators. Any indications of inadequate flow on any of these instruments will be sufficient cause to stop the test and restore flow from the 190 Building and/or the export line. If there is any suspicion that steam has formed in the pile, the standby flow available in the 190 Building will be sufficient to sweep out steam.

The standby flow available in 190 Building will be 15,000 gpm at about 40 psig TORP, and an export line flow of 3,000 gpm will also be available. 2,000 gpm is sufficient cooling 20 hours after shutdown and flow can be stopped completely for about 3 1/2 minutes before boiling would start.

SCHEDULE

This test should be run at the next outage at 105-D. The results will be used to check calibration curves obtained by theoretical calculations. If good agreement is obtained, one or two verification tests at other reactors may be required; however, if there are differences which cannot be resolved, further tests at most of the old reactors may be required. This Production Test authorizes the initial test at D Reactor; further tests can be authorized by a simple supplement referencing this document.

This procedure can also be used to run at least the maximum high tank flow point (if it has not already been done) before any reactor runs the high tank cleaning Production Test* and again after cleaning to check the results of the cleaning process and to re-establish high tank back-up adequacy.

COSTS

This Production Test authorizes a maximum of two hours of downtime.

The costs associated with the installation and use of the special instrumentation by Plant and Industrial Engineering Sub-Section will amount to approximately \$2000 for this test and will be borne by Process and Reactor Development Sub-Section.

All other costs incidental to running the test such as the installation of four crossheader Δ P gauges in the control room will be borne by D Processing Operation.

RESPONSIBILITIES

D Processing Operation

Will be responsible for scheduling and running the tests, for assuring that the tests are run safely, and for obtaining some of the required data.

Process Technology Sub-Section

Will be responsible for writing detailed test procedures, for coordinating the tests, for assuring that the tests are run safely, and for publishing the numerical results of the tests.

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Process and Reactor Development Sub-Section

Will be responsible for assisting in determining test requirements and for integrating the test results into the over-all water back-up studies being conducted.

Plant and Industrial Engineering Sub-Section

Will be responsible for providing the necessary instrumentation for, and obtaining high tank water level measurements and TORP's during each test.

D Power Operation

Will be responsible for assisting in valving operations and for providing immediately available water back-up to the reactor during the test.

J. L. Benson

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IRRADIATION PROCESSING DEPARTMENT

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