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PRODUCTION TEST IP-245-A

DUAL AREA TRIP-OUT OF B & C REACTOR PROCESS PUMPS

This document consists of 8
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Series A.

This document classified by:

P. Thompson

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PRODUCTION TEST IP-245-A
DUAL AREA TRIP-OUT OF B & C REACTOR PROCESS PUMPS

The objectives of this test are to obtain current knowledge of the flow characteristics of the B and C Reactor flow systems under various transient conditions that have a reasonable probability of occurrence. These tests will be used to reevaluate (1) the B and C Reactor bulk temperature limits, (2) the Ball 3X low pressure trip settings, and (3) quantitative adequacy of emergency flow from the combined high tanks - export system.

BASIS AND JUSTIFICATION

Changes in reactor flow characteristics and operating levels have out-dated B and C Reactor flow decay data. These data are used for determining (1) bulk effluent temperature limits, (2) Ball 3X riser pressure trip settings and (3) whether emergency water supply from the combined high tanks - export system is adequate.

Power level advancements which result in closer approach to tube boiling during transient flow conditions after BPA electrical failure require more accurate knowledge of this reactor flow transient.

No experimental high tank or export flow data are available for C Reactor. The adequacy of this system depends upon the flow capacity of the high tank strainers and the temperature of this high tank water. This test will determine the flow adequacy of the high tank and export system. Temperature measurements and/or additional tests will determine the adequacy of this high tank export flow during the summer months.

At the C Reactor, fine mesh screens (32 mesh) are installed in both the crossheader screens and the high tank strainers. This is considerably finer than the equivalent 8 mesh opening of the process tube flow annulus and means that these screens are the most restrictive part of the flow system. It is important to establish that even with this more restrictive system (other reactors have larger strainer screens) the C Reactor back-up system can provide adequate reactor cooling to prevent a severe reactor incident upon loss of reactor area pumping power.

The power supplies for B and C electric process pumps are closely related and interdependent by their being supplied from the same busses. Tripping only one reactor's pumps would require special equipment, risk tripping the other area's pumps if they were operating and would not give data similar to the transient flow conditions that exist after BPA electrical failure. For these reasons, combined B-C Area trip-out-tests are proposed.

PROCEDURE

Test Instrumentation: The following instrumentation will be installed and checked prior to the actual test performance:

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1. 190 Buildings - Visicorder or equivalent high speed recorders will monitor actuation of power loss relays in the 190 Building branch of each reactor's safety circuit. A 60 cycle timing signal and a signal that power has been tripped in the 151 Building will be included with recorded data.

In addition, at 190-C only, pump speed of one far-side and one near-side process pump will be monitored on the high speed recorder.

2. 151 Building - Visicorder or equivalent recorder at the 151 Building will provide sufficient monitoring of bus conditions that energy loss by pump-flywheel-motor complex to loads other than process water pumping can be ascertained.

3. 105 Buildings -

- A. A calibrated Heise gauge at each Control Room will be set to read average pressure from reactor supply risers.
- B. An electric timer supplied by stable 60 cycle source and two signal lights at each Control Room will be mounted in such position that they can be included in photographs of the Heise gauge used for these tests. One signal light will be set to go on the instant the power is tripped in the 151 Building; one set to go on the instant IXX relay contacts open in the #1 Safety Circuit.

Performance of the Tests: A summarized description of the desired tests is given here. More complete procedures for conducting the tests will be provided by Process Engineering Operation and B-C Power Operation in accordance with provisions of this Production Test.

Test I: (Should be performed just before Test II).

1. With C Reactor down at least 19 hours and B Reactor down for at least one hour, full normal flow will be supplied to the reactors from the maximum number of electric pumps available for service (9 or 10 at C; 7 or 8 at B). Motor current limitations will not be exceeded.
2. Emergency water supply equipment (high tanks, steam turbines and export) will be set for automatic operation (as it would be during reactor operation). The B Reactor high tanks and export line will be tested and flushed just prior to this time. The C Reactor high tanks and export line will be left unchanged.
3. After initial riser pressure, reactor flow and pump speed data, etc., is obtained, a coordinator at 151 Building will start a count-down. Recording instrumentation, timers and cameras will be started, and when the count is completed, BPA power at the 151 sub-station will be separated from the B-C Reactors and Water Plants.

The emergency bus will continuously maintain power from the 184 Building turbo-generators to supply power for instrumentation and necessary lights.

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Test I (Continued)

4. Reactor flow and pressure will be allowed to decay according to pump flywheel characteristics until all flow is provided automatically by steam driven pumps. At this point, final riser pressures and total flow data will be obtained.

Test II

1. B Reactor must be down for at least two hours; C Reactor for at least 20 hours.

After steady state data are obtained at the end of Test I, six electric pumps at B and eight at C will be restarted as power is made available from BPA supply. Valve off water supply to high tanks at C Reactor.

2. Riser pressures and reactor flows will be raised to maximum obtainable from that number of pumps, with two or three brief pauses at spaced intervals to obtain data correlating riser pressures to reactor flow.
3. With high flow restored to B and C Reactors, the emergency steam turbines at the C Water Plant will be placed on manual control. They will be de-activated in such manner that they can quickly be placed back into service if needed.

To avoid warping turbine blades, a small flow of steam will be left on the turbine supply lines. Test will be so coordinated that the turbines will be sub-normally cooled no longer than 10 minutes prior to Step 4.

4. Disconnect the 151 power to B and C Reactors and Water Plants as in Step 3 of Test I.
5. B Reactor will decay down to flow from 7 steam pumps, C Reactor process water flow will be allowed to decay according to flywheel characteristics until the high tanks come in.
6. When 190-C process pumps no longer are supplying flow to the reactor, the pump discharge valves will be closed and the steam supply promptly restored to the turbines. The pumps will be held on ready stand-by status during remainder of high tank and export test, with continuous manual coverage.
7. At C Reactor high tank flow will be allowed to decay until export water comes in and flow data obtained with the reactor at steady flow supplied by the export system. Test will be terminated by increasing reactor flow with steam or electrically driven pumps.
8. Since high tank flow decay will be relatively slow, photographic recordings of pressures will be terminated when rate of flow decay permits accurate logging of visual pressure and flow readings.

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HAZARDS

Since both reactors will have been down specified lengths of time before the BPA outage tests are performed, there is no danger of a gross reactor incident. At the C Reactor, flow from any one of three sources (each high tank or the export line) will be adequate to prevent boiling in process tubes and it is unlikely that all three sources would experience severe screen plugging. If so, the 190 Operators will have 20 minutes to provide steam turbine pump flow (3 pumps) to the reactor.

In the unlikely event of unexpected total flow loss during the tests, prompt corrective action can prevent slugs from reaching temperatures which affect subsequent proneness to rupture. In the worst case, slug jacket melting temperatures will not be reached if flow and pressure are restored within the following schedule:

B Reactor 20,000 gpm or 66 psi TORP within 6 minutes.

C Reactor 8,000 gpm or 11 psi TORP within 20 minutes.

As a precaution, the outlet temperatures will be monitored during transient and low flow conditions of the tests. This will be done by fast scanning 20 representative high powered tubes. A tube outlet temperature in excess of 60°C will be cause for terminating that portion of the test and increasing reactor flow.

Direct communications between the 105 and associated 190 Building Control Rooms will be continuously maintained during transient and low flow conditions. Should such communications fail, Power personnel will raise flow to 20,000 gpm for B and 8,000 gpm for the C Reactor.

Filtered and raw water contains some suspended particles. Before reactor start-up, a thorough check of the Panellit systems for tube inlet plugging will be made.

PROCESS STANDARDS

Standard 190-B-070, Process Standards - Water Plant, HW-27155 Rev1.

The requirement that Power immediately restore riser pressure after loss of power to electric pumps during shutdown is waived for performance of these tests. The requirement that riser pressure be maintained above boiling suppression values except when lower pressure is requested by 105 Supervisor is also waived for B Reactor. (C Reactor can maintain required pressure throughout the tests).

Standard A-080, Process Standards - Reactor, HW-46000 B

The requirement that raw water be used to cool the reactor only under emergency conditions is waived for C Reactor during Test II.

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SCHEDULE

The dual-area tests will be performed as jointly scheduled by B-C Reactor Operations and Production Operation. Completion of the tests by April 30, 1959 is requested.

It is estimated that it will require not more than three hours of additional shutdown time at C Reactor and not more than one hour additional shutdown time at B Reactor.

COSTS

In addition to the costs associated with a total of four hours lost production, the following costs are involved:

TABLE I

ESTIMATED OPERATING TEST COSTS

<u>ITEM</u>	<u>CHARGEABLE</u>	<u>APPROXIMATE COST</u>
Additional instrumentation and testing costs.	Reactor Engineering Operation	\$1,500.
General instrumentation at 151 Sub-Station	Water Plant and Utilities Operation	300.
Photographic instrumentation and personnel	Process Technology Operation	150.
Preliminary test of high tanks and import lines plus Project Engineers' services and miscellaneous costs of shutdown time.	B-C Reactor Operation	2,000.
APPROXIMATE TOTAL COST		\$3,950.

RESPONSIBILITY

B-C Reactor Operation: Will be responsible for the detailed scheduling of this test and for operational safety and production continuity of the reactors.

B-C Power Operation : Will be responsible for supplying the required pumping conditions during these tests, maintaining reliable steam supply and steam pump back-up and for detailed test procedures that concern test operations by Power personnel.

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RESPONSIBILITY (Continued)

- B-C Processing Operations : Will be responsible for monitoring tube outlet temperatures during the testing program, maintaining communications and for returning the system to full back-up flow whenever this appears necessary during the test.
- Production Operation : Will be responsible for over-all production scheduling with respect to this test.
- Process Engineering Operation : Will be responsible for observing test preparation, preparing detailed 105 Building test procedures, and the selection of the 20 tubes for continuous monitoring at each reactor.
- Utilities Operation : Will be responsible for performing the actual trips of BPA power from the process pumps and for restoring power to busses as promptly as possible consistent with obtaining good test results and following normal procedures of adding loads to the HAP0 Loop, avoiding establishment of new peak load.
- Project Engineering Operation : Will be responsible for directing test preparations, and for over-all coordination of the test.
- Water Plant and Utilities Engineering Operation : Will be jointly responsible with Reactor Engineering Operation (PARDO) and Process Standards Operation for interpretation of test results and for publishing a test report.
- Reactor Engineering Operation : Will be jointly responsible with Water Plant and Utilities Engineering Operation and Process Standards Operation for interpretation of test results and for publishing a test report.
- Process Technology Operation : Will be responsible for the test procedure being within the broad intent of applicable Process Standards; that deviations from specific requirements, as necessary for these tests, are listed in the Production Test, and jointly responsible for interpretation of test results and for publishing a test report.

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Process Standards Operation
PROCESS TECHNOLOGY OPERATION

S. S. Jones, Engineer
Reactor Engineering
PROCESS & REACTOR DEVELOPMENT OPERATION

JTL:SSJ:gf

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10/21/94

END