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HANFORD ATOMIC PRODUCTS OPERATING DIVISION, RICHLAND, WASHINGTON

DOCUMENT NO.

SEP 21 1955

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September 21, 1959

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PRODUCTION TEST IP-285-C
MEASUREMENT OF OPERATING TEMPERATURES OF
UNCOOLED THERMAL SHIELD COOLING TUBE

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PRODUCTION TEST IP-285-C

MEASUREMENT OF OPERATING TEMPERATURES OF
UNCOOLED THERMAL SHIELD COOLING TUBE

INTRODUCTION

The purpose of this test is to obtain data that may be used as a basis for revising certain Process Standards applying to the cooling of existing reactor shields. The data may also be useful in connection with NPR thermal shield design work. The fact that one of the H reactor bottom thermal shield cooling tubes presently has a flow blockage makes possible an immediate opportunity for test data without undue risk other than that already encountered.

BASIS AND JUSTIFICATION

Shield heat formation and heat transfer calculations, necessarily based on broad assumptions, are usually reliable only for order of magnitude and trend predictions. In order to specify conditions of shield cooling under which the Hanford reactors may be safely and economically operated, therefore, operating data must be available regarding shield operating temperatures as related to the flow of cooling water through the shield. Any measured data of this nature that is now available for the six old reactors was taken several years ago and is therefore not directly applicable to current power levels and operating conditions.

This test is designed to provide measurements of temperature conditions which prevail in an H Reactor uncooled bottom thermal shield cooling tube during operation at present-day equilibrium power levels. The tube to be used for the test is one which

BASIS AND JUSTIFICATION (Continued)

has been totally obstructed during the current extended reactor operating period. It has therefore been subjected to no-flow conditions for a period of several days with adjacent tube powers (process tube No. 0170) in the range of 500 to 525 kw. This shield cooling tube is located near the vertical central axis of the reactor and therefore is well suited for this test. This test authorizes the maintaining of this tube in the uncooled state so that it can be instrumented and observed during the first outage and equilibrium operating period, respectively, following its approval. This condition is considered justified by the following assumptions:

1. The bottom fringe tube powers will not run significantly higher during the time of this test than they have already run while the uncooled situation prevailed in this tube.
2. Therefore, any damage to the thermal shield that may be caused by operating with no flow through the subject cooling tube has already been done; no appreciable additional damage should be caused by isolating this tube from the loop headers and allowing it to remain uncooled for the duration of this test.

Under current operating conditions and present shield cooling standards, flow stoppage in a single thermal shield cooling tube may curtail reactor production. The results of this test may provide a basis for revising the standards to make them less restrictive in this respect.

The outlet temperature of five thermal shield cooling tubes is to be measured incidental to this test. This information will be used to calculate the heat removal rate in various portions of the shield and will allow the results of the test to be extrapolated, with a fair degree of confidence, to other sections of the shield.

PROCEDURE

Operating temperatures are to be measured in an uncooled thermal shield cooling tube by means of a thermocouple assembly which will be installed in the tube. The tube which is to be used in this test (bottom thermal shield tube in line with vertical process tube row No. 70) currently contains an obstruction. The procedure for preparing the tube for the test and installing a thermocouple stringer in it is outlined below:

Preparation of the Tube

1. It is planned that during the next reactor outage the H Reactor maintenance group will clear this obstruction so that there is a minimum of .75" diameter clearance through the tube. In so doing they will isolate the tube from the front and rear loop headers and remove the fittings from each end of the tube.
2. A sizing piece, .75" minimum diameter, will be passed through the tube.
3. The tube will be swabbed to clean and dry it.
4. Following this the tube will be capped on the rear.
5. The fittings will be left off the front of the tube leaving the threaded end of the tube exposed.

PROCEDURE (Continued)

Installation of the TC Stringer

The thermocouple stringer, described below, will be assembled in a wooden trough and will be installed by hand into the tube. (In the event that the TC stringer is not completed in time for installation during the outage, the front of the tube will be shielded for anticipated operating conditions. In this case it is planned that the stringer will be installed during reactor operation.)

Removal of the TC Stringer

At the completion of the test the procedure for removal of the stringer will be as follows:

1. The minimum "cooling-off-period" after reactor shutdown before removal of the stringer is accomplished will be 24 hours.
2. The shielding pieces will be removed from the front of the tube and the cap removed from the rear of the tube.
3. The stringer will then be pushed out the rear of the tube into the basin.

The tube will be pressure tested, reconnected to the loop headers and returned to service

Strap-on Thermocouples

Strap-on thermocouples will be attached to the outlet fittings of the following five thermal shield cooling tubes:

- Tube in line with vertical row No. 71 (bottom)
- Tube in line with vertical row No. 76 (bottom)
- Tube in line with vertical row No. 77 (bottom)
- Tube in line with vertical row No. 72 (top)
- Tube in line with horizontal row No. 24 (far side)

The leads from these thermocouples are to be strung out in a location on the far side of the reactor where they will be accessible during operation, and they will be identified at this point.

COSTS

Direct costs incurred as a result of this test will be charged to cost code 5340-511.61. It is estimated that a total of two hours outage time will be required for this test:

Time required for installing two and removing five strap-on thermocouples	1 hour
Time required for discharging the TC stringer	1 hour

(An additional approximately two hours of time in the discharge area will be required. However, it is planned that this work be done during the time that fog spray equipment is being installed in this location.)

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COSTS (Continued)

Estimated outage manhours required are:

Instrument	4 manhours
Mechanical	1 manhour
Processing	2 manhours

HAZARDS

No hazards to reactor or personnel are anticipated in connection with this test. If it is necessary to install the thermocouple assembly during operation, a strong gamma beam will be expected to project from the open, unshielded end of the tube. Dose rates for the job are not likely to be excessive considering that workmen will be advised not to enter this beam during the course of the work.

RESPONSIBILITY

Research and Engineering Section

Operational Physics Sub-Section (W. L. Smalley) will be responsible for:

1. Coordination of details of:
 - a. Preparation of the cooling tube for the test.
 - b. Preparation, installation, and removal of the thermocouple assembly.
 - c. Installation and removal of the strap-on thermocouples.
2. Collecting, analysis and reporting of data.

Manufacturing Section

H Reactor Sub-Section will be responsible for:

1. Actual preparation of the tube for the test.
2. Returning the tube to service following removal of the thermocouple assembly.
3. Operational safety and production continuity of the reactor.

W. L. Smalley

Operational Physics Sub-Section
Research and Engineering Section
IRRADIATION PROCESSING DEPARTMENT

W. L. Smalley:mwe

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THERMOCOUPLE ASSEMBLY FOR INSTALLATION IN AN H REACTOR
BOTTOM THERMAL SHIELD COOLING TUBE

This TC assembly is designed for installation in an uncooled H Reactor bottom thermal shield cooling tube in order that temperature data may be obtained from this location during reactor operation. The following pieces are required:

<u>Piece Number</u>	<u>Number of Pieces Required</u>	<u>O.D.</u>	<u>I.D.</u>	<u>Length</u>	<u>Description</u>
1	5	.70 in.	.25 in.	6.0 in.	Aluminum TC block
2	1	.70	--	3.0	Aluminum guide piece
3	44	.70	.25	6.0	Aluminum spacers
4	3	.80	.25	6.0	Steel shield pieces
5	3	.80	.25	6.0	Graphite shield pieces
6	1	.80	.25	9.0	Steel shield piece
7	1	.80	--	30.0	Steel shield piece with spiral groove for lead wires

The pieces will be assembled in the following order:

4, 5, 4, 5, 4, 5, 7, 6, 8-3's, 1, 9-3's, 1, 9-3's, 1, 9-3's, 1, 9-3's, 1, 2

Installation in this order will place the thermocouples in the following locations in the tube:

1. Center of the tube
2. 5 feet downstream from center
3. 10 feet downstream from center
4. 5 feet upstream from center
5. 10 feet upstream from center

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