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TITLE

PRODUCTION TEST IP-278-A
SUPPLEMENT A
VERIFICATION OF BPA LOSS BULK TEMPERATURE SURGE
AT THE DR-REACTOR

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R. E. Trumble

January 7, 1960

PRODUCTION TEST IF-278-A

SUPPLEMENT A

VERIFICATION OF BPA LOSS BULK TEMPERATURE SURGE AT
THE DR-REACTOR

OBJECT

To run a second BPA outage test at the DR-Reactor using the same instrumentation and procedure but increasing the trip-out level from 800 MW up to a maximum of 1200 MW.

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BASIS AND JUSTIFICATION

When this test is run in a manner that avoids scrambling the D as well as the DR Reactor the flow decay transient is only half as fast as for the case of a full area BPA outage. This is because of the following circumstances. The method of power trip-out used in the original Production Test and planned for this Supplement involved simultaneously separating the DR-Reactor's pump motors from their buses. This produces an open circuit in the pump motor system and yields a maximum of flywheel energy for pumping. However, in the case of a full area BPA power loss the pump motors will remain connected to their buses for about 30 cycles and will generate power to supply electrical energy to whatever loads these buses contain.

A comparison of the experimental flow decrease has been made for these two cases of power separation from the buses and power separation directly from the pump motors. For electrical trip-out at the motors the flow decreases only one-half as fast during the first second.

In addition to this difficulty with the original Phase III test, there was instrument trouble with the very important riser bulk-temperature measuring elements. Two of these elements were recording at the upper edge of their temperature scale and could not indicate any temperature surge and one was unstable. Thus, only one of four temperature readings was obtained. The unstable element has been replaced and these temperatures will now be obtained on a different recorder in the DR Control Room. The recording traces of these elements will be set to monitor temperatures throughout the range of +10 to -50°C from the trip-point value.

This test will duplicate the original test except that it will be performed from a higher level. This will counterbalance the low flow decay rate obtained by this required test procedure and should give individual tube and bulk temperature surge transients of sufficient magnitude to permit extrapolation with reasonable accuracy to actual BPA outage conditions. (See Table I)

TEST PREPARATIONS

These have been completed for the original production test; it will merely be necessary to confirm that these requirements are still met. The details of the instrumentation requirements and test procedure are presented as an appendix to this Production Test Supplement. Because of the current uncertainties concerning DR-Reactor operation and shutdown dates these preparations are to be brought to a state of completion that will permit running the test 22 to 24 hours after notification to all responsible parties, at any time after January 22, 1960.

TEST PROCEDURE

A summary of the test procedure is presented below, while a detailed procedure is given in the Appendix, to be issued separately:

1. After a preliminary shutdown check of all the test instrumentation the reactor power level will be increased as quickly as allowed from shutdown

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TABLE I

EXPECTED TEMPERATURES FOLLOWING BPA TRIP-OUT

Time After Trip-Out	Reactor Flow (76,000 gpm initial)		Reactor Power Output		Central Zone Temperatures at End of Active Charge ($t_1 = 10^\circ\text{C}$)				Bulk Outlet Temperatures (Rear Risers) ($t_1 = 10^\circ\text{C}$)			
	% Flow (Trip-Out) of DR- Pump Motors)	% Flow (Trip-Out of D-DR Buses)	800 MW	1200 MW	(Experi- mental)**	(Theoretical)			(Theoretical)			
Seconds			Initial	Initial	A	B	C	D*	A	B	C	D
0	100	100	800	1200	62	62	88	88	50	50	70	70
0.5	99.5	97.8	798	1197	62.2	63.2	88.2	89.6	"	"	"	"
1	98.5	96.3	794	1189	62.3	63.5	88.5	90.2	"	"	"	"
1.5	96.8	94.9	782	1173	62.5	63.5	88.7	90.3	"	"	"	"
2	95.2	93.7	765	1137	61.7	62.5	87.5	88.7	"	"	"	"
2.5	94.3	92.6	705	1061	58.8	59.7	83.2	84.5	"	"	"	"
3	92.3	91.8	626	938	54.0	54.3	76.1	76.5	"	"	"	"
4	89.1	89.8	474	711					"	"	"	"
5	87.1	87.2	432	648					"	"	"	"
6	85.5	84.4	334	500					50.2	50.7	70.3	71.1
7									50.3	50.7	70.4	71.2
8									50	50.3	70	70.3
9									48	48.2	67	68

** Result of original Test (P.T. - IP-278-A, Test III)

These four cases represent four ways of running this production test. The conditions represented by these letters are:

A - Original method of power trip-out (separation of motors from their buses: Power Level = 800).

B - Revised method of power trip-out (separation of power from the motor buses: Power Level = 800).

C - Original method of power trip-out at revised power level: 1200 MW.

D - Revised method of power trip-out at revised power level: 1200 MW.

It is evident from this Table that only Method D will yield data that can be transposed to full level normal BPA loss conditions with any reasonable accuracy.

- to 75 percent of full level. (The actual value will depend upon the hours down, and the poison and rod configuration but it will be within the range of 65 to 75 percent of full level total power.) The power level will be maintained essentially constant for 10 to 15 minutes and then the BPA power will be separated from the D-DR buses at the 151 Substation.
2. While the reactor power level is being increased the boiler house steam load will be increased by accelerating seven DR steam pumps and holding at full acceleration during the rest of this BPA trip-out test.
 3. After the trip-out of electrical power the DR-Reactor flow will decay down along the flywheel curves until secondary steam pumps take over the load.
 4. This test will be completed as soon as stabilized secondary steam pumping is obtained, i.e., in about 180 seconds. As soon as possible thereafter at least two electric pumps are to be returned to the process.

PROCESS STANDARDS

The standards pertaining to flow backup requirements will be met or exceeded.

HAZARDS

Effectively, this test is no more hazardous than the test originally approved since the results of the original test indicated a less severe temperature transient than had been expected. This, combined with safety features of accelerated steam pumps, negligible graphite heating, and a decay heat corresponding to approximately 30 hours after reactor shutdown will provide an ample margin of safety for the test. Even if no steam pumps were available, adequate cooling would be obtained during flywheel flow decay down to the high-tanks. These tanks will be flushed prior to the test to ensure their proper operation.

SCHEDULE

These tests are an essential part of the bulk temperature increase program. Their completion is necessary both for the theoretical studies in progress and for the model studies that are scheduled at Washington State University. The instrumentation is to be completed, subject to 22 hours test notice, by January 22, 1960 and this test is to be run not later than February 28, 1960.

In view of the unpredictable nature of the reactor operation with inadvertent shutdowns occurring about as frequently as scheduled outages the following schedule will be followed to complete this Production Test Supplement and the associated original Production Test:

1. Following the date of January 22, the first time the decision is reached to shut down the DR-Reactor in 24 to 48 hours, then the Test II of the original Production Test will be scheduled for completion immediately before the actual shutdown.

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2. In this event, or in the event of any reactor scram following January 22 (scram without prompt recovery) then this Production Test Supplement is to be completed at the time of startup from this shutdown, provided the D-Reactor is down at this time.
3. If inadvertent scrams prevent the completion of Test II of the original Production Test past the date of February 28, then a scheduled reactor shutdown will be made two weeks following the last scram before this date of February 28, and this test will be made just prior to this scheduled shutdown.
4. At the time of this scheduled shutdown it will be possible to also complete the D-DR BPA outage test scheduled for these two reactors.

COSTS

This test will be run at the end of the shutdown following the completion of Test II of the original Production Test (HW-61456). Under these conditions the costs should be minimal. In addition to 2 hours of lost production, the following test costs are expected:

PRODUCTION TEST COSTS

<u>No.</u>	<u>Item</u>	<u>Responsible Unit</u>	<u>Code</u>	<u>Approximate Cost</u>
1.	Obtain test data on special I & E outlet temperature elements.*	Irradiation Testing	5320.53	\$100
2.	Obtain test data on development strain gages.	Materials Development	5320.53	50
3.	Obtain test data on test strain gages.	Radiographic Testing	5330.56	150
4.	Photographic data of front riser pressure and VSR rod drop.	Photography	5330.56	200
5.	Obtain test data on effluent system pressures.	Reactor Plant Engineering	5320.53	200
6.	Determine pump flywheel speed decay.	Instrument Development	5330.56	100
7.	Determine zone temperature monitor temperature decay.	Instrument Development	5463	75
8.	Obtain comparative tube outlet temperature data.	Instrument Development	5463	100

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* This test authorizes the charging of 5 replacement I & E outlet temperature elements when the original tubes are discharged.

RESPONSIBILITY

D-DR Power Operation: Will be responsible for supplying the required pumping conditions during these tests, maintaining reliable steam supply and steam pump backup and for detailed test procedures that concern water plant operations.

D-DR Reactor Operation: Will be responsible for scheduling this test and for operational safety and production continuity of the reactor.

DR- Processing Operation: Will be responsible for shutdown scheduling of the test, for obtaining usual reactor data, maintaining communications with Power and Electrical Utilities during the testing period and for returning the system to normal after completion of this test.

Instrument Development: Will be responsible for monitoring a DR- process pump speed decay, the change of the power rate meter, and for obtaining a comparison between the 5 special I & E element temperatures and the regular tube outlet temperatures on these tubes, provided adequate equipment and manpower are available.

Irradiation Testing: Will be responsible for monitoring the outlet temperature of the five special I & E tubes.

Materials Development: Will be responsible for monitoring the 6 development strain gages installed on the effluent piping.

Process Engineering: Will be responsible for observing test preparations, preparing detailed reactor operations test procedures, and obtaining non-recorded test data.

Production Operation: Will be responsible for fitting this test into the IPD overall production schedule.

D-DR Power Operation: Will be responsible for general coordination of this testing program.

Radiographic Testing: Will be responsible for monitoring all the other effluent system strain gages not monitored by Materials Testing and for submitting a report of the test results.

Reactor Engineering: Will be responsible for technical coordination of the testing program, for interpretation of the test results and for publishing a test report.

Reactor Plant Engineering: Will be responsible for monitoring all the effluent system pressures, the downcomer bulk temperatures, and for submitting a detailed report of the results obtained.

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