OSTI
INV
89

HW-25902

This document consists of
7 pages, No 28
28 copies, Series a

RECEIVED
300 AREA
CLASSIFIED FILES

1. R. R. Bloomstrand
2. C. W. Botsford
3. H. A. Carlberg
4. A. B. Carson
5. R. G. Clough
6. E. J. Filip
7. D. J. Foley
8. F. C. Franklin
9. R. B. Hamilton
10. T. W. Hauff
11. H. L. Henry
12. E. P. Lee
13. C. G. Lewis
14. D. S. Lewis
15. J. E. Maider
16. G. E. McCullough-P. H. Reinker
17. R. O. Mehann
18. S. L. Nelson
19. R. W. Reid
20. H. G. Spencer
21. P. Thompson
22. J. E. Robb
23. J. H. Warren
24. W. K. Woods
25. A.E.C. Attn: D. G. Sturges
26. 700 Files
27. 300 Files
28. Yellow Copy

CLASSIFICATION CANCELLED
OR CHANGED TO UNCLASIFIED
BY AUTHORITY OF *CH HENNINGER 8/1/91*
BY *H.M. Allen* DATE *1/3/94*
M.O. Gill *1/3/94*

October 15, 1952

FINAL REPORT PRODUCTION TEST 105-417-P
PROCESS TUBE PURGE DURING PILE OPERATION

INTRODUCTION

Periodic solids purges of reactor process tubes are necessary to remove the film deposition on slugs and tubes. This film is undesirable for it constricts the water annulus, and thereby reduces the flow of cooling water and impedes the transfer of heat from slugs to the water. (1) Prior to February, 1951, purging was accomplished only while the reactor was in a non-operating status. Subsequently, the feasibility of successful film removal during operation has been demonstrated in accordance with the provisions of Production Test 105-417-P, "Process Tube Purges During Reactor Operation".

This document reviews, in the light of additional purging experience, the initial test results, which are recorded in HW-20717(2), and subsequent purging experience to consider the desirability of adopting the use of this purging technique as a standard practice when reactor power levels are restricted by excessive film formation in the process tubes.

- (1) Production Test 105-417-P, HW-19957, "Process Tube Purge During Pile Operation", R. O. Mehann.
- (2) Interim Report, Production Test 105-417-P, HW-20717, E. J. Filip and P. A. Johnson.

MASTER 1 2378

RESTRICTED TO U.S. ONLY

SUMMARY

Analysis of the data obtained from the ten (*) operational purges conducted to date at the DR Reactor has revealed the following pertinent facts:

1. Decreases in process tube pressure drop of 3-21 psi resulted from each of the purges. The average pressure drop decrease was 10 psi.
2. There was no evidence of header or orifice screen plugging, and there were no reactor control problems caused by purging during reactor operation.
3. Estimates of the hazard of high activity due to radioisotopes in the reactor effluent water indicate that two purges per week at reduced power levels of 350 MW will increase the potential dosage rate at the time the water leaves the reservation by about ten per cent over that delivered by routine effluent if all of the purge material is eliminated to the river. Present operating procedures where this material is collected in a separate retention basin and disposed to a crib should result in a negligible increase (3)
4. The exit water monitoring system was removed from service for approximately two hours during the purges and considerable adjusting of the water flows in the sample lines was necessary because of plugging of the regulating valves.

DETAILS

The DR Reactor was purged with diatomaceous earth at nominal concentrations of 100 ppm while operating at reduced power levels of 350 MW and while shutting down from equilibrium power levels. These purges were carried out in a manner similar to those routinely conducted during reactor outages. Table I in the Appendix contains operational data obtained during these purges. Data obtained from purges during reactor shutdown are included for reference purposes.

In each case the diatomaceous earth slurry was pumped through screens into the process water lines which supply the two risers. The reactor was operated at a reduced level during the purges to lessen the induced radioactivity in the purge material and also to lessen the danger of serious damage if a tube or header screen should become plugged.

- (*) For these purges, the power level was reduced to 350 MW during the addition of solids, and then increased to the maximum power output consistent with operating limits.
- (3) "The Effect of Purging During Pile Operation on the Effluent Water", HW-24578, J. W. Healy

Surveillance of riser flows and panellit pressures during these tests revealed no evidence of crossheader or process tube orifice screen plugging. Although the possibility of plugging a header or individual tube screen always exists, present operating experience indicates that the occurrence of such an event during a purge is improbable. With 30-mesh screens in the crossheaders and 50-mesh primary screens in the purge pump discharge, there have been few instances of crossheader screen plugging in the last several years of operation. The 50-mesh screens in the purge pumps, however, have plugged and have ruptured in some instances. Recent experience with 40-mesh screens in the purge pump discharge has shown that this larger size screen has significantly decreased the plugging problem at this point and has not noticeably affected header screen plugging. Because no direct measurement of header pressures was available during this test, the power level of the reactor was reduced to 350 MW so that the header pressure would be sufficient to sweep steam from a tube when the low alarm limit on the panellit gauge was reached. With this precaution the reactor could be safely shut down should plugging occur. Now that pressure monitoring is available for individual headers, it is possible to purge with a greater degree of safety at higher power levels consistent with the tube temperature rise limits listed in Table II in the Appendix(4).

In any case the plugging of the crossheader screens should occur gradually, and it is improbable that the screens on both ends of a given header would begin to plug simultaneously. The plugging of a process tube orifice screen is even less likely inasmuch as the screen is more coarse than the two screens through which the water has previously passed.

There was no noticeable effect on reactor reactivity as the purge material passed through the tubes. It had been calculated that this effect would be much less than one inch.

These purges were in general as successful as normal shutdown purges in reducing the film deposit. The pressure drop across the tubes in which film deposit is routinely measured was reduced by 3-21 psi by the purges and the total water flow through the reactor was increased by 600-1400 GPM. The resulting power increases possible because of the increased flow through the tubes were approximately 10MW. Although a production loss of about 15 to 20 MW days occurred during the reduced level purges, it is apparent that these losses were regained in two days of operation at the higher power levels. With an outage frequency of one per month, a purge held midway between the outages would thus gain an estimated 125 MW days of production per month in a reactor which is operating at the maximum level possible under vapor-lock considerations.

(4) Rough Draft Process Specifications - Pile Process, HW-24929,
G. E. McCullough

Although the benefits from a high water flow with film-free tubes are most evident in those reactors operating under vapor-lock limitations, other benefits could result from the practice of conducting purges during actual operation. The reduced film decreases the temperature drop across the slug surface and allows the slugs to remain cooler for any given heat generation rate. This cooler slug surface tends to reduce the slug jacket overall corrosion rate. Also, since it may be feasible to operate the reactors in many cases with a one month or longer interval between scheduled outages, the time gained for maintenance work by conducting all the purges during operation could be of significant value.

During each of these purges it was necessary to remove the exit water monitoring system from operation for a period of about two hours. A ruptured slug would be first detected by increased panellit pressure during this period. After the return of the water monitoring system to operation, considerable difficulty was experienced in adjusting the flows properly because of plugging in the sample lines. This same problem occurs after normal purges held during a shutdown, and in any case the present sample rooms operate with little reliability for a period of approximately 24 hours after a start-up because of control rod movements.

CONCLUSIONS AND RECOMMENDATIONS

Since the adoption of alum coagulated process water and/or the elimination of sodium dichromate from the water, operational purges have been unnecessary except in the case of operating periods of long duration. However, if the method of water treatment should be changed such that film build-up again becomes an operating problem, the following gains may be made by purging during reactor operation.

1. When the operating level of the reactor is limited by boiling considerations, a successful purge between normal outages scheduled three or four weeks apart should increase production by approximately 100 to 125 MW days per month.
2. The time normally required for purging will be available for shutdown maintenance work.
3. The necessity of occasionally scheduling outages primarily for the purpose of purging will be eliminated.

It is recommended that the tube temperature rise limits listed in Table II be used to determine the power level at which the purge should be conducted. If surveillance of the header pressure panellit

gauges reveals that header screen plugging is occurring, the reactor should be shut down immediately.

R B Hamilton

R. B. Hamilton
Process Improvement
Process Unit
Reactor Section

HL Henry

H. L. Henry
In Charge, Process Control & Analysis
Pile Engineering Sub-unit
Pile Technology Unit

RBH:HLH:lac

APPENDIXTABLE IDATA FROM PROCESS TUBE PURGES DR REACTOR

<u>Date</u>	<u>Psi drop across</u>	<u>Decrease in</u>	<u>Increase in</u>	<u>Power level</u>	<u>Power level</u>
<u>of</u>	<u>tubes due to</u>	<u>P due to film</u>	<u>total water</u>	<u>during purge</u>	<u>increase after</u>
<u>Purge</u>	<u>film before purge</u>	<u>removal in psi</u>	<u>flow in GPM</u>	<u>in MW</u>	<u>purge in MW</u>
		#			
11-3-50	9	8	600	0	*
12-18-50	16	8	500	435	18
1-5-51	20	15	600	0	14
1-15-51	6	1	200	0	*
2-7-51	26	21	1100	200	10
3-7-51	21	11	600	472 to 0	*
3-22-51	22	14	900	350	11
4-2-51	15	8	600	350	2
4-9-51	17	12	200	485 to 0	*
5-2-51	27	12	1400	350	15
5-21-51	15	10	700	350	--
6-5-51	17	11	400	470 to 0	*
6-15-51	11	5	600	350	10
6-26-51	17	14	400	515 to 0	*
7-16-51	19	14	---	0	*
8-7-51	12	11	1000	350	20
8-22-51	8	10	600	0	*
9-6-51	3	4	800	350	5
9-22-51	6	10	500	---	--
10-16-51	12	11	900	---	--
10-26-51	1	-4	-160	0	--
11-2-51	5	6	200	0	*
11-21-51	9	5	800	0	*
12-1-51	9	8	600	0	*
12-31-51	15	15	100	0	*
1-17-52	1	0	300	0	*
2-3-52	7	10	400	0	*
2-18-52	-2	3	1000	0	*
3-7-52	1	3	1000	350	20
3-20-52	5	9	800	500 to 0	*
4-9-52	1	5	800	0	*
4-24-52	-1	5	200	0	*
5-15-52	-4	1	500	0	*
6-15-52	2	4	600	0	*
7-25-52	4	7	900	350	10
8-4-52	-4	1	600	510 to 165	*

The decrease in pressure drop is not a precise measure because the data are taken at varying times before and after the individual purges.

* Production gains attributable to increase flow could not be separated from gains due to improved flattening made at the same time.

-- No data available.

APPENDIX

TABLE II

ALLOWABLE TUBE TEMPERATURE LIMITS FOR OPERATIONAL PURGING

B, D, and F Reactors

<u>Orifice Zone</u>	<u>Lower Panellit Trip Setting</u>	<u>Maximum Tempera- ture Rise</u>
.140	50 psig	95°C
.175	50 psig	70
.200	100 psig	60
.240	150 psig	51

H Reactor

<u>Orifice Zone</u>	<u>Lower Panellit Trip Setting</u>	<u>Maximum Tempera- ture Rise</u>
.140 inch	50 psig	95°C
.175	50	75
.200	100	64
.240	150	54
.285	200	49.5

DR Reactor

<u>Orifice Zone</u>	<u>Lower Panellit Trip Setting</u>	<u>Maximum Tempera- ture Rise</u>
.140	50 psig	95°C
.175	50	72
.200	100	60
.240	150	50
.285	185	44.5

ENC

DATE

FILMED

3/21/94